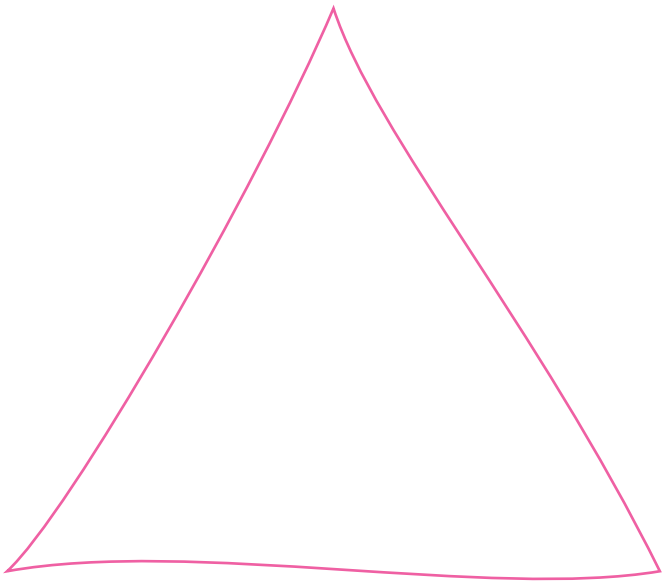
Looking for the soft spot in "The Iron Triangle":

Explorative research into the effect of serious gaming on the level of empathy and the experienced client contractor collaboration of professionals in the construction industry

J.E.L. (Janneke) Ambagts



TU Delft

dutch process innovators

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Master thesis Construction Management & Engineering

By

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Abstract

This master thesis addresses the challenge of project performance in the Civil Engineering (CE) sector, emphasizing the significance of collaboration, communication, and understanding among interdisciplinary project teams. Focusing on the role of empathy in contractor-client collaborations, the study investigates the potential impact of serious gaming on enhancing the level of empathy of CE professionals.

The research uses a mixed-method pre- and post-test design, utilizing a quasi-experimental approach without a control group. The study uses the Interpersonal Reactivity Index (IRI) and the short version of the Empathy Quotient (EQ short) questionnaire to measure the individual self-reported level of empathy before and after participants engage in the serious game '*Fouten maken Moed*.' A subscale of the IRI showed a slight decrease in the level of empathy that possibly can be explained by a growth in awareness. While quantitative analysis did not reveal a significant change in overall empathy scores, qualitative findings suggest positive influences on interpersonal dynamics, openness, and talkativeness among participants, aspects that relate to the concept of empathy.

Despite the limitations that arise from researching a difficult to operationalise main concept (empathy), a small sample size and having no control group. It can still be concluded that the intervention, including the serious game, created an environment that was conducive for participants to share personal information and vulnerabilities, fostering a sense of approachability and relatability. It seems like the game can, if facilitated well, function as a context-setter for Project Follow Up (PFU) or Project Start Up (PSU) meetings, enhancing collaboration between contractors and clients.

Although the study acknowledges the fact that results cannot be generalised, it recommends refining empathy measurement methods and enhancing training interventions' briefing and debriefing aspects. Future research should include more extensive experiments with control groups to better isolate the impact of serious gaming on empathy levels in the CE sector, providing a more comprehensive understanding of the game's potential contributions to collaboration and project performance through empathy

Preface

In front of you lies/ lights up my thesis about empathy, collaboration, serious gaming but above all about people. This might sound a bit strange since this thesis is written for obtaining a master degree in Construction Management and Engineering (CME). But what every discipline, study or sector has in common is that there are always people involved. This fact is, I think sometimes forgotten in Delft where we are all technicians that study exact and (heavily researched) facts, right? Because that is what science does, well at least that is what I came to Delft for at the end of my psychology bachelor in 2017. I wanted to learn some facts instead of theories that might or might not be true. Because of the fact that math is not my favourite thing to spend my time on, I decided not to go with physics but started a bachelor in Technology, Policy, and Management (TPM). I found out pretty quickly that also at the TU Delft there are several theories for the best policy, for calculating the best decisions, and for analysing the daily life. Even in courses like "physical transport phenomena" we used booklets with numbers and formulas from different researchers that all used their own assumptions in order to try to come close to making realistic calculations.

After this second bachelor I initially thought of ending my "career" as a student after seven years of studying. However, at that time I was studying from behind a screen in my tiny room in the city centre of Delft, only leaving the house to go ride and take care of my horse. On the way to the stable I passed a construction site everyday this inspired me to look further for a combination of psychology and TPM and found this in the projects and people track of the master CME. A lot of people I met but also friends and family thought I made a strange switch from psychology to TPM and CME. But in the end, they/you will see it's not as farfetched as it might sound. It was three weeks ago (September 2023) that I attended the graduation event of the Project Management Institute (PMI) project management course I followed where one of the key note speakers said "*Project management really is an independent discipline, in which you actually need to be part engineer and part psychologist, be a master of methods with a focus on the people".* As you can see from the subject of this thesis, I feel like I can finally say, after 10 years of study, the circle is closed. I am looking forward to the next phase in my life in which I can no longer use the "I am just a student" excuse even though I will most certainly always keep learning.

This thesis is written by me, but wouldn't have been here if it were not for a few people that I would like to mention and thank! I believe that a lot can be done on your own but never *alone*. There are many people that have supported me through my thesis period. Because yeah, I like to study, but I feel like I am not made for doing research... Therefore, thanks to my friends and roommates, Mom, Dad and Lindert for often not asking how thesis life is going but simply believing that one day I would be ready with it. And enjoying time together focussing on other things to prevent my mind from being too much on my thesis. Thank you, mama, for making it possible for me to study this long! Thank you, Shannon, for helping me not quitting before I practically even started, thankyou Toof for helping out at exactly the right time right after the summer break, and right before handing in the final version and thank you Vince for offering to help me enjoying a day full of data analysis! Joanne, your message also reached me at exactly the right time! Thanks Nina, Lindert, Ward, Carmen and Papa for taking the time to read my work. It helps to see through someone else's eyes what is and isn't understood. A thank you also to my colleagues from Theater de Veste for stepping in for me in the final race to handing in my concept and final report.

Thank you, dpi, for giving me the opportunity to get a glimpse of advisory work in the construction sector and for being a fun and nice team to be part of for a while! Special thanks to Nick for being my supervisor and taking time to let me get to know dpi and keep me sharp during the process by checking in regularly and providing me with some compliments that helped me to keep going. Also, a special thank you to Philine for being my early morning chauffeur to quite a few events across the Netherlands and for giving me the opportunity to work with real cases in my data gathering phase

and really making me feel like a colleague. Thank you, Erik-Jan, for being my first supervisor and giving me inspiration and motivation to keep going and believe in the project. Thank you Geertje for being a curious and helpful chair of the committee, especially in the beginning you helped me get started, which was in hindsight the hardest part of the project. And thank you Jelle for being available for questions. To all of you I feel like when I had not been such a centipede with all my many priorities, I could have learned a lot more from all of you.
Thank you to Goudvisie for helping me get started with *Fouten maken Moed*, by being willing to cooperate with me and my project. And thank you to the clients and colleagues of dpi that dedicated their time to filling out the questionnaires, played the game and were available for interviews afterwards!

At home we have a philosophy calendar of which you tear off one page a day and on the 8th of October 2023 it had the following quote on it:

"'The word is a mighty ruler,' Plato once wrote. Nishida Kitaro, the most important Japanese philosopher of the 20th century stated that he learned much from Aristotle and Plato in his later life. According to him, however, it is important to understand someone's words correctly. This can only be done by generating as much openness as possible - a process, by the way, for which Nishida himself used zen meditation. Setting yourself aside while reading philosophical texts is supreme. Hence, he gave his readers the following wish: 'I wish my words to be understood not from the coordinates of others, but from my own coordinates.' "
(Bassie, & Dijkstra., 2023)

I think that this final quote resembles the way I have interpreted empathy in this thesis and it might be a good practice for anyone of us. Try sometimes to listen to another person from their perspective for a chance, instead of from your own perspective.

Janneke Ambagts

Delft, January 2024

Summary

This thesis begins by acknowledging that numerous construction projects in the Civil Engineering (CE) sector are not considered successful. Project success is typically assessed based on the Iron Triangle (or Triple Constraints) concept, which includes time, budget, and quality. However, research on project success factors often emphasises the 'soft' side of projects and project management. Projects in the CE sector often require collaboration among multiple interdisciplinary parties due to their complexity, uniqueness, and size. Effective communication, knowledge sharing, trust, and understanding of each other's interests are crucial for successful collaboration.

Recent studies have concluded that empathy can enhance collaboration in CE projects, particularly during the integrated design phase. Some recent theses have examined empathy in relation to construction projects. This raises the question of whether professionals in this sector could improve their level of empathy to enhance collaboration and positively impact project performance. It was observed that time is a valuable and scarce resource on projects. Project Follow Up (PFU) and Project Start Up (PSU) meetings are one of the few moments when contractors and clients work and focus on their mutual collaboration in real-time. During these meetings, they get to know each other and reach agreements on how to work together. When researching methods for learning useful behaviours, it was found that serious gaming is often used in practice. Serious gaming refers to games with the primary goal of education rather than entertainment (Chen & Michael, 2006, p. 17). The objective of this research was to investigate whether serious gaming could enhance or activate empathy in civil engineering (CE) professionals working in contractor-client collaborations. The research question that arose from this objective is:

How can serious gaming positively impact the level of empathy within project teams in the civil engineering sector to foster client-contractor collaboration?

To address the research question, a mixed-methods pre- and post-test design was employed, using a quasi-experimental design without a control group. A questionnaire was developed to measure different forms of empathic behaviour and empathy, using the Interpersonal Reactivity Index (IRI) and the EQ short (Empathy Quotient, short questionnaire). The questionnaires were completed by CE professionals that were at that moment part of a contractor-client collaboration during a PFU or PSU of their project, before and after playing the serious game (SG) '*Fouten maken Moed*'. Additionally, data was collected through session observations and qualitative analysis of interviews with team members who participated in the serious game.

Upon analysis of the quantitative data, it was determined that playing the serious game did not result in an increase in personal levels of empathy as measured by the questionnaires. The statistical analysis (paired t-test) did not reveal a significant difference between the pre-test and post-test mean empathy scores. However, the results did show a significant decrease in the mean scores of the empathic concern construct on one of the subscales of the IRI questionnaire. One possible explanation for this finding is that individuals tend to overestimate their abilities. When confronted with their actual behaviour and interests, they become more realistic and self-critical. It is important to note that the results of this research cannot be generalised to the entire field of CE and serious gaming due to the limited number of experiments conducted and the small sample size of participants involved.

The qualitative analysis indicates that playing the serious game resulted in increased talkativeness and openness among the participants. The game sessions provided a safe space for some participants to share personal information and vulnerabilities, which made them more approachable and relatable to their colleagues. Additionally, the collaboration consultant from DPI, who was present at

the sessions, perceived the game as a context-setter for the rest of the PFU or PSU. The use of game-related topics can enhance collaboration between contractors and clients. The coded interviews revealed that participants found the serious game to be a valuable tool for improving team dynamics and observing interpersonal interactions. Although interviewees reported gaining new insights, they found it challenging to articulate the specifics of what they had learned.

To address the main question, first four sub-questions related to teaching or improving empathic behaviour have been answered. This was followed by an exploration of the use of serious games to promote behaviour change, specifically in the context of empathy among professionals in the CE sector. The study concludes that while no major discoveries or surprises were made, the qualitative data suggests that playing the game did have a positive influence on the level of empathy towards each other in the group. However, it is unclear whether this is due, for example, to the time spent together, the questions answered, or the game itself, as there was no control group in the study and only one game was tested.

For future research, it is recommended to modify the method of measuring empathy and enhance the briefing and debriefing of the total training or intervention in which the game is placed to address more learning opportunities in the serious game. To be more certain about what effects can or cannot be addressed to the game and the circumstances, a more extensive experiment should be executed with control groups.

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Abbreviations

CE– Civil Engineering
DMP – Data Management Plan
dpi – dutch process innovators
EI – Emotional Intelligence
EQ – Empathy Quotient
HREC – Human research ethics committee
IRI – Interpersonal Reactivity Index
PFU – Project Follow Up
PSU – Project Start Up
RQ – Research Question
SG – Serious Game
SRQ – Sub Research Question
TPM – Technology, Policy, and Management
UAV-GC – Uniforme administratieve voorwaarden – geïntegreerd contract

Chapter 1: Introduction

Construction projects have a name to fail to be completed in time and budget (Youssefi, & Celilk, 2023). Over the past years many reasons for the lack of project success in the construction sector have been identified and researched (El-Sokhn, & Othman., 2014). The iron triangle, also known as triple constraint, is a widely used concept in defining whether or not a project has been successful. This concept consists of three main factors that are interrelated and, when managed well, are supposed to result in project success. Usually, the three vertices of the triangle are described as: time, cost (or budget) and quality. The quality vertex is in some publications or projects replaced by scope, performance or requirements (Pollack et al., 2018). Once something deteriorates on either of those vertices, a project will have a hard time getting back on track. Despite many years of studying how to generate project success, still a lot of projects are exceeding budget, are running late, and are causing financial and practical problems for the project teams and managers (Haaskjold et al., 2020). The increasing complexity is one of the reasons mentioned as a cause for construction projects to fall outside of the boundaries of the triangle (Bosch-Rekveldt et al., 2011).

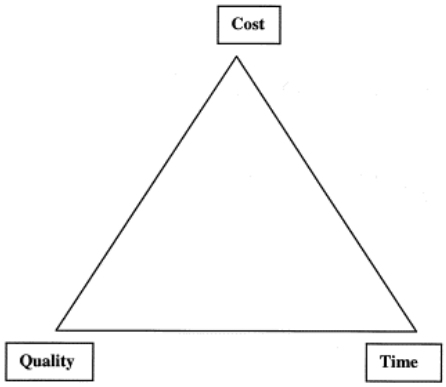

Figure 1. The Iron Triangle (Atkinson, 1999)

1.1 Project success

Elaborate literature research on project success in the construction industry with additional expert interviews by Kumar et al. (2023) and El-Sokhn, & Othman. (2014) has resulted among other things, in several critical success factors and project failure factors. They have looked into in which phases those factors play an important role and who are responsible for making sure those factors are taken care of, part of this table can be found in appendix J. Many experts mention the following success factors as critical: good communication, good relations with contractor and good relations with the client. Project success appears to relate to the willingness of parties to execute a project together again in the future as well. When defining the concept of project success Sinesilassie et al. (2019) can be cited, they define the success of a construction project as "*a construction project is considered successful when it is completed in time, without cost overruns, and within the specified quality parameters*". Other ways that can be used to look at project success are metrics like functionality, the competitiveness of the contractor, the absence of lawsuits and legal cases. It also relates to the concept of 'fitness for purpose' of the project according to Nguyen et al. (2004). Furthermore, Kumar et al. (2023) state that more parameters are needed than just the three in the iron triangle to define project success. At the same time, they support Jugdev and Müller (2005) in their statement that project success is one of the most studied themes in project management, partly due to the complexity of defining success and the factors leading or contributing to this. Despite all the effort the subject still remains vague and open to many interpretations. When looking at what good or effective collaboration in the construction industry entails, an overlap can be observed with the success factors that are not part of the iron triangle.

1.2 Increasing complexity

Over the past years projects both in infrastructure and in the built environment are said to have become more complex (Bosch Rekveldt et al., 2011). This can be assigned to several reasons, of which one is the increasing technical difficulty in space, materials and techniques. Space is limited, places get fuller and both infrastructure and the built environment are thus getting more interrelated which results in the need for adapted ways of working. The fact that supply chains for building materials have become more fragmented as well, which yet again, results in the requirement of coordination between the different suppliers and customers (contractors) in the construction industry. This results in the involvement of more separate parties per project. Which ultimately results in the second reason for the increased complexity, namely the interrelated structure with many stakeholders. This means the risk for executing the projects gets higher and thus companies are looking for ways to share the risk. As a result, the construction sector is starting to use more integrated design processes such as *bouwteam* (stakeholder collaborations with shared risk constructions) and turn-key contracts. But also, in the building/execution phase public private partnerships or other forms of collaboration are often used (De Ridder & Noppen, 2009).

However, the downside of these collaborations of different companies in the various project phases is that it results in unclear responsibilities and objectives. In order to clearly assign the responsibilities and objectives, good communication and collaboration are important. Stakeholder collaborations are said to have many benefits but at the same time it contributes to a more intricate and complex process (Cuppen et al., 2016). The complexity of a project is mentioned as a reason to resort to the iron triangle, since it offers a simple and unambiguous measure of performance according to Pollack et all. (2018). Other ways to deal with the complexity of projects is researched by for example Bosch-Rekveldt et al. (2011). They have come up with the so called Technical, Organisational and Environmental (TOE) framework. This framework helps to focus on three aspects in dealing with complexity. One of the differences between the TOE framework and the concept of the iron triangle, is that the TOE framework does entail collaboration and the organisation of the project. Whereas the Iron triangle focusses on just the “hard” aspects of projects.

1.3 Benefits of good collaboration

Good collaboration in the construction industry can help to improve project success through both quality improvements, cost savings, a reduction in delays, a safer environment and client satisfaction. It can help to overcome complexity issues combining the knowledge and skills from the parties involved in the collaboration towards the common project goal. In the previous section, several examples of contracting and collaboration were mentioned. Van den Berg et al. (1996) describe in their book “*De ontwerpende bouwer”* that, in addition to traditional forms of construction contracts, there are modern forms of construction contracts. In these modern forms, the contractor has a more active role in the design process. It is assumed that the integration of the design and execution phases of the process results in a mutual positive influence on the expertise that exists in both functions. As a result of this integration, knowledge about the project is gained at an earlier stage by the contractor through the design process, which helps to anticipate and solve problems that may arise at a later stage in the construction process. In addition, the overall duration of a project can be reduced as a result of these positive effects (Van den Berg et al., 1996).

The more complex a project is, the greater the need for knowledge sharing, mutual coordination and a good atmosphere (Koolwijk et al., 2020). Collaboration is subject to a variety of interpretations. In this thesis, a distinction is made between a more formal type of contractual collaboration, in which the common goals and rules of collaboration are defined. And a more informal type that revolves around direct collaboration with colleagues. Both within the 'parent' organisation of a company or

government agency, and in the joint project organisation of two or more organisations. A key aspect of integral collaboration is the extent to which parties dare to share knowledge. The way in which progress is monitored and when and how action is taken to speed up or slow down the project is also important.

The fact that collaboration is now sometimes mentioned in the context of the Iron Triangle can also be seen in day-to-day business (Dieterich et al., 2022). In some organisations or projects, it is common practice to pay attention to collaboration in the bidding phase, but also at the start of the project in Project Start-Ups (PSU's) and during the project in Project Follow-Ups (PFU's). Collaboration and communication training/sessions used to be practised in other sectors or in companies with mixed backgrounds and more socially oriented professions. It is a recent development that also in the civil engineering (CE) sector consultancy firms are being asked to support the creation of good collaboration on projects, for example within integrated project teams.

1.4 Empathy, Collaboration and Project Success

A recently mentioned term in relation to project success and collaboration in the CE sector is "empathy". Keusters et al. (2023) propose empathy as an important competence for leaders in all leadership styles. He states that empathy increases people's concern for the welfare of others, for example in their team. This leads to smoother conflict management and better cooperation. This in turn leads to greater team effectiveness and higher productivity. According to Ickes (1993), empathy can be useful in resolving conflicts or impasses, i.e. it helps to put oneself in the other person's position. In the book "Social Psychology" by Vonk (2007, p.277, p.312, p.560, & p.568) several reasons why empathy is useful are explored. For example, empathy allows you to see things better through someone else's eyes. People who are more empathetic are generally more motivated to help others. Empathy helps to develop norms, an important condition for moral behaviour. According to Vonk (2007), empathy as a character trait is an important determinant in various situations. In experiments conducted by Batson (1991) and colleagues, empathy, when experimentally manipulated, was found to be a significant predictor of prosocial behaviour.

Another research that made the link between (complex) project performance and empathy is that of Keusters et all. (2022). They have been researching the role which the integrated design processes can play in overcoming complexity and say:

"The complexity of civil engineering projects is increasing, while those projects have been facing poor performance for a long time already. Project teams need to integrate a growing number of stakeholders' interests and aspects, a process which is driven by growing urbanisation, the need for mobility, climate adaptation, biodiversity, circularity and the renovation of the existing infrastructure systems." (2022, p. 17).

They argue that design teams of civil engineering projects should stimulate the development of competencies that have a focus on integration in order to improve performance. On the role of empathy within this integrated contract and design process they conclude the following: "*Empathy seems to be a competence of the design team participants that fosters problem orientation and subsequently an integrated approach and project performance. While empathy has been acknowledged as a relevant competence in disciplines that have been affected by problem context by nature, there is reason to further investigate the role of empathy in civil engineering projects."* (2022, p. 17). As support research to this PHD research of Keusters et all. (2022), Batelaan (2021) and Bertels (2022) have been researching the effect of empathy in specific circumstances on the quality of collaboration in their master theses. In different sectors the closely related concept of emotional

intelligence is seen as a predictor for successful work- and personal relationships (Salovey, & Gerwal., 2005)

1.5 Problem statement and research goal

The first phase of the thesis research consisted of literature study, field trips and conversations with people working in the construction industry to get a feeling with the work field of collaboration in the construction industry. The literature study focused more on the background of studies on contract forms, collaboration, empathy studies and existing serious games. The research gap was found to be two-sided. On the one hand side little research is done on the validity and the actual learning abilities from serious games that are already used in several fields, one of those being the construction industry. On the other hand side, the first steps towards measuring the effect of empathic people in enhancing collaboration and with that project success have been taken. However, no research was done so far to see whether empathy can be developed through playing a serious game in construction industry.

The competence 'empathy' could possibly offer a part of the solution for improving the understanding and thus the collaboration of such integrated project teams. However, how and if empathy can be developed in a day-to-day practice has not been investigated. Civil engineering professionals have a low level of empathy compared to the average level of empathy that people have. A high level of empathy appears to be beneficial to project performance through improved collaboration. It seems possible to train or improve empathy or the extent to which people use empathic behaviour.

The research objective is therefore to find a method to increase the empathy of people working in contractor-client collaborations in the construction industry, where the need for good collaboration is high due to the complexity of the sector. Serious gaming has been identified as a potentially promising tool due to its surge in popularity and the claims made about the games by their creators.

1.6 Research question

This problem statement leads to the main research question stated below:

How can serious gaming positively impact the level of empathy within project teams in the civil engineering sector to foster client-contractor collaboration?

In order to answer this question four sub questions have been formulated. The fourth and last sub question is divided into the null hypotheses (H0) and the alternative hypotheses (HA). H0 assumes no effect or difference exists between researched situations, HA assumes there is an effect or difference.

- Sub research question 1: How can the empathy within project teams be influenced?
- Sub research question 2: Why would serious gaming be a suitable tool to use in order to influence the level of empathy within a project team?
- Sub research question 3: How can serious gaming be used to enhance empathy within projects in the construction industry?
- Sub research question 4: What is the effect of playing the serious game *Fouten maken Moed* on the level of empathy within client-contractor teams in civil engineering projects?
  H0: There is no effect of playing the serious game Fouten maken Moed on the level of empathy within client contractor teams
  HA: There is an effect of playing the serious game Fouten maken Moed on the level of empathy within client contractor teams.

1.7 Research environment

This thesis is written in a graduation internship at dutch process innovators (dpi). Dpi is a company that advises the construction sector on four main pillars: Tender Management, Environmental Management, Process Management and Asset Management. In recent years, more and more value has been seen in the way project teams work together. As a result, dpi is currently developing a collaboration service. The aim is to establish a robust methodology for building, improving, repairing and maintaining good collaboration in the projects that dpi works on and in projects that come to dpi when collaboration is not working well. One of the things that has been observed to go wrong in projects is that important prerequisites for good collaboration, such as trust and discussing and agreeing on common goals, are merely ticked boxes in a process, without being sufficiently addressed. Ticking a box or mentioning an issue does not mean that these agreements are effectively implemented and lived by. Let me illustrate this with an example. Imagine that a discussion about common goals has taken place, but when a particular decision has to be made, the individual goals turn out to be more important than the common goal. This could be called 'split loyalty of project members to their own company and the goals of the project' (personal communication (Van den Berg, 3 November 2023)).

In addition to dpi, Goudvisie was also approached. Goudvisie is an Amsterdam-based company that develops and sells serious games. They also offer instructions on how to play the game. After approaching them, they offered to provide the serious game for a test session that they helped to organize. Many of the serious games developed and used by Goudvisie are games designed to promote cooperation within a particular company or organisation. The second test session took place within dpi and the participants were employees. A few other companies were involved as by participating in the data collection process. This data collection was integrated into a PFU and a PSU. These companies and the people working on these projects will remain anonymous.

1.8 Reading guide

Chapter two elaborates on the concepts introduced in this first chapter, with a focus on empathy. The chapter provides a theoretical background and defines empathy as the ability to recognise and react to another person's experiences. It also discusses the measurement of empathy. The chapter provides a theoretical background and defines empathy as the ability to recognise and react to another person's experiences. It is evident that enhancing empathy among professionals in the construction industry could be beneficial. However, no attempts have been made so far to create an environment or training to achieve this.

Chapter three introduces serious gaming as a potential solution for this gap. It explains what serious games are and how they can contribute to learning or activating empathic behaviour. This text describes the selection process for the game to be evaluated in the research, as well as the empathy training session that will be used.

Chapter four describes the exploratory pre-post-test design chosen to evaluate the potential of the intervention, including the serious game, for enhancing empathy. The chapter operationalises the concepts of empathy and serious gaming and describes the research instruments used, including a survey, observation, and interviews. The results of the test sessions before the actual data gathering are also depicted. The two test sessions resulted in a shorter version of the original empathy questionnaire. The amount of game facilitators has been expanded from one to two, and a few questions were removed from the original serious game. The target group is described again, and the chapter concludes with an explanation of how data collection will occur.

Chapter five presents the qualitative and quantitative results of this research. The hypotheses have been specified and either rejected or accepted. The quantitative results do not indicate a change in the level of empathy among CE professionals, except for the empathic concern subscale of the questionnaire, which shows a slight decline. CE professionals appear to be slightly less empathic towards the people in their surroundings. However, the overall score does not indicate a decline, and this lower level of empathy is not reflected in either the observation or in the results from the interviews that were conducted a month after the sessions.

Chapter six discusses the method and results of the study. This study found that empathic concern was lower in the post-test questionnaire compared to the pre-test due to a change in awareness. Additionally, the competitive dynamics of the game were found to be possible explanations of the decrease in empathy towards opponents in the game. The limitations of the study, such as the small sample size and the exploratory nature of testing only one game, are also mentioned. The discussion concludes by stating that the game cultivates an open climate, facilitating meaningful communication and emphasizing the role of empathy in team dynamics and project coordination. However, it acknowledges its inability to replace formal collaboration, such as contracts.

Chapter seven is the conclusive chapter, which also includes recommendations. Despite a slight decrease in the empathic concern scale based on quantitative data, the qualitative observations and interviews suggest improvements in empathic behaviour and collaboration within teams. The research concludes that serious gaming, particularly the game used, fosters collaboration by providing a platform for building relationships, improving awareness of behaviour, and promoting discussions among team members. The chapter reflects on the research design and offers recommendations for future studies. These include exploring the use of serious games beyond existing project teams, considering the optimal level of empathy, and examining the impact of game sessions on collaboration within PSU/PFU sessions.

Following the final chapter, the appendices contain detailed information on specific aspects of the study, including activities attended by the researcher prior to and during the research period. Additionally, a data management plan is presented, along with background information on the questionnaires used in this research.

Chapter 2: Empathy

The introduction stated that collaboration contributes to better project performance. In this second chapter, a theoretical background of collaboration and empathy (within the CE sector) is given. The focus is on how empathy is related to collaboration and project success. Furthermore, empathy is defined in relation to this thesis on the basis of the theory. In order to answer the first sub question, ways to influence empathy are also explored.

2.1 Communication and collaboration

In complex projects integral project teams are more and more turned to, working with integral project management teams (IPM). Integral means a need for working together regardless of whether this is about collaboration between colleagues in a company, collaboration between a contractor and a subcontractor or collaboration between people from different companies for example between a contractor and client. Collaboration in integral or integrated project teams is about how people from different organisations dare to share their knowledge in a project. It is also about the way they dela with coordinating, and making changes to, activities as the project proceeds. The more complex the greater the importance of this shared coordination and knowledge sharing gets (Koolwijk, 2022). Koolwijk et al. (2020) found that a good atmosphere in the team is very important in complex and integrated project situations. Another aspect that plays a role in order to achieve a good collaboration is communication. Swuste et al. (2010) conclude that communication is of great importance simply because of the fact sometimes accidents and constructional failures can be traced back to a lack in communication either within the project team or between contractor and client.

As mentioned earlier in this and the previous chapter, collaboration comes in various forms and is associated with different definitions. In the context of projects, collaboration is often defined by specific types of contracts. These contracts outline, to a certain extent, the expected behaviour of both parties involved in a project, including their responsibilities, communication procedures, and initiatives within the collaboration. Beyond this formal collaboration, the day-to-day informal collaboration holds significant importance. This informal collaboration pertains to how team members, who may come from different companies with varying objectives, work together and their attitudes toward one another. In the context of this thesis, collaboration primarily refers to this informal form. Collaboration encompasses elements such as open communication, the sharing of knowledge, alignment on common goals, mutual trust, and creating a work environment where team members enjoy working together and feel comfortable. When these aspects are present, the project stands a higher chance of succeeding (Inayat et al., 2015).

2.2 Team Quality

So, important for good collaboration are at least, effective communication, trust, shared objectives or values and goals and a good ‘atmosphere’ in the team. These findings are in line with Lencioni’s pyramid of the Five Behaviours of a Cohesive team (n.d.). This pyramid illustrates the importance of trust and a good way of coping with conflict in a team in order to rise to the top of the pyramid with the team. Team results are achieved through creating commitment on this basis of trust in order for people to be accountable for their work and actions. This pyramid, developed by Lencioni is widely known.

The question is how does a team achieve this trust, effective communication and good atmosphere? For this it helps to have a shared mission or goal. It however requires understanding of the interests and values of both parties collaborating to reach a shared mission or goal that people are really committed to be loyal to. In order for this loyalty both parties should see their interest reflected in this shared goal. And in order to understand the interest of the other party one will have to relate to

the other parties perspective, and be able to step into the shoes of the other. This is an important part in the negotiation theory of Fisher et al. (2010). It is here where the connection to the possible importance of empathy of the CE-professionals is first seen.

Another research provided the insight that the way team members collaborate and share knowledge, is influenced by the no-blame culture in the team. Long-term and close relations in the construction sector can only be developed under the condition of mutual trust and power balance between partners. *"Team members should feel safe to speak their minds, ask questions, learn from their own and others' mistakes, and openly share information if the knowledge that resides within team members is to be unleashed. Knowledge sharing is crucial if we want these team members to solve complex design issues and other unplanned or emergent situations that often occur in complex construction projects."* (Koolwijk, 2022. P.131). The advantage of durable collaborative relations is said to be saving time and money, it enables to learn from a previous project and causes less double work due to the fact that people know how to work together and sometimes trust each other because of the relation that was built between them (Koolwijk & van Oel, 2022). With taking collaboration and empathy into account in relation to project success in the CE sector the link with social psychology can be seen. This is because the success factors for collaboration are related to human behaviour.

2.3 Empathy in CE projects and project teams

In healthcare, social justice and international relations, empathy is seen as the cornerstone of these sectors ((Bearman et al., 2015), (Derksen et al., 2013)). In the Civil Engineering sector specific, not much research was conducted into the effect of empathy on project performance. A recent PhD research by Keusters et al. (2022) however did focus on this subject and found that empathy can be beneficial to project performance too.

For this research the assumption is made that higher empathy is better for CE professionals because research has shown that CE professionals have a below average level of empathy and that it is beneficial to project performance to have a higher level of empathy. It is however good to bear in mind that this assumption might not always hold. Batelaan (2021) states, based on research of Akgün et al. (2015) and Eriksson & Westerberg, (2011) that higher empathy doesn't have to be better, for example sometimes the goal of the project gets overshadowed by the goal of collaboration because of too much empathic behaviour, or group think develops. However due to the current observation of a lack of focus on empathy in the construction sector and the mentioned below average empathy scores of CE professionals it is safe to follow up on the research of Batelaan, Bertels and Keusters and provide a continuation based on their recommendations to look for a way of improving the empathy of CE professionals.

2.4 What is empathy

In general, it can be seen from the literature that publications describe the concept of empathy in two different ways. Empathy as a single concept or empathy as a dual concept. In the case of a single concept, for example, empathy is seen as a competence that is about being able to interpret the right emotions in the gaze of others (Côté, 2014). Or empathy is the ability to put oneself in the shoes of others and empathise with them (without being overwhelmed by the suffering of others), it is a socially engaged emotion (Vonk, 2017. p.314). Often empathy is seen as a personality trait that may be genetically determined. Akgün, et al. (2015) explain empathy as a collective phenomenon within a team, "*Collective empathy is a shared state of empathy that includes more than one person and indicates the extent to which team members collectively empathize within the team during the project*".

Other studies see empathy as a dual concept, distinguishing between different forms of empathy. For example, Heyes (2018) concludes that 'empathy can be enhanced and redirected by novel experiences and disrupted by social change'. Drawing on Decety and Cowell's (2014) research on learned matching theory, Heyes concludes that empathy is not constrained by genetic evolution; even adult humans can learn to empathise more or less intensely. Heyes divides empathy into empathy 1, an automatic function that develops early and is also found in some animals. And empathy 2, which develops later and involves controlled processing.

The social psychological literature distinguishes between the affective and cognitive components of empathy. The affective component of empathy is the immediate response of the empathiser to the affective state of the one empathised with. The cognitive component can be consciously influenced (Vonk, 2017). In psychological terms, a definition that many people recognise is the following: "*Empathy is the ability to recognise, understand and share the thoughts and feelings of another person, animal or fictional character. Developing empathy is crucial for building relationships and behaving compassionately. It involves experiencing another person's point of view, not just one's own, and enables prosocial or helping behaviours that come from within, rather than being forced*." (Psychology Today, n.d.).

The final dual concept that will be mentioned here is that of external and internal empathy. This distinction made by Koppen & Meinel, (2015), Adamson et al., (2018) refer to this as interprofessional empathy. Either way they refer to these concepts as being about working in multidisciplinary and often bigger teams that make collaboration important. In order to do this well people need to adjust their viewpoints (Koppen & Meinel, 2015). This description is well suited to the contractor client collaboration situation in the construction sector. Internal empathy refers to empathy within the project organization, fostering understanding and collaboration among team members or colleagues. External empathy, on the other hand, is meant to be the empathy towards the stakeholders and client, aiming to understand their perspectives and context and gain acceptance for the project. Both internal and external empathy seem to be relevant for a construction project, where on the one hand the designed project has to meet the wishes of the client and/or end user, and on the other hand many different people have to work together to deliver and/or execute this design (Batelaan, 2021). In a serious research game method thesis Bertels (2022) found that external empathy has the greatest positive impact on collaboration.

In research, empathy is sometimes considered part of emotional intelligence (EI) or part of emotion or empathy quotient (EQ), which are scales used to measure emotional and empathic intelligence skills, just as IQ is used to measure intelligence. Empathic understanding goes beyond knowledge: "When you empathise, you do not judge, you relate to the situations and understand why certain experiences are meaningful to these people" (Battarbee 2004). Empathy could also be described as a relationship that involves an emotional connection (Battarbee and Koskinen 2005). According to Sleeswijk Visser and Kouprie (2008), "*the empathic is related to a deep understanding of the user's circumstances and experiences, which involves relating to, more than just knowing about*".

The concept of empathy has been referred to in many ways in the above background research on empathy. The following is chosen as a working definition of empathy: "***Empathy is the ability to recognise and react to another person after trying to understand reactions of one individual to the observed experiences of another.***" (Davis, 1980). This definition assumes that the tendency to be empathic is inherent in one's personality (genes) and that the ability to be empathic is a behavioural aspect of empathy that can be (consciously) influenced or developed.

2.5 Measuring empathy

When it comes to contractor and client both parties are trying to get out the best of the project for their own benefit. It is believed that time should be spend on the actual work and documents to secure the work by contracts. Empathy has now been defined but to define “good empathic behaviour” or “sufficient empathic behaviour” for construction projects in contractor client collaboration is a different and difficult task. It is clear from research that in general man are lower in empathy than woman, this could also partly explain why the empathy of construction professionals in the research of Bertels (2022) was below average. For this research good empathic behaviour is simply defined as more empathic behaviour or behaviour that could be seen as empathic. Behaviour like helping out a colleague that has a difficult time, asking questions, laughing together and taking each other’s concerns serious. These are typical things that can be observed or spoken about. When measuring empathy with a questionnaire a higher empathy score is considered positive.

Looking into measurement tools for empathy the above stated definition by Davis (1980) is used as the definition of empathy in the Interpersonally Reactivity Index (IRI) that can be used to measure empathy on four different constructs. The IRI is a self-report measurement questionnaire on empathy and defines empathy as the “**reactions of one individual to the observed experiences of another**” (Davis, 1980). It was chosen to use this questionnaire due to its wide use in literature. Despite being 40 years old studies comparing several measurement tools keep falling back to the IRI due to its solid validation and stable results. Even though new ways of defining empathy and new questionnaires have been made since. The thesis research of Bertels (2022) also used the IRI to determine the level of empathy of her participants after a thoroughly comparing it with other empathy measurement tools.

A growing movement is observed that supports a view of empathy as a multidimensional construct. The IRI captures four separate aspects of empathy, their relationships with measures of social functioning, self-esteem, emotionality, and sensitivity to others was assessed. Each of the four sub scales present a distinctive and predictable pattern of relationships with these measures, as well as with previous unidimensional empathy measures. *“These findings, coupled with the theoretically important relationships existing among the four subscales themselves, provide considerable evidence for a multidimensional approach to empathy in general and for the use of the IRI in particular”* (Pulos et al., 2004).

Due to the fact that empathy is often defined in different ways, and in order to make the question more up to date and broad the more modern questionnaire that measures the empathy quotient was looked into. The IRI originally has 28-items that can be answered on a 5-point Likert scale that ranges from “Does not describe me well” to “Describes me very well”. The measure has 4 subscales, each made up of 7 different items. The Empathy Quotient questionnaire originally consisted of 40 questions. Wakabayashi et al. (2006) found that a shorter version of this questionnaire still gives a reliable impression of the empathy quotient of a person. This is now called the EQ Short, the 22 from the original 40 questions of this version can be found in Appendix C in Dutch and were added to the questionnaire for this research. The EQ-short can easily function as an addition to the IRI since it’s also measured on a 5-point Likert scale with the same labels.

The four subscales from the IRI are:
Perspective Taking (PT) – the tendency to spontaneously adopt the psychological point of view of others
Fantasy (FS) – taps respondents' tendencies to transpose themselves imaginatively into the feelings and actions of fictitious characters in books, movies, and plays
Empathic Concern (EC) – assesses "other-oriented" feelings of sympathy and concern for

unfortunate others
Personal Distress (PD) – measures "self-oriented" feelings of personal anxiety and unease in tense interpersonal settings

The questionnaire is a self-report tool, another way to get an idea of the level of empathy of CE professionals is observing their behaviour. When observing the observant can pay attention to the way the participants engage with other people, are they listening, showing interest through asking questions, are people adjusting their emotions to that of the other people that are present? The observation protocol used in this research can be found in appendix F. Those two methods both provide information about the level of empathy of a person or of a group of people at that moment. To gain information about empathic behaviour of people at another moment in time interviews can provide insight in the way someone behaved in a (specific) situation in the past.

2.6 Training empathy

The Empathy Framework by Batelaan, (2021) as depicted in appendix A suggests to facilitate and stimulate empathic behaviour of people. This is suggested through workshops, trainings, team building activities. But also, by making people experience parts of other people's work and by facilitating interaction between people which are especially things that can be accomplished in a serious game. Serious games can be used as a safe space to experience and practice in and with social situations. Empathic behaviour can be triggered and practiced in multiplayer or simulation games. Empathy is something that is only relevant or possible in interaction with other people since it is about relating to another person. There were only a few matches when searching for a combination of training or learning and empathy. What has been found is that empathy can be created through narrative, in for example books or stories (Keen, 2006) and (Guarisco & Freeman, 2015). Bearman et al. (2015) try to simulate situations in which empathy is desired in health care through simulation games. And finally, Bertrant et al. (2018) teach empathy through the illusion someone is on someone else's body in virtual reality.

2.7 Conclusion

In the search for empathy both within and out of the construction sector no specific empathy training formats or methods have been found for the construction industry. It is however mentioned that empathy both of a single person and that of a group or the empathy towards another organisation can be developed. So, in order to follow up on the research of Batelaan (2021) and try to improve the empathic ability of professionals in the construction industry a suitable manner has to be found to enhance the level of empathy of construction professionals.

The first sub research question, *How can the empathy within project teams be influenced?* Can now be answered by saying:

Context can make people act more empathic, in Batson's experiment people were manipulated to feel or to not feel empathy for another person and thus help or not help that other person (Batson et al., 1988, cited by Vonk 2007). People differ in the degree to which they can feel empathy, or in other words, the degree to which they can take on the perspective of others (understand what someone feels and why) and can empathize with their emotions (feel what the other feels). Differences in the extent to which people can feel empathy are partly determined by genetic innate causes (Davis et al., 1994) and partly by specific experiences that people have during their childhood. One of the main obstacles for children to develop empathic abilities is when parents try to control their children's behaviour by becoming angry with them. In health care through simulation, gaming and in general through story telling empathy has found to be possible to activate and learned.

Chapter 3: Gaming for behavioural change

In this chapter serious gaming is proposed as a means to train or enhance empathy in CE projects. To do so a background to the concept of serious gaming is given and it is compared with current practice. The second and third sub-question are answered in this chapter. The first paragraph defines serious gaming and describes how it is used to change behaviour. The second paragraph describes how a serious game can or should be designed to achieve behavioural change. The last paragraph illustrates the choice and design of the game that is part of the intervention that will be used in this thesis.

The thesis and PhD researches of Keusters et al. (2023), Bertels (2022) and Batelaan (2021) have dealt with identifying critical behaviour, the first point that Arnold et al. (2005) mention. They have concluded that empathy might be a factor that improves project success. The next step according to the theory for changing behaviour is to measure the behaviour this can be done in several ways; part of this research will be the choice for and adaptation of an empathy measurement survey. The fourth step, developing an intervention strategy is dealt with in the selection and execution of a serious game because of time constraints the intervention will however not be totally suited/specified towards the goal of the intervention, which would be increasing the level of empathy of CE professionals. In the previous chapter serious gaming was mentioned as a potential safe environment to practice with and learn empathy to people. This research focuses on learning empathic behaviour and creating awareness about empathic behaviour to professionals in the civil engineering industry.

3.1 What is serious gaming, and how is this used to change behaviour?

Playing games is an old phenomenon; serious gaming may sound contradictory, as games are often played as a fun activity and are, therefore supposed to be fun. Serious games still aim to be a fun activity for players; in fact, fun is sometimes mentioned as a catalyst for motivation and learning (Hellström et al., 2023). Serious gaming refers to games in which the primary goal is education, in its various forms, rather than entertainment (Chen & Michael, 2006, p. 17). The 'serious' in serious gaming means that the game is not just played for fun but has a more serious purpose. At the faculty of Technology Policy and Management (TBM) of the TU Delft the use of serious gaming is divided into three categories which are the following:

- **Learning**: serious games as a tool for education and learning
- **Policy:** modelling real life situations and understanding complex socio-technical systems
- **Research:** data collection of the results of games, observing player behaviour or

This list is also based on research on serious and simulation games by Lukosch et al. (2018). Serious games can thus be designed and used in different ways. From real-life, physical, interactive multiplayer or single-player games to online, digital or virtual reality games. Although evidence has been found that a SG can be a suitable tool to contribute to learning skills, gaining knowledge, creating awareness or activating certain behaviours in people. “Serious gaming aims to alter a player’s knowledge, attitude, or behaviour in the domain of the game (Gautier, 2016). Wouters et al. (2013) found in their meta-analysis that serious games are more effective for learning than conventional teaching methods. Despite expecting otherwise, they found that it is not necessarily the fun of the games but other factors that serve as greater predictors of the amount of learning that can be achieved by playing an SG. These other factors that predict learning include instructions, support associated with the game, and specific learning tasks (Iten & Petko, 2014). Still, more research could

be done to explore the functionality of serious games for learning, according to Boyle et al. (2016). In this thesis the focus lies on gaming for behavioural change.

There are several ways to develop new behaviour, the originally most well know theory on learning is the learning theory and the concept of behaviourism. The learning theory was based on the conditioning experiments of Skinner (1987) in which people can be conditioned to learn new behaviour and habits by the use of reward and punishment. Another theory is the Relational Frame Theory (RFT), this was developed by Hayes and his colleagues in 2001 and is a psychological theory that explains how human abilities establish relationships between all kinds of things lead to cognitions, language and behaviour Tyndall (2022). The theory of learning by Kolb says that grownups learn from experiences by matching those to what they already know and can do. He describes learning as a four phased cycle. Concrete experience → observe and reflect → understanding towards hypothesis or conclusions → experiment or test. From there the cycle returns to concrete experience, this experiential learning cycle dates back to 1984 (Kolb & Kolb, 2013). Garris et al. (2002) implements this learning cycle to learning from serious gaming stating that through gaming an ongoing learning cycle can be achieved within the game, see also figure two.

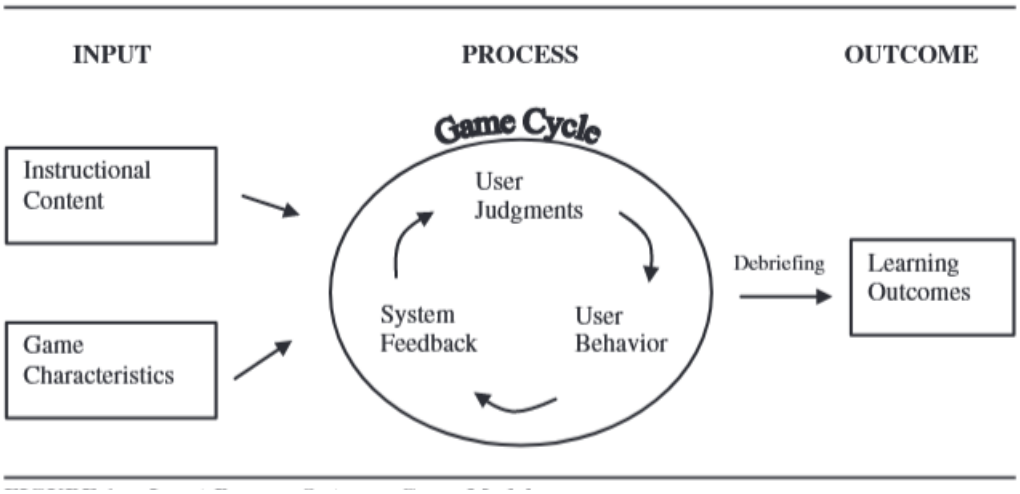

Figure 2. Garris et al. (2002) Input-Process-Outcome Game Model

Yet another cyclic approach is the five-step approach by Kreitner and Luthans (1984). They describe five steps that form a procedure to make change possible on the basis of operant principles:

1. Identifying critical behaviour
2. Measuring those behaviours
3. Executing a functional analysis of those behaviours
4. Developing an intervention strategy
5. Conclude whether or not the intervention caused a behavioural change

All those theories have resulted in all kinds of methods for example in schools, students are thought knowledge by sending information in lectures and test this in exams. In more practical cases students are sent on internships to experience practice. Other methods used are project group work and simulations. In the professional world, trainings and courses are a commonly used way to learn new theory and competencies to personnel. All the above examples are meant to help and improve learning; however, they rarely include all stages of the learning cycles as mentioned above. As described by Kolb & Kolb, (2013) and Garris et al. (2002) serious gaming can be an environment in which this learning cycle is incorporated.

A development in professional training situations is that serious games (both digital and analogue) start to play a larger role in the professional learning industry. Working together towards a common goal is something that can be achieved in a game situation (Hellström et al., 2023). Commercially used games often claim to achieve certain learning objectives for the people playing those games this however is not always researched well. Gautier (2016) tested whether serious gaming can indeed be a method to change people's behaviours in. The results were promising and therefore a next step could be to continue this testing in different cases. Gautier mentions the following on changing people's behaviour: "The traditional way of awareness campaigns is providing information and knowledge. The idea is that if one knows the effect of its own behaviour and realizes the impact of the effects, one would change its behavioural pattern. However, simply knowing or caring more would not change a person's behaviour (McKenzie-Mohr & Schults, 2014)".

According to Daoudi, (2022) serious games are indeed suitable for achieving behaviour change outcomes. In this research behavioural objectives refer to the enhancement of relational abilities and social/soft skills like collaboration/coordination, communication/interactivity, feedback, reflection, and leadership; as well as the improvement of organizational skills, project management, and teamwork (Vlachopoulos & Makri, 2017) (Lamb et al., 2018).

3.2 Sub research question two

The second sub question; *"Why would serious gaming be a suitable tool to use in order to influence the level of empathy within a project team?* Can now be answered by stating that serious gaming could be a suitable tool because it allows for including a proven effective learning cycle. Numerous serious games are available, which combine entertainment and fun elements with the ability to discuss and practice important skills. A gaming environment can create the impression that the behaviour being discussed or practiced is real. Discussing and practicing behaviour in a safe, controlled game environment can help to improve empathic skills for people working in a client, contractor, or integral project team. Spending time together and observing colleagues' reactions can improve coordination and collaboration abilities

Important to note is the fact that according to Bekebrede et al. (2005, p.6) serious games work best when they are "*embedded into broader research, learning or intervention process in which a number of complementary methods and activities are used*". They mention that it is often falsely assumed that a game in itself will be powerful enough to achieve change and or learning. Their research was on simulation-games and they call for careful attention to the preamble, debriefing and follow-up stages of the game.

3.3 Sub research question three

In the construction industry projects are usually started officially by a project start up (PSU) in which the collaborating parties sometimes meet for the first time, usually the different management positions from both contractor and client are present in such a meeting. This start up is than followed up by one or more Project Follow Up's (PFU). Traditionally the end of the project is marked by an evaluation session. It is during those sessions that attention could be focused on collaboration since the whole team is together, which is a rare opportunity.

Serious games are often used as a tool for training, learning, raising awareness and/or improving various skills. To enhance empathy through a serious game, design should focus on creating experiences that encourage players to practice empathy, understand its value, and apply it in their real-world interactions. By carefully adhering to established design principles and continually refining designs based on player feedback, game designers can create powerful tools that foster empathy,

engage players, and promote meaningful and impactful learning experiences (Wang & Huang, 2021; Tanner et al., 2022; Stepien & Baernstein, 2006).

In essence, designing a serious game for empathy is a process that requires careful thought and consideration. The game should allow players to experience and practise empathy, allowing them to experience the benefits. The game should encourage players to understand and apply new behaviours, creating a novel and immersive experience. As described earlier, empathy consists of the ability of people to understand and share the feelings and perspectives of others. When the aim is to teach someone something, there are several strategies and forms that can be used within a SG. For example:

- Be a role model: demonstrate empathic behaviour in interactions with others; seeing empathy being used can lead to learning from the example.
- Observing and listening: in order to be empathetic, it is important to observe and listen. Active listening can be taught through exercises and organised feedback, as can observing and checking that you have drawn the right conclusions.
- Perspective taking: participants could be encouraged to put themselves in someone else's shoes by asking how they would feel and react in a particular situation.
- Encourage open discussions: honest discussions about feelings, emotions and concerns should be encouraged and praised. A safe environment should be created so that participants feel comfortable opening up.
- Communication: communication is an important part of developing empathy, asking and giving feedback on both verbal and non-verbal communication and checking interpretations.
- (Role) Playing: role-playing exercises can help to simulate real-life situations where real behaviour can be observed and practised.
- Encourage kindness: praise kind and compassionate behaviour.
- Different perspectives: be open to discussions on different (cultural) perspectives in order to create understanding.
- Feedback and reflection: Provide opportunities to give and receive feedback on oneself and others.

The aim of playing a serious game for enhancing empathy should be to create the start of an ongoing learning process and to have different approaches available, as different people sometimes relate to different learning strategies. It is important to create an environment that encourages the development of empathy and shows that it is an important and valuable skill.

The third research question; *How can serious gaming be used to enhance empathy within projects in the construction industry?* Can be answered stating that a serious game can be implemented in sessions where both the contractor and the client are present, such as PFU and PSU sessions. Through experiences, CE professionals can develop or enhance skills, get to know each other better, become aware of their own behaviour, and enhance the level of empathy within their project. Serious games can influence motivation, creating a functional learning environment. Incorporating feedback in a serious game can trigger an ongoing learning cycle. The next paragraph will show how a possible empathy training including a serious game could look like based on availability and the theory in this chapter and by this further answer this question.

3.4 Creating an empathy training intervention

The capacity of this research does not facilitate the development of a serious game for teaching and improving empathy. It was therefore decided to look at existing serious games that contain as many

elements as possible from the above lists. In order to find a suitable game, an internet search was carried out to find out which companies offer serious games related to empathy and collaboration. Several companies were found and contacted. *Fouten maken Moed*, a serious game by Goudvisie, was found to be a suitable game for this research because of its interactive, live character, the duration of the game and the possibility to modify the themes and wording of the questions used. More information on this game can be found in this chapter and in Appendix G.

In order to find a suitable game for this research google was used to search for serious games for empathy and collaboration. Search terms were "serious game empathy", "serious game for collaboration" "serious game construction industry" "improving empathy with serious game". Through this search several organisations that make and facilitate serious games for several organisations were found. The website of five organisations have been scanned to see if there were any games related to the concept of empathy, collaboration and or the construction industry. Two of these companies were than approached with the question if they wanted to help out with this research. A third party was contacted through e-mail as well, this was a contact of dpi that sometimes is involved in a project dpi is working on or with. One company did not respond, the contact of dpi and Goudvisie did respond. The contact of dpi did not have a suitable game and no time. Goudvisie had two potential games in stock for the subject of this thesis. The first being: "*het huis van licht en shaduw"* (The house of light and shadow). And the second: "*Fouten maken Moed*" (making mistakes is mandatory/courageous). For an overview see table one. In order to make it possible to really test the game and use real data from construction project teams *Fouten maken Moed* was chosen mainly due to its simplicity and duration. For "*het huis van licht en schaduw*:" at least 4 hours of playing time are needed the game was developed to get hidden interests and team quality and pitfalls to light. *Fouten maken Moed* was available, suitable to implement in a PSU of PFU and had some questions that suite the goal of enhancing empathy.

Table 1: *Serious games*

Organisation	game	goal	available	duration
Goudvisie	Huis van Licht en schaduw	Uncovering interests	yes	4 hours +
	Fouten maken Moed	Open climate, collaboration	yes	1-2 hours
Dpi/Dura Vermeer	Commons game	?	?	?
	Culture game	Improving collaboration	?	?
4Challenge	?	Collaboration (option for customised)	no	?

Training empathic behaviour

The game *Fouten maken Moed* in this research serves as the main part of the intervention in the research. It also serves as one of the main parts of the proposed and researched empathy training. Roughly the empathy training has a preparation/introduction, the game in which behaviour is shown, reflected on and practiced with and a debriefing. In this research middle part of the training, the game is looked into. The intervention was placed in a day and a half a day PFU and PSU session. Prior to the intervention the participants arrive at the location (in all cases this was a hotel in proximity to the project). The first part of the PFU/PSU session is reserved for arrival with thee/coffee, a word of welcome by the collaboration advisor from dpi followed and a walk through the agenda of that day. This setup is chosen since it is common practice, it allows for a smooth walk-in in which people don't

feel like they have to wait and can start of their morning at ease, since for avoiding traffic, these meetings often take place early in the morning. Sharing the agenda of the day helps for managing expectations and allows for participants to react on this and see whether it matches their expectations. When seated and welcomed the participants are asked to express their expectations and wishes for the session of that day. In case expectations differ from the original agenda they are added to the list if suitable and related/relevant for the session. If not, it is explained why and it is discussed what would be the right place, moment and people to work on that point instead. Those goals and expectations will later also be used to reflect on the session in the debriefing. After taking inventory the game rules and goals are introduced.

During the introduction of the game, emphasis was placed on the importance of approaching and answering the questions and tasks seriously and personally. The participants were asked to use real and recent (when possible) examples of situations in answering the questions. It was explained that in this way the most benefit would be gained from playing the game for the project and the team. When forming teams, the people were asked to form their teams as mixed as possible, so combining people from different companies, functions age and gender etc. in one team. This way people that would usually have opposite goals or ideas have now the same goal, winning the game together. After forming the teams, the game rules were explained according to the manual. The game was played for approximately one hour and 15 minutes.

Game description and materials

Due to plagiarism rules the full game manual is only available to the researcher and the thesis supervisors. This paragraph however does give a description of the game and how it was placed in a PFU or PSU session as the research intervention for the quasi-experiment. For research purposes, the complete game manual and questions can be requested from the researcher or the makers of the game (Goudvisie).

The game set consists of a manual/question book, a playing board, 4 coloured pillions, 2 dices, paper, pencil and “magic cards”. With magic cards a team can either help or annoy another team. All teams have a secret mission that they have to complete in order to make their points count at the end of the game, if the secret mission fails the team cannot win anymore. The dices decide how many points can be made during a turn and next to that they decide which question will have to be answered or which task has to be fulfilled. Paper and pencils are provided, in some tasks they are needed but, they can also be used to write down themes that need further discussion or questioning after the game. The game guide or facilitator has the book with questions and tasks (30 in total), after the dice decided which question has to be answered the facilitator reads it out loud and listens and watches carefully to the answer. The facilitator then decides whether or not extra points are awarded, for example when a team is placing themselves in a vulnerable position, or when a personal example has been shared. For the setting in session two see figure 3.

Figure 3: Quasi-experiment session

Aim of the game

On the website of Goudvisie (https://goudvisie.nl/serious-gaming/fouten-maken-moed/), the makers of the game *Fouten maken Moed* (making mistakes is mandatory/courageous) the following description of the game is placed (the description is translated from Dutch to English):

"*Fouten maken Moed is a is a culture change game in which you and your team engage in various knowledge, action, and application tasks. The objective? Progress as far as possible on the game board and fulfil your secret mission. The underlying idea? Through the light-hearted nature of the tasks, gradually feel more comfortable making and sharing mistakes, and create a learning environment within your team. The dynamics of the game are about having fun, winning and most importantly the dynamics that emerge amongst the player about vulnerability, recognition and reflection on how to deal with the themes that come forward*" (Goudvisie, 2022).

The skills that are said to be developed by playing the game are: one, daring to make mistakes and share them with others. Two daring to show your vulnerability. And three creating an open learning climate. In order to achieve the development of those skills several questions and tasks have to be answered and fulfilled. The following paragraph shows a few examples of those questions and tasks.

Questions and tasks

The exercises in the game are divided into four categories: Knowledge, Dilemma, to do and apply. Five examples of exercises that can come forward in the game are described below. Those descriptions are translations from the original Dutch manual by Goudvisie, (2022). The manual is a paper booklet with written text in it, for the knowledge questions the answers are written in the bottom of the question page. All questions are in Dutch the examples given below are translated into English.

A first example is the knowledge exercise four from the facilitators manual and it is the following:
Exercise 4 "knowledge" duration: 1 minute
According to Lencioni trust in a team is the fundament of good collaboration. What, according to Lencioni, is the link between trust in a team and making mistakes?
Answer: Trust only starts to exist when people are open, ask for help, share mistakes etc. Lencioni says: "Team members who are not genuinely open with one another about their mistakes and weaknesses make it impossible to build a foundation for trust".

An example from the category "to do" is exercise seven.
Exercise 7 "to do" duration: 4 minutes
"Think of how others might see you. For all teammates, give a stereotypical or parodic example of how you think people in your team see you and how they think you are filling in your role in the organisation or project."

The below mentioned exercises 16 and 17 are in the category dilemma
Exercise 16 "dilemma" duration: 3 minutes
"Situation: You see a new, young and enthusiastic colleague taking on all kinds of projects. You know from experience that this is too much and that several colleagues have collapsed on these tasks. However, the new colleague has a lot of energy, is eager to learn and wants to do well. Are you going to let him go, or are you going to try to prevent him from making a mistake?
Make a case for why you should protect him and a case for why you should let him experience it for himself."

Exercise 17 "dilemma" duration: 3 minutes
In the following situation, you are going to estimate what the members of the other teams would do.

Situation: While waiting for a meeting room to become available, you overhear a colleague talking to some team members. You work closely with this colleague. You hear this colleague addressing her team members in a way that makes your hair stand on end. She cuts people off, puts them in their place and is not empathetic. You don't feel good about it. Are you going to deal with it or not? (wait for answer)
- Let each of the other teams think for themselves what they would do, without sharing.
- The acting team estimates how many people will come back to it.
- When this has been shared with the facilitator, everyone announces their choice.
Points are awarded if the estimate is 1 above or below the current answer. If the number is exactly right, the team gets an extra point.

The final example question that will be given here is exercise 26. This question allows for the players to open up about a situation in their work environment that is uncomfortable. Possibly the person with the story is afraid of what others might think of the situation, it might trigger stories or a situation in which others could practice empathic reactions, or allow to show behaviour that cannot be categorised as empathic.
Exercise 26 "apply" duration: 3 minutes
"What do you know that you actually don't want to know at this moment? Earn points if everybody in the team answers this question."

Total training setup

Back to the total training setup, in a bit more than an hour, 3 to 4 rounds of exercises can be played, while there is still room to elaborate on examples and make all teams think about the question. Empathic behaviour such as supporting the other teams, trying to understand or get more clearance on an answer by another team is emphasised and rewarded by providing extra coins that can be used to buy cards or as a point at the end of the game. Vague or general answers will be challenged to become more specific through follow-up questions from the facilitators. The role of the facilitator is important (Scannell, 2010), since the profundity of the conversations and answers can be assured by supporting though questions and nonverbal support like nodding and humming. It is also the task of the facilitators to create a safe environment for the players by encouraging respectful, open and curious behaviour and stopping the opposite behaviour. The facilitator is also the time keeper and makes sure to keep the game and energy flow going.

At the end of the game there is a debriefing in which players have room to react on the session, for the facilitator there is also room to give some insights and explanation about the context and content of the game. During the debriefing the main message is to take time to ask questions to colleagues, to not make assumptions as of why someone does or does not do things. And through this be able to see some things from the others point of view. It will be explained that the research they had been participating in is about the effect of playing the game on their empathy with the aim to improve their collaboration. The word 'empathy' in not used until after the second questionnaire was filled out.

A few example questions in the debriefing are:
- What did you experience during the game?
- What did you like and dislike about the game?
- What will you personally implement or take home from this session?

Next to this there will be the opportunity to ask questions about the research.

In the end the total intervention includes the following steps:

- Email with invitation to PFU/PSU and agenda of the day, including questions to think about prior to coming to the session
- Welcome with tea and coffee
- Introduction advisor and researcher
- Agenda of the day walk through
- Addictions to agenda from participants
- Pretest (questionnaire)
- Group division explanation and division
- Game instructions
- Playing *Fouten maken Moed* (1 hour and 15 minutes)
- Warning for final game round
- Question for themes or subjects that need further debate or explanation
- Post-test (Questionnaire)
- Debriefing
- Word of thanks to the participants

The facilitator can act as a role model and demonstrate empathic behaviour throughout the game. *Fouten maken Moed* has plenty of opportunities to practice observation, communication and listening through the questions used. Offering help, openness and showing vulnerability are rewarded by the facilitator by awarding coins that can be used in the game. Perspective-taking and role-playing are built into the game in some of the questions and tasks, where people are asked to judge how their colleagues would behave in certain circumstances. Or they are asked to act out a small situation they have experienced or imagined. However, these examples relate to making mistakes and learning from them and are therefore less focused on improving empathy. There could be room for feedback and reflection in the game, but this is not the focus of the game as it is designed. As it is not possible to know what experiences all the participants have had so far, it is hard to say whether or not the participants really practised and experienced new situations.

The serious game *Fouten maken Moed* will function as the main learning activity in the empathy training intervention as designed for this research. The rest of the research design that will be presented in the next chapter; research approach. Is organised in order to explore and evaluate the effect of this serious as part of the empathy training that also includes the introduction and debriefing as shown in the list in the previous paragraph.

Chapter 4: Research approach

Now that it became clear that CE projects still often fail to succeed and a possible part of the solution might lie in improving the empathic behaviour of CE professionals and an intervention has been looked into, a method is chosen to evaluate the effect of this intervention. This chapter describes the research method and target group, constructs are defined and research instruments will be described. Finaly this chapter will close by showing the setup and results of two test sessions that helped shape the final intervention design.

4.1 Research design

The methodology of this research consists of a combination of several, both qualitative and quantitative methods and therefore makes this a mixed-methods research. A mixed method research design was chosen because the combination of qualitative and quantitative data provides a more comprehensive view and it allows for obtaining conclusions from different perspectives. Furthermore, with a mixed method design it is possible to conduct a preliminary exploration with individuals to make sure instruments, measures and interventions fit the field that is being studied. And lastly it allows to add qualitative data to the quasi-experiment through assessing the personal experiences of participants in a follow-up to further explain the outcomes of the study (Creswell, 2015). Creswell (2015) elaborates on several mixed method designs. This research has used a combination of the convergent parallel design and the transformative design as can be seen in figure four.

This research consists of a quasi-experiment with a pre-post-test design without a control group. In this quasi-experiment the serious game "*Fouten maken Moed*" is part of the intervention in between the pre- and post- measurements. The quasi-experiment will be used to answer the question whether or not the level of empathy is influenced by playing a serious game. This experiment is done in an explorative manner since the experiment doesn't include an extensive setup with a control group or a double-blind setup.

Within the explorative experiment quantitative data will be generated with the use of an empathy measurement survey. This can be analysed in a descriptive manner. However, because of this being an explorative study with a small data set, no extensive valid statistical data analyses can be done and hence no generalisations will be justified on the basis of this research. Generalisations are not in place as well due to the fact one game was tested so no generalisations on the fact whether or not serious gaming in general can achieve change can be done. In order to get to know more about the attitude towards the research and the lessons learned from the game, observations and semi structured interviews will be used. It was chosen to make use of semi structured interviews because they enable to achieve a focus on the topics you want to cover by preparing and redirecting the questions. And at the same time the interviewer is able to tie into other topics that might emerge (Dingemanse, 2021). Those interviews and observations are again part of the qualitative part of this study.

Figure four shows a schematic picture of the research design. In this figure t1 is the moment before the intervention (the serious game) is played. The moment right after playing the game is t2. Approximately one month after t2 comes t3 in which the interviews will be held. In the first two time steps the empathy measurement questionnaire based on the IRI (see appendix B) and the EQ short (see appendix C) will be filled out by the team members. Additionally, to this the observations will be input for finding an answer to the research questions.

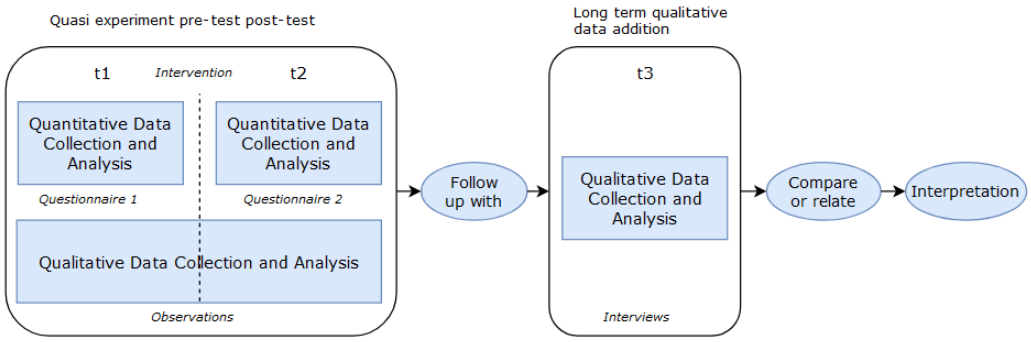

Figure 4. The convergent parallel design combined with the transformative design based on Creswell (2015).

4.2 Operationalisation of empathy and serious gaming

The most important concept that will be measured in this research is empathy. In chapter two this concept has been defined as: "*the ability to recognise and react to another person after trying to understand reactions of one individual to the observed experiences of another".* According to Davis, (1980). The IRI and EQ short have been combined to form a measurement tool based on this definition and literature. For this research empathy will be operationalised as both an individual concept measured quantitatively by the empathy questionnaire partly divided into three constructs according to the IRI questionnaire excluding the fantasy scale. In this questionnaire a higher score shows a higher level of empathy. And as a group concept in which a distinction can be made between empathic behaviour from one person towards another and empathic behaviour of the group. The information on the individual level of empathy measured by the questionnaire will be extended with information from Interviews and observations. The information about the level of empathy in and of the group will be described by the results from observations and information derived from interviews.

A second important construct in the research question is serious gaming. According to the definition of Chen & Michael, 2006, p. 17) serious gaming refers to games with the primary goal of education rather than entertainment alone. In this research the serious game *Fouten maken Moed* by Goudvisie is used as the game tested on its effectiveness positively influence the level of empathy of CE professionally. So serious gaming in this research mainly refers to this specific analogue multiplayer game as described in chapter three.

4.3 Research instruments

Survey

Many empathy surveys exist for this research, after a short exploration on measurement tools through google scholar, it was decided to follow the path of Batelaan (2021), Keusters (2022) and Bertels (2022). Batelaan reviewed the Chapin Social Insight Test, the index of Empathy for Children and Adolescents (IECA), The Empathy test by Kerr (1947), the Questionnaire Measure of Emotional Empathy (QMEE) the Empathy (EM) scale The Empathy Quotient and the Interpersonal Reactivity Index (IRI). The final four questionnaires are also discussed by Bertels (2022). In all the above the IRI was considered to be the most suitable tool despite its age, being designed by Davis in 1980. The main concern for the Empathy Quotient (EQ) by Baron-Cohen & Wheelwright (2004) was the length. In this research the IRI will thus also be used.

The IRI is a self-report measurement questionnaire on empathy and defines empathy as the "*reactions of one individual to the observed experiences of another"* (Davis, 1980). This was chosen due to its wide use in literature, despite being 40 years old. As an extra check the EQ short was

added to the empathy questionnaire for this research, those questions can be found in the next appendix C. The IRI originally has 28-items that can be answered on a 5-point Likert scale that ranges from “Does not describe me well” to “Describes me very well”. The measure has 4 subscales, each made up of 7 different items. The Fantasy subscale was removed in this research since it doesn’t suit the empathy definition and the means of this research. Next to this it also helped to reduce the length of the questionnaire.

Each item in the IRI is rated on a 5-point scale, ranging from A to E where A corresponds to 0 and indicates "does not describe me well," E corresponds to 4 which indicates "describes me very well." Each empathy scale within the IRI comprises seven items, resulting in a possible total score range of 0 to 28. In this research the fantasy subscale was deleted and therefore the total score per construct can range from 0 till 21. The means from the study of Davis (1980), Fultz & Bernieri (2022) and that of this research are depicted in table four. The initial publication from Davis (1980) reported internal reliabilities (Cronbach’s alphas) ranging from 0.71 to 0.77. Appendix B shows the questions and the constructs they belong to.

Due to the fact that empathy is often defined in different ways, the more modern questionnaire that measures the empathy quotient was looked into. In appendix C the Dutch version of the questionnaire is presented. Originally the Empathy Quotient questionnaire consisted of 40 questions, or 60 questions with the optional 20 additional questions that should prevent the surveyed from focusing only on empathy to make the questionnaire more reliable. Wakabayashi et al. (2006) found that a shorter version of this questionnaire could still give a reliable impression of the empathy quotient of a person. This is now called the EQ Short, the 22 from the original 40 questions of this version are added to the questionnaire for this research. The EQ Short is also answered on a 5-point Likert scale with the same labels as the IRI this makes them easy to incorporate in one questionnaire.

Semi-structured interviews

In order to get more information on how the participants feel and behave after the session with the serious game interviews are conducted. The participants of the game all received an email with an invitation to participate in this interview. The collaboration consultant that will be present at all sessions will also receive an invitation. The interviews will be held using the program Microsoft Teams and are transcribed through this. The transcriptions will then be transferred to Atlas.ti and coded in that program. The codes will then be categorised into three categories; attitude towards the game, lessons learned, and other of general messages that interviewees have taken from playing the game. The interviews will be held in Dutch, the questions that are used for the semi structured interviews of this research can be found in appendix E. All questions in Dutch are also included in that appendix, the English translation is added there as well. It can be seen from the star notations that some of the questions had been slightly changed to make them applicable for the 4th interview with the collaboration advisor. Quotes mentioned in this report are translations by the researcher.

Observations

During all sessions both facilitators (being the researcher and a collaboration advisor from dpi) combined guiding the game with observing and taking (mental) notes of what they saw happening in the interaction between the game participants. The focus of the observation will be on observing the behaviour and interaction of the participants. The aim of the observation is finding out whether or not participants show different behaviour before, during and after the game. The focus is on both individual and group behaviour and interactions related to the concept of empathy. Appendix F has more elaborate descriptions and includes the observation guide.

4.4 Target group

The target group for this research consists of professionals working in the civil engineering sector, that collaborate either on the contractor or client side of a team in a civil-engineering construction project. The focus of this research is on the Dutch market. It was due to practicality chosen to only look for project teams that are connected to dpi due to the fact they have either a PFU or a PSU organised by dpi. This scope choice was made in order to make the study feasible in time. In order to test the game and the empathy measurement tool, test sessions will be held with two available teams that are in marketing and in consultancy. Hence the target group for this research differs from the group that participated in the test sessions. Those test sessions will be held in order to improve and practice the use of the serious game and the questionnaire.

4.5 Validation and testing

In order to shape the intervention, and be able to implement the serious game in a real PSU and/or PFU meeting with CE professionals working in a client contractor collaboration two test sessions took place. The main goal of the test sessions was to form an intervention that could fit into a PSU of PFU program while at the same time providing a valid research environment in which the pre-post-test design could be implemented. Based on the experience from attending a few PFU and PSU sessions organised by dpi a first test session was setup.

The questionnaire was considered to be too long because the questions were rushed through a bit and no critical questions were asked to steer the answers towards work related themes.

Test session one

During this session there were 14 participants that were colleagues in a marketing bureau, the serious game was guided by an employee of Goudvisie and lasted for about 1,5 hours prior to and after the game the questionnaire was distributed. The researcher was taking notes and provided a short introduction about collaboration and the confidentiality/research ethics followed by the informed consent form and the questionnaire. The session started with a mistake because the employee that guided the game explained that the level of empathy would be measured, this didn't result in problems for the reliability of this research because the gathered data has not been used for this research. This session was on a Friday afternoon, the participants asked if they could have a beer during the game, this was not allowed by the researcher. This is an example of the mood they were in. The participants said to be ready for weekend. During the game the participants did answer the questions and participated in the tasks, they however didn't really give practical examples from their work life or lessons learned in contact with colleagues. The game leader didn't really try to make them be more open and personal as the focus for the game leader was more on the progress of the game technically and time wise. Furthermore, this test session resulted in the conclusion that the questionnaire was taking too much time since it took about 20 minutes to fill it out. The questionnaire has to be filled out twice so that means the procedure of filling out the questionnaires in this setup costs almost as much time as the game itself. The game was found to have had to little depth to it, this could be changed for the better by focussing on the content and subjects of the game rather than the duration, here lies a responsibility for the facilitator.

Test session two

This second session was held end of September with a group of colleagues from dpi, some of them had been working together on projects others are working in different divisions of the company and therefore know each other mainly from social activities and seeing each other in the office. Eight people were present during this session and the game was guided by the researcher. A lot of humour was present in this session, sometimes to deal with an awkward topic or a difficult situation. The

questionnaires were again filled out prior to and after the SG. The game was played for about 1,5 hours and especially in the second half of the game the jokes became less frequent and during the debriefing a sensitive topic was discussed by the whole group. This second test session was held with a reduced questionnaire by taking out the questions from the fantasy scale of the IRI part of the questionnaire since it fits the empathy definition used in this research the least and the original questionnaire was considered to be too long. The guidance of the game was now done by the researcher and more time was taken to go into depth on some discussions and conversations that resulted from questions in the game. In the evaluation it became clear that they still thought the questionnaire was pretty long (about 10 minutes per questionnaire) however it was decided to keep it this way since otherwise the consistency and validity of the test would drop. Some questions in the game were not understood right away and didn't match or relate to the background of CE professionals and thus found not to be suitable for the construction sector. Therefore, those questions have been either removed or some changes in wording have been made. It was also observed that more time should be taken to answer the questions from the game and that more might be achieved when 2 people guided the game together so that time keeping, observing and asking questions became a shared responsibility instead of one person having to juggle all these things.

Serious gaming is used in this research as an intervention in the quasi-experimental part to answer the question of to what extent it can influence the empathy of the players. And as an object of study in the sense that it is investigated whether the game has an effect on the level of empathy of CE professionals. Clark (2007) says that serious gaming should be tested more for its ability to learn or adjust behaviour. In preparation for the data collection sessions of this study, the game was tested twice. Some adjustments were made, questions were removed (3,6,20,21,22) and more appropriate words were chosen to better reflect the complex socio-technical environment of the CE environment in which it is used.

Missing values

Sub question four will be answered quantitatively through data analysis using python to execute a paired sample t-test to compare the mean outcomes of the questionnaires from t1 and t2. In the case of missing values, the problem of the missing data will be solved by imputation (Bhandari, 2023). This will be done by accounting the mean score for that specific construct or part of the questionnaire of that same participant to the question that was left blank. In case more than 2 questions in a construct or 5 questions in total are left blank the participant will be taken out since no valid empathy score can be derived from such a questionnaire. The questionnaire data will be transferred to Python manually by the researcher form the paper questionnaire, this allows for noticing all missing data points, and manually impute all missing values.

4.6 Data collection and confidentiality

The data collection as stated before is both qualitative and quantitative. Figure five shows the moments of data collection in time. The survey data from the questionnaire will be collected right before and right after playing the serious game. The qualitative observation data will be collected from the moment the first participants arrive until the last participant has left. The qualitative data from the interviews is collected about a month after the game session through an online interview in which the researcher asks the questions.

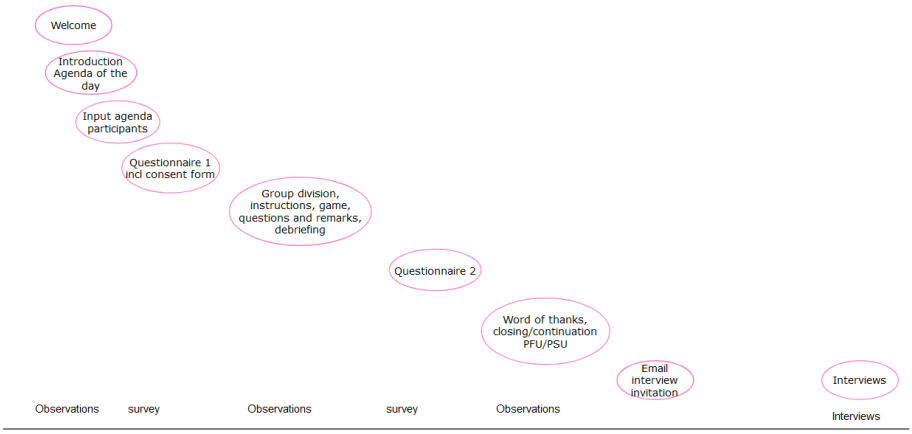

Figure 5: Quasi-experiment session and data collection

The target group of this thesis was professionals working in a client contractor collaboration in the construction or civil engineering sector. Within dpi several projects hire advisors on different expertise's, one of those expertise's is collaboration. Within the time frame of this thesis research five project managers that were in contact with dpi have been approached by e-mail to help out with this research by playing a Serious game in their PFU or PSU that was planned to be hosted by dpi. Two projects didn't match the time frame of the research. One project was slightly late and did not have enough time available to also include the questionnaires. Two other project managers did react enthusiastic on the idea of contributing to a thesis by playing a game in their PSU or PFU. Those two projects have therefore been chosen based on their availability in the right time frame for this research.

This research will be conducted following the Human Research Ethics Committee (HREC) rules and regulations of the TU Delft. In order to get the approval for this research a data management plan was made and the following steps were followed. All participants will get a combined informed consent with the t1 questionnaire labelled xA (x ranging from 1 till n) those forms will be scanned and handed over to the TU Delft archive. The informed consent form is marked with the name and makes it possible to hand out the xB version to that same person after the intervention. When the t2 questionnaire is handed out the informed consent forms are separated from the t1 questionnaires, after which no name can be traced back to the forms. The original forms will then be transferred to an Excel file that only contains the xA and xB followed by the answers. The excel file will be stored at the researcher's personal TU Delft one drive. The TU Delft one drive is protected by the TU Delft data security regulations.

As for the interviews, they will be conducted and transcribed online through the TU Delft MS Teams. After the interview the transcriptions will be anonymised and the recording will be deleted. The anonymised transcriptions will be stored on the TU Delft one drive and will be uploaded to the TU Delft repository only to be seen by the thesis supervisors. The analysis of the interviews will be done in ATLAS.ti and the results of this analysis will be shared in this report and thus will be openly available in the TU Delft repository. The original data linking to the participants and the projects is thus only available to the researcher. In order to make this a high integrity study, the procedures of the TU Delft Human Ethics Code were adopted and the plan was therefore approved by the Human Research Ethics Committee (HREC). Part of this process was the creation of a data management plan, which is included in appendix K. During this research, meetings were held with supervisors from both TU Delft and dpi to review and guide the research in terms of integrity.

Chapter 5: Results

In order to be able to answer the research questions data was gathered, this chapter shows the results derived from both the quantitative and the qualitative part of this research. The results from the questionnaires, observations and interviews will be shown. No conclusions are drawn yet from those results, as this will be done in the final chapter "conclusions" after they have been discussed in the next chapter.

5.1 Intervention sessions

Two sessions provided the data for this study. The participants of those sessions fit the target group because they are working in a client contractor collaboration situation on a project in the CE industry. The first of the two sessions was a PFU about a bridge construction project with 8 participants, the second a PSU with 14 participants of the installation of a water pumping system. Those sessions started off with a short introduction by the researcher, followed by the first questionnaire. The game was then played and guided by the researcher with some additions from the collaboration advisor from dpi. The questionnaire was then filled out again.

The first session of which the data was collected for analysis was held as a part of a PFU of a bridge renovation project, the design of the project was done under a *bouwteam* contract and the execution under a UAV-GC contract form. The parties working on this contract were a contractor and a provincial governmental body. In total 8 people were present during the session of which half contractor and half client employees. The second session in which data was collected prior to and after the game intervention happened as a part of a PSU for a water pumping system. The first part of the project was finalised also using a *bouwteam* contract and will now be followed by a UAV-GC contract for the execution phase. In both cases the client was a governmental organisation, in one case a waterboard and in the other a province. The contractors were private contractor companies that hire subcontractors when necessary for the works to be done in case, they are not able to do it themselves. Finally, a third session, a PFU with 14 participants was held. It was not used for the data gathering through the questionnaire because there was no time for that in the session. It did however give extra background to what the effect of playing the serious game could be on a session like that.

Missing values

The database with all the individual test results will not be presented in this report according to the data management plan. In total 3 respondents only filled out the first questionnaire because they had to leave directly after the game, those respondents have been left out of the dataset in accordance with the described handling of missing values . The dataset with the pre- and post-test results of the leftover 19 respondents had 3 missing values. In one case a question was answered using a question mark and in two cases the question was left black. An example of imputation: a data point was missing in the EC construct, the other questions in that construct were answered by this person with (3,1,2,2,2,2) so the mean (2) was filled out in the blank spot. In another case the mean of the construct turned out to be 2,33 so this was filled in in the data set.

Table 2: *Participants per session*

session	Participants (n)	Complete data (n)	Interviews (n)
Session 1 (PFU)	8	6	1
Session 2 (PSU)	14	13	2
Session 3 (PFU)	14	-	1

5.2 Data analysis

In order to find out the if the serious game had an impact on the level of empathy from the CE professionals a paired t-test was executed in python. The pre- and post- intervention means of the following outputs have been compared:

- Total questionnaire score (EQ Short and Interpersonal Reactivity Index)
- EQ Short score
- Interpersonal Reactivity Index score (without the fantasy scale)
- IRI sub scale scores (perspective taking, personal distress, empathic concern)

For the total questionnaire the higher the score the more empathic the respondent is. The same goes for the separate IRI and EQ short parts of the questionnaire. No exact names or categories are given to certain scores, so a precise type or level of empathy cannot be spoken of.

Table 3: *Results Empathy Questionnaire (n=19)*

Scores of:	Mean t1	Mean t2	Mean t2-t1	St.dev	T-value	P-value
Questionnaire	97,87	96,45	-1,42	6,27	1,010	0,325
EQ Short	56,8	55,65	-1,15	5,37	0,957	0,351
Interpersonal Reactivity Index	41,07	40,08	-0,27	2,69	0,443	0,663
Perspective Taking	16,75	17,05	0,30	2,23	-0,603	0,554
Personal Distress	8,4	8,75	0,35	1,50	-1,046	0,309
Empathic Concern	15,92	15,0	-0,92	1,69	2,432	0,025*

*Significant result (p-value < 0,05)

As can be seen in table three the results show one significant difference between the pre- and post-game means, CE professionals scored significant lower on the empathic concern scale from the IRI after the serious game compared to before. The pre and post test scores are also visually represented in the bar-chart in figure six. The visuals in figures 7a to 7f show the results per output in box-plots.

The hypotheses stated in the introduction were:

H0: There is no effect of playing the serious game Fouten maken Moed on the level of empathy within client contractor teams

HA: There is an effect of playing the serious game Fouten maken Moed on the level of empathy within client contractor teams.

Those two hypotheses have been specified to the tested data and have been tested for all sub categories of the questionnaire that are also displayed in table 3. This means that the hypotheses shown below are adopted:

- H0: There is no difference between the total scores of the empathy questionnaire before and after playing the SG *Fouten maken Moed*.
- H0: There is no difference between the total scores of the EQ Short before and after playing the SG *Fouten maken Moed*.
- H0: There is no difference between the total scores of the IRI before and after playing the SG *Fouten maken Moed*.
- H0: There is no difference between the total scores on the subscale Perspective Taking before and after playing the SG *Fouten maken Moed*.
- H0: There is no difference between the total scores on the subscale Personal Distress before and after playing the SG *Fouten maken Moed*.
- HA: There is a difference between the total scores on the subscale Empathic Concern before and after playing the SG *Fouten maken Moed*.

In all cases except for the Empathic Concern subscale the Null hypothesis will be accepted. For the empathic concern scale the alternative hypothesis, there is a difference between the empathic concern score before and after playing the SG *Fouten maken Moed* will be accepted. This difference is a mean difference on the mean total scores of this construct of -0,92. The maximum score of a construct is 4*7= 28 the minimum score is 0*7= 0. The mean score of the participants went down with rounded off 1 score point.

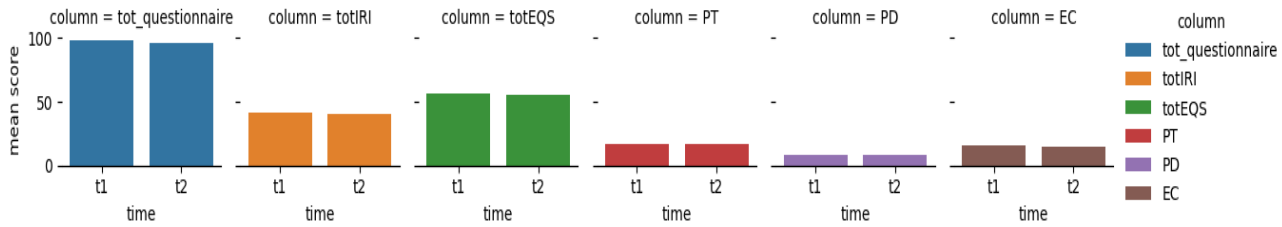

Figure 6. Mean pre- and post-intervention empathy scores

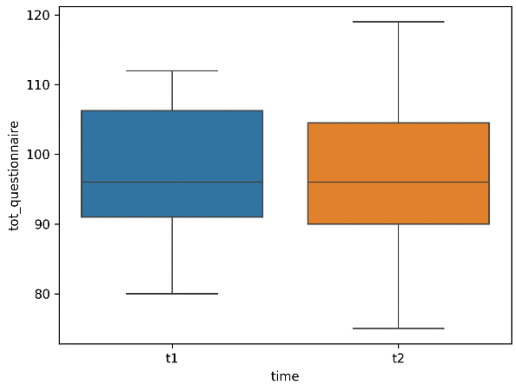

Figure 7a. Total questionnaire scores

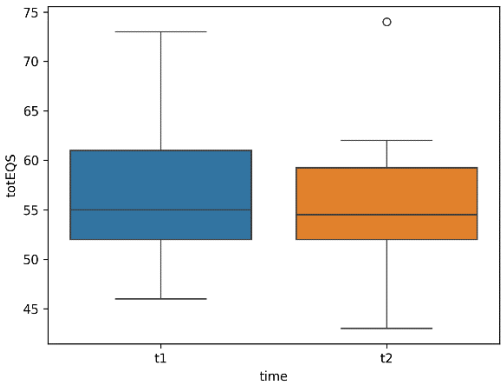

Figure 7b. Total EQ-short scores

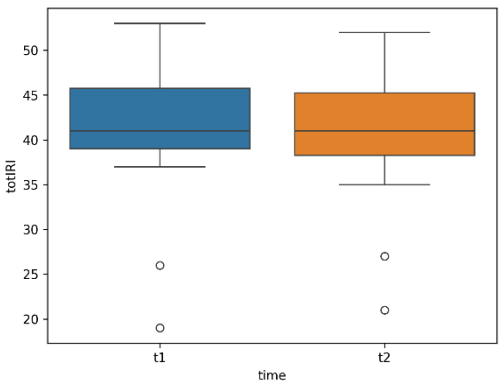

Figure 7c. Total IRI scores

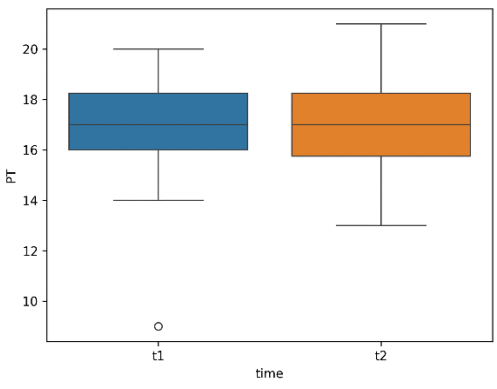

Figure 7d. Perspective taking scores

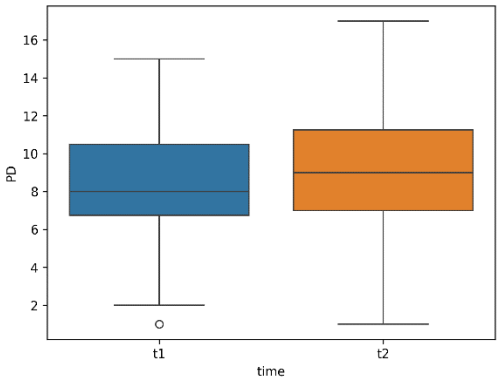

Figure 7e. Personal Distress scores

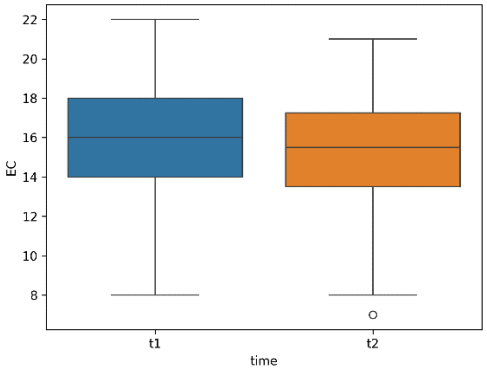

Figure 7f. Empathic Concern scores

Table four shows the mean results for the IRI part of the questionnaire spit into the different subscales. The third and fourth collum show the mean results of research from Fultz & Bernieri (2022) and Davis (1980). It can be seen that the average results in this research are lower than the results from the other two researches. The target group of the two other researches is with psychology students and divers other people not similar to the CE professionals that have taken part in this research.

Table 4: *Mean results IRI*

(sub) scale	Ambagts (2023) t1	t2	Fultz & Bernieri (2022)	Davis (1980)
Perspective Taking	16,75	17,05	18,56	17,37
Personal Distress	8,4	8,75	9,74	10,87
Empathic Concern	15,92	15,0	19,34	20,36
Fantasy	-	-	17,74	17,24
Total	41,07	40,8	47,64	48,6

5.3 Observations

Observations session 1 (PFU)

During this first data gathering session 8 CE professionals were present, they were divided into two groups with mixed mother companies. Those eight professionals had been working on a bridge renovation project together for a while already, the Bouwteam phase had come to an end and the UAV-GC contract was starting. The total budget for this project was in a range of 1-5 million euros. The game session was guided by the researcher with contributions from the collaboration advisor who also asked for more clarification or depth in some answers that were given. The game was played for a bit more than one hour. The first questionnaire was filled out by all 8 participants but the second only by 6 participants since two had to leave right before the debriefing after the game. The group was equally filled with professionals from client and contractor side. Project managers, technical managers and omgevingsmanagers were present. During the game this also surfaced and both teams got to explain how this situation felt and occurred. It seemed that the issue was then resolved, after the session it became apparent that the contractor didn't really accept the apologies and did not trust the client to behave differently next time. Furthermore, as the game evolved the answers got more personal which was really appreciated by the client participants, the project manager on the contractor side was a bit afraid of showing the doubts and vulnerability as an organisation and withheld his colleagues a bit from elaborating too much on the subject. After the game the professionals filled out the questionnaire.

Observations session 2 (PSU)

In this session 14 CE professionals were present, this meant that the whole core team was complete except for 1 member of the team who could not attend the day. After the game one person had to leave due to private reasons, besides this everybody filled out the two questionnaires. The setup was the same as the first session with the researcher guiding the game and the collaboration advisor contributing to the session by asking questions for clarification. Some of the participants had been working together towards the start of this project but many of them had not seen each other before. The project was about a water pump installation and also has a total budget in the range of 1 to 5 million and a background in a Bouwteam combined with an UAV-GC contract. The roles present were: project supporter (client side), technical manager (contractor side), advisor mechanical engineering (client), contract manager (client), advisor civil engineering (client), project leader, advisor PA (client), technical manager (client), manager project control (contractor), project manager (contractor), project leader (contractor), omgevingmanager (contractor), project manager (client), advisor (client). The group was spilt into four teams with mixed people from client and contractor side in one team.

All four teams took the time to read the secret objective cards and the magic cards. Some questions about the rules were asked and the first team started. During the question on core values that one team received, it became clear that this team did not yet have core values established for their project and team. The researcher than assigned the team with the task to come up with a core value in all 4 game teams and organise a short sharing and discussion on what values each team had come up with. This turned into a sharing of values, many of the team members were nodding their heads when a value was mentioned. The values that were vague got more direction by some more specific explanations.

During the discussion about core values one team mentioned the importance of being helpful to each other (“behulpzaamheid”). This related to them closely to the before mentioned value “honesty” being able to be helpful is only possible when you are honest about how things are. On the one hand people have to speak up about what they need and on the other hand team members should be willing to help other team members without wanting direct personal gain from it, even though it can delay their own work.

Another subject that came to the table during the game was first impressions and direct reactions to situations. A few people mentioned that primary reactions can sometimes be so harsh and unconstructive they might workout harmful in the end. It is therefore wise to wait, think and reflect, use the help of a colleague before you speak up to a colleague on something you didn’t like or understand. Some players had a more active role in the strategic part of the game and some others had a bigger role in the discussions or answering their own questions.

Observations and conclusions session 3 (PFU)

This final additional session was not used for data gathering with respect to the questionnaire. 14 people participated during the game that lasted a bit more than one hour. The project was already more than a year on the way and will continue for at least 4 years since it is about a long-term maintenance project. The total project budget is > 50 million euro. The group was divided into four teams of mixed contractor and client employees. From the beginning the participants listened carefully and focused on the tasks and questions. The participants said to have had fun and did share many personal and practical cases. When comparing the events and sessions the difference between the collaboration of the teams can also be seen through the answers on some questions. For example, one question is about whether or not you would tell a colleague “En plain public” if he is presenting from an old version of the information. Some teams would tell their teammates

unanimously and others really wouldn't to prevent putting each other in a bad light. Whereas teams that know each other better would feel comfortable showing each other's their mistakes, which will in the end most likely be beneficial for the project outcome through efficiency.

Throughout all the game sessions, it was observed that the conversations became more interactive as the game progressed. The answers given by the CE professionals needed less questions from the game facilitator at the end of the session because they were more elaborated and other team members started to show interest by asking questions. After a while, in all sessions, it was observed that different teams helped each other by sharing their own experiences with the subject under discussion. Before the session started participants entered the room chatting with people from their own "parent" organisation and looking at their mobile phones. After the game, during the remaining PFU or PSU, people from the different organisations also seemed to have found each other to talk to.

5.4 Interviews

Four interviews were conducted: the first interview was with a team member from the PFU in the first "official" game session in which data was collected. This was the project manager from the contractor side. The second and third interviews were with team members from the PSU. The fourth interview was conducted with the collaboration consultant from DPI who was present during all data collection sessions, including the test session at DPI and the second PFU (the second PFU was not originally included in the research method). The questions used for the semi-structured interviews can be found in appendix E. The results of the coding process can be found in appendix I.

In the coding process, quotes were selected that showed attitudes towards the game, lessons that participants did or did not learn, or gave a general idea of the message that emerged from the interview. The attitude towards the game are things like motivation to play the game, what the players thought of it in terms of fun or boredom, what they thought about the game session in general, or if and how they found the game to be an effective instrument and what they thought about the quality of the game. In the lessons learned, or not learned category the codes about, good or bad collaboration, learning, listening, empathy and agreements are placed since these are codes relating to codes that say something about what the participants did or did not feel like to have learned. The final category is a rest category that presents other codes that provided another general message than the attitude or the lessons learned in the game but were found to be interesting and of relevance for either the subject of empathy or collaboration in general. The codes that have been used to categorise and structure the information from the interview are presented in the table below. Some of these quotes and the codes associated with them are shown in table five.

Table 5: *Interview codes categorised*

Category →	**Attitude towards the game**	**Lessons learned, or not learned**	**General message from interview**
Code ↓	motivation	learning	knowing each other
	fun	(bad) collaboration	Situation/person dependent
	game session	agreements	interests
	competition	Listening	guidance/coach
			empathy
	effectiveness	empathy	atmosphere
	quality game	atmosphere	openness
	duration	contribution	kind of people
	follow-up		facilitator

An example of how a perceived good relationship can influence someone's motivation to be empathic with a colleague: From the first interview with a project manager from the contractor is the following part of the interview:

Interviewee: ".And That's a very good one. We just always understand each other. I mean, we may swear at each other. We always know exactly how the other person is, so to speak. And That's the same with colleague y, isn't it? Who comes a few years after that who yes you just understand each other and and yes."
Interviewer: "Yes."
Interviewee: "*Then then, That's just super."*
Interviewer: "*So that relationship that you have then built with each other actually makes you that you can and want to be so empathetic."*
Interviewee: "*Yes absolutely."*

Table 6: *Interview quotes*

Interview	Quote*	Codes
1 (Project manager Contractor side)	*"And, this is very much about having and creating a good relationship. Well, I think I know fairly well how I am, but many other people can benefit from it. Well*."	Learning, Knowing each other
1	Interviewer: "*How empathetic are you?"* Interviewee: "*It entirely depends on the other person."*	Situation/person dependent,
1	*"You see, one thing is important for me, and that's just the project. So, we get to work on that, and if it doesn't go left, we'll go right. We've been working together for over a year now. That's how you get to know each other a bit better, and then you know that if I press that button of yours, you'll react that way."*	Interests, Collaboration
1	*"But well, a few more months, and we're done."*	Motivation
1	*"In this project, we really missed a coach."*	Guidance, Coach
1	*"The plan can definitely change if everyone decides to change the plan, but it must be a shared decision."*	Agreements, bad Collaboration
2 (Advisor client side)	*"Verry enjoyable."*	Fun
2	*"You often have to listen well, you know, that's the first thing. And yes, I present it to someone and ask for feedback. But I can't judge it myself, so I try not to do that."*	Empathy, Listening
2	*"Of course, I can't really solve it, but I can help, so to speak, to provide some kind of support. Yes"*	Collaboration, Listening
2	*"That was a bit competitive, but also a bit of thinking about certain things, really fun, yes"*	Game Session, Competition, Fun
2	*We made it a topic of discussion, so to prevent that there is fear among people, so to speak.*	Atmosphere
3 (Environmental Manager contractor side)	*"Yes, because you don't know each other, and there are age differences. You don't normally come together, but maybe you have some common interests, so you start thinking about what we have in common. So, you really have to think about that, but I think it's good to do because you might find a common ground, and that's nice."*	Knowing each other, Empathy, Listening

3	*"Maybe people seem very serious at first, but when you do something like that, people become more relaxed and easier to get along with afterward, I think."*	Contribution, Learning, Openness
3	*"Honestly, I didn't apply it during the situation."*	
3	*" The team did really improve, especially because of also that PSU, I think. OG is just really super busy, they really, I heard sometimes that they have as many as 16 projects per person. That's really, I think they are very understaffed, which makes initial contact with them quite complicated. So, when you email someone, they said in the game that they'd rather be called. Well, those kinds of statements are good to know, so I think the PSU contributed a lot. But I do think it's important to follow up on it in the long run."*	Appointments, Game session, Interests, Empathy, Effectiveness, Follow-up
3	*"But overall, I found that people were quite open, dared to bring their own examples. And that indicates that they felt comfortable doing so."*	Facilitator, Listening, Openness, Atmosphere
3	*"Many people don't know each other at all. It's nice to see that people still dare to do it because after such a short time, about an hour, maybe also because of the game, you felt that you could say whatever you wanted. Yes, actually."*	Effectiveness, Duration, Openness, Atmosphere, Knowing each other
4 (Collaboration advisor)	*"Everyone got a lot more energy from it. It also focused more on the answers given in the game format. Whereas normally, if you have a conversation in a different way, there's a bit less patience and a bit less fun. So, I found the fun factor quite remarkable to see, and the fact that people were encouraging each other more in that form to reveal more about themselves."*	Knowing each other, Motivation, Fun, Atmosphere
4	*"I think they've learned that there are different perspectives, how people look at certain situations, for example, and how to deal with them."*	Interests, Learning, Person dependent
4	*"Well, I think a facilitator can play a very significant role, and I think that's an indicator. How much energy the facilitator has to put into taking those questions forward, for example."*	Facilitator, Contribution, Kind of People
4	*"I do think that if you don't play the game, you'll really miss something."*	Effectiveness, Contribution
4	*"The sessions are quite similar in terms of the conditions created, so I find that very nice to see. You really see that composition and a certain phase in the collaboration they're in, that plays a role."*	Duration, Game session
4	*"In my opinion, it could really be a standard part of PFUs and PSUs."*	Contribution, Effectiveness, Quality game

** All quotes have been translated from the original Dutch quote to English.*

The results show that the individual level of empathy based on the empathy questionnaire did not significantly change by playing the serious game. When isolating the subscale empathic concern from the IRI a significant drop of one point on the mean score of all respondents can be observed. The observations show a development of social and empathic behaviour over the time of the sessions.

The interviews show that the game was appreciated, some learning has been taken out of it according to the interviewee's the behavioural examples the interviewee's give show some empathic and some less empathic characteristics. The next chapter will discuss the results and relate it in some cases back to the theory that has been provided in earlier chapters.

Chapter 6: Discussion

This section provides comments on the method and execution of this research in terms of validity, reliability, usability and integrity. In addition, striking results are mentioned and discussed based on the literature that was provided in the second and third chapter.

In order to explore the possible usability of serious gaming in teaching civil engineering professionals to behave more empathic this research was done. The explorative mixed method research was a good methodological fit. To make the results more valuable a control group could be added to change the design from a quasi-experiment to an experimental design. A bigger sample would also make the results more valuable although this is not necessary for the explorative goal of this research. The quantitative pre-post-test part of the design made use of a questionnaire consisting of two well-known questionnaires. The overall empathy score did not change after the intervention in the experiment, doubling the questionnaire (IRI + EQ short) did not result in new insights. It is therefore advised to leave the EQ short out, since it entails less information compared to the IRI.

6.1 *Fouten maken Moed* in the intervention

The game used in this research was not designed especially to increase/ focus on empathy. It was chosen to use it anyway due to many aspects that theoretically would be suitable for enhancing empathy and its focus on improving openness and collaboration. In hindsight it seems the game was indeed partly suitable because of those aspects; the total training would however probably have more effect if the instructional content of the game and the feedback in the game would have been more present. The message that being empathic really is beneficial to the collaboration could have been, in hindsight, stated a bit clearer in the game or the debriefing. For future research it would be interesting to see if the results would be different if a different game would be used. It would also be interesting to see what would happen to the results if more explicit focus would be put on empathy and if the game included more practice with empathic behaviour and had more moments with direct feedback in the game. In this way the learning cycle like presented by Kolb & Kolb (2013) and by Garris et al. (2002) linked to show the promising learning ability of serious games would be incorporated more. Partly the system feedback was present in the form of the game facilitator that provides feedback and compliments during the game session.

According to Daoudi (2022), assessment methods like pre/post-questionnaires, qualitative interviews, observations and notation grids are not suitable to measure the learning ability of Serious Educational games. He even says, based on research of Smith et al. (2015), Calderon & /Ruiz (2015) and Barr (2018) that those methods can have a negative impact since they are too intrusive and thus negatively impact the engagement of the learners. In relation to this research, the observations and interviews did not seem to disrupt or influence the session. Rather, it seemed that the extra person supervising and observing the game was beneficial to the game, as it allowed one person not to have to keep track of the time, and therefore to be able to give full attention to the session. However, the questionnaire still took quite some time to complete twice and was not necessarily helpful to the group as it was only used for analysis by the researcher. For further research, in order to make people more aware of their own level of empathy, it might be helpful to add the results of the empathy questionnaire and discuss them individually or in the group.

6.2 Results

Contrary to expectations, the alternative hypothesis was accepted on the IRI subscale of empathic concern. Thus, there is a difference between the pre- and post-intervention levels of empathic concern for CE professionals. The mean scores on this subscale were about one point lower after the session than prior to the session. There are, of course, several possible explanations for why the level of empathic concern was reduced after playing the SG. It could be that people expect themselves to care about their colleagues and to be open and interested in their problems. But when they are confronted with their actual behaviour in the game, they realise that they are not that concerned about their colleagues' feelings or inner world, and they fill in the next questionnaire more realistically. In addition, being in a competitive environment (trying to win the game) can take away some of the compassion for other team members. It often happens in the learning process that people first become aware of the fact that they are unable to do something, consciously unable, before they learn something new. The game that was played seems to be a game that creates awareness, which is a first step towards new behaviour.

In the previous chapter it was mentioned that “After the game, during the remaining PFU or PSU, people from the different organisations also seemed to have found each other to talk to.” The question is if the game was really crucial for this to happen since often after being together for a certain time people eventually start talking to each other. From the interview with the collaboration advisor from dpi it became clear that in the opinion of this advisor the way people were talking and interacting with each other after the game was different from other PFU and PSU sessions in which no game was played. Another reason to link this transition to the game is that in both the official first session and the (extra) third session the people present were working together for a longer period already, in other words, they already had information and a relationship to talk to each other. On the other hand, during the PSU and PFU’s also breaks were held in which not all people could be observed and after the game also more project content information was discussed and worked on. This could also have led to the change in behaviour of the participants. So, it is safe to say that this change in behaviour could have been caused by the game but not that that is the case for sure.

The first interview partly was a conversation about a previous encounter between the client and contractor. The weekend prior to the PFU session a situation had taken place where the client told the contractor that some documents about safety did not comply to their standards. The contractor was not happy about this message since they now only had the weekend to fix those documents as the works outside would continue the day after the weekend. This issue also played a significant role in the game. It was however, a suitable mistake to practice being empathic on. It is therefore assumed that it didn’t have a negative effect on the effect of the game session.

6.3 Validity and reliability

In theory, the reproducibility of this research is high, the game and questionnaire used are available, and the procedure of this research has been described in this report. However, there are a few aspects that might have influenced the results. It was mentioned and observed that the facilitator of the game session might have an impact on the value and learning possibilities of the game. A next researcher will not be able to ask exactly the same questions and create the same atmosphere with the participants.

The questionnaire consisted of two highly recommended and tested tools for measuring empathy. The sample size of this research is too small to generalise to the population or other circumstances. However, this exploratory method and small sample size was deliberately chosen in this thesis in order to fit within the time constraints. Although the results cannot be generalised, they do provide

directions for future research. Combined with the issue of replicability, this research is considered reliable. In terms of validity, did this research measure what it set out to measure? This is somewhat controversial as the definition of empathy used for this research may not be a one-to-one match with the type of empathy measured by the questionnaire. This means that the small decrease in individual empathy scores does not mean that the game had no effect on empathy within the group. However, it can be said that the way people see their behaviour does not change after playing the serious game in terms of the empathy measured by the overall empathy questionnaire. The additional qualitative data shows a somewhat different picture, but also allows conclusions to be drawn about a broader definition of empathy than the one found in the questionnaire.

The results of the interviews conducted one month after the quasi-experiment, may be influenced by the collaboration between the people in the team in the period between the experiment and the interview. However, the impact of this on this research is likely to be limited, as the interviews revealed that in one case the team had not had many meetings in the intervening period. The other teams' long-term information was based on only one interview. It would have been more valuable to have had the opportunity to talk to the other party to the contract. Talking to both parties can give a more complete picture of how the collaboration is experienced.

6.4 Conclusion of discussion

Playing *Fouten maken Moed* allows for an open, playful climate in which stories are told that wouldn't have been told otherwise. This gives the opportunity to touch and be touched by the experiences or feelings of others. This facilitates mutual understanding (empathy in the team). When one person opens up, it can pave the way for others to do the same.

Even though it was not necessarily a research question or objective for this research it does again show that people, when working together, appreciate and benefit from getting to know each other and spend real time together. This was already concluded form Batelaan (2021) in her thesis on empathy in the design process. Recently Gerlag, (2023) also concluded that starting a project together and taking the time to create an open atmosphere with the right values to collaborate is beneficial to the result of a project since this is important for good coordination of a construction project.

So, empathy cannot replace contracts and clear agreements, but it can definitely help to increase the chances of successfully dealing with situations that do not go according to plan, to be flexible and to help each other based on the ability to step into the other's situation, to understand why a situation has become or is the way it is, and to go from there. Soft and flexible instead of hard and fragile like the iron triangle without empathy.

Chapter 7: Conclusion, reflection and recommendations

In this final chapter, the first paragraph presents the conclusions drawn from answering the research questions. The second paragraph contains a reflection on the methods used in this research. The final section, with recommendations, provides input for practice, for example for dpi and also for the academic world.

7.1 Conclusions

Due to the fact that many construction projects in the CE sector are considered to be unsuccessful to date, this research has attempted to contribute to the body of knowledge on good collaboration and how it can be achieved by gaining empathy through playing a serious game. In order to answer the research question both qualitative and quantitative data was collected through an exploratory, quasi-experimental pre-post-test research design. The quantitative data was derived from a combined questionnaire measuring empathy. The questionnaire consisted of the classic and frequently used IRI questionnaire and the EQ short. Qualitative data was then collected through observations during the game sessions, which took place as part of a PFU and PSU session. The qualitative data was complemented by four semi-structured interviews, which were used to gain insight into the long-term effect of the intervention by researching the behaviour and experiences of the CE professionals involved in the research.

Sub research question 1: ***How can the empathy within project teams be influenced?***

Empathy can be influenced at both the individual and the group level. The literature suggests that everyone has a certain level of empathy. It is therefore easier for someone with a naturally higher level of empathy to behave empathetically than someone with a low natural level of empathy. Making people aware of their own behaviour and showing them how empathy can be used to benefit their projects can influence the level of empathy they use and/or experience. The environment people find themselves in can also influence the (empathic) behaviour they bring to the table. For example, creating a safe and open environment can help. When the environment is changed by playing the serious game, people behave differently than before the game.

Sub research question 2: **Why would serious gaming be a suitable tool to use in order to influence the level of empathy within a project team?**

A gaming environment can help to make what is being discussed and/or practised feel like, or be, real behaviour. Talking and practising behaviour in a safe, controlled gaming environment can help to improve the empathic skills of people working in a client, contractor or integrated project team. Spending time together and seeing or experiencing how colleagues react is valuable in itself, as it is said to improve co-ordination and collaboration.

Sub research question 3: **How can serious gaming be used to enhance empathy within projects in the construction industry?**

In order to answer this question, the serious game *Fouten maken Moed* was chosen to practice and experience empathic elements. This serious game was and can be implemented in sessions where both the contractor and the client are present, such as PFU and PSU sessions. Through (new) experiences, the CE professionals can develop or enhance their skills, get to know each other better, become aware of their own (empathic) behaviour and thus increase the level of empathy within their project. The game elements in a serious game can influence motivation, which helps to create a functional learning environment. By incorporating feedback into a serious game, a continuous learning cycle can be initiated.

Sub research question 4: **What is the effect of playing a serious game on the level of empathy within client-contractor teams in civil engineering projects?**

In the quantitative part of this study, the null hypotheses are accepted in all cases, except for the empathic concern scale of the IRI. In this case, a significant decrease of 0.92 points was found in the empathic concern of the participants. In other words, based on the quantitative data, the answer would be that there was a slight decrease in the level of empathic concern of the participants in the serious game *Fouten maken Moed*. With regard to the overall concept of empathy, both measured by the questionnaire as a whole and by the IRI and EQ-shorts separately, no effect of playing the serious game can be seen on the individual self-reported levels of empathy of the CE professionals who participated in this research. However, looking at the observations and interviews, some improvements seem to have been made. Playing the serious game shows the actual behaviour of the participants, they are confronted with how they behave in several work-related situations in the presence of their colleagues. They are asked to rate their own behaviour twice, before and after the intervention. This leads to greater awareness of their own behaviour.

*RQ**: How can serious gaming provide a positive impact on the level of empathy within project teams in the civil engineering sector, in order to foster client-contractor collaboration?***

The question is whether it really matters for the success of a construction project whether a person is actually more empathetic or just behaves more empathetically. If an intervention such as a serious game can improve the empathic behaviour of team members, it is already beneficial for a project. The guidance of a facilitator and a fun, yet serious, structured learning environment such as a serious game can create a situation in which empathy can be positively influenced. According to Keusters' research, empathy can indeed lead to better collaboration. The right environment can trigger empathic behaviour in and towards the team, even if the individual level of empathy is not high.

Despite a slight decrease in the mean score of the IRI empathic concern scale before and after the intervention (serious game), the overall empathy of the CE professionals did not change the level of empathy of the participants. The perspective taking subscale of the IRI did not change as a result of the intervention, which seems logical as it is about spontaneously taking the perspective of others, whereas in the game they got to know each other and learned to be interested and ask questions. The fact that personal distress didn't change could also be because the professional’s felt anxiety and didn't experience tense interpersonal situations, since the atmosphere in all intervention sessions was quite relaxed. The short EQ also showed no difference.

Playing the game, especially in the short term (during the PFU and PSU sessions), led to more empathic behaviour as people were more open and interested in each other. This was inferred from observing people asking each other questions and showing empathy by acknowledging that they could imagine the situation someone was describing, or by thanking someone for sharing a personal story. In the longer term, in one case the atmosphere was not necessarily good, but it was still functional. In the other case, respondents felt that the session had contributed to their current way of working. In other words, playing the serious game *Fouten maken Moed* did not lead to an increase in the participants' individual empathy scores on the questionnaire used. It did, however, promote empathic behaviour, and from the interviews it was clear that cooperation in the participating teams was sufficient or good. During the sessions from observations, it was clear that the CE professionals opened up more to each other, which led to better shared decision making and agreements on how to work together in the future. The game was found to be helpful in practice, according to the collaboration consultant who participated in and facilitated the PFUs and PSUs that served as the data-gathering game sessions for this research.

The evaluation of this research includes the idea that perhaps more could be achieved by allowing more time to play the game (each session now lasted about an hour). Another improvement could be made by collecting real situations from the participants in order to make the topics discussed even more relevant and practical.

To conclude from this research, it can be said that serious gaming, or more specifically the game *Fouten maken Moed*, can provide a form of spending time working on relationships, getting to know each other, making people aware of their own behaviour and thus promoting client-contractor cooperation. It cannot be concluded that the level of empathy of individual people improves by playing the game. However, the project teams, as observed during the sessions and discussed in the interviews, focus more on each other's experiences and seem to be more empathetic as a result.

7.2 Reflection

When I started researching empathy in the construction sector, I contacted a professional in the CE industry who nearly finished a PhD on empathy in the construction sector. I asked for the definition of empathy in that research context. He then found it difficult to provide a clear definition. I was surprised to learn that the main concept of the research project had not been defined after four years of work. However, I now understand that when research involves a term without a clear and widely accepted definition, it can lead to a world of interpretations. Interpretations of words and concepts are shaped by individuals' unique experiences and reference points. This subjectivity poses a challenge for research.

Measuring empathy is challenging due to difficulties in operationalisation. While a validated questionnaire exists, interpretations of empathy can vary. Research on empathy in the construction sector has led to broader definitions, including more practical ones. Therefore, this research includes observations and interviews to supplement the quantitative data. The challenge with using interview and observation data is that it is difficult to determine whether they measured the impact on the level of empathy or the effect of the CE professionals simply becoming better acquainted by spending time together. However, it was revealed through the interviews that the game facilitated a meaningful conversation and established a foundation for the PSU and PFU sessions to continue. This raises another debatable question: was it the game that had this effect, or was it the effect of the game facilitators on the group process? It was observed that the facilitators had a significant influence on the game process when comparing the two test sessions with different facilitators to the three other sessions where the game was facilitated by two (other) people. Of which one has a theoretical background in facilitating training sessions and one a practical but none have had a focus on empathy in training situations before.

Suitability of the game used

The theory of behavioural change provides guidance for establishing criteria that a game or training course should meet to effectively train empathy. Table eight shows which aspects from chapter three came to the fore in the game *Fouten maken Moed* and where improvements can be made to create a more suitable game for improving empathy. It is evident that *Fouten maken Moed* was not designed to train empathic behaviour. Although the game provides a suitable structure and includes some relevant questions, it may not be the most effective tool for this purpose. Suggestions from the table could be used to adjust the game and make it more suitable. Additionally, briefing and debriefing sessions could be valuable in raising awareness of the importance of empathy, reflecting on how empathetic individuals are, and providing feedback on how people can act more empathetically. It is for this however again important, to have a solid operational definition of empathy and empathetic behaviour.

Table 8: The effectiveness and possibilities for empathy training with *Fouten maken Moed*

How to teach empathic behaviour?	Wat was done and what could more be done?
Be a role model: demonstrate empathic behaviour in interactions with others; seeing empathy being used can lead to learning from the example.	Both facilitators have tried to be a role model in the sense of empathy during the game sessions. It could be that when the game is facilitated by two people a question or task could be included in which the participants are asked to provide feedback or rate the facilitators on their empathic behaviour to get a conscious experience of this
Observing and listening: in order to be empathetic, it is important to observe and listen. Active listening can be taught through exercises and organised feedback, as can observing and checking that you have drawn the right conclusions.	Listening was stimulated and practiced in the game. A possibility for improving the empathic learning from the game it could help to make participants also observe a part of the game or some questions instead of participating at that point. Seeing a good or bad example and providing feedback or reflecting on that could be beneficial
Perspective taking: participants could be encouraged to put themselves in someone else's shoes by asking how they would feel and react in a particular situation.	This was stimulated by the facilitator, but could have been stated more clearly in the briefing. It could also be more rewarded by handing out the coins
Encourage open discussions: honest discussions about feelings, emotions and concerns should be encouraged and praised. A safe environment should be created so that participants feel comfortable opening up.	The facilitator is of importance to help shape the safe environment. In this research open and honest discussion was stimulated. If the conversations really were honest is hard to check
Communication: communication is an important part of developing empathy, asking and giving feedback on both verbal and non-verbal communication and checking interpretations	Communication and interaction are stimulated by the game. The facilitator plays a role in making it work related and personal and can also provide feedback on how communication is done, this happened only little in this research
(Role) Playing: role-playing exercises can help to simulate real-life situations where real behaviour can be observed and practised.	Some exercises contained short role-plays this could be used more to the benefit of training empathy by adding questions that specifically require playing an empathic person or the opposite and make the group reflect on the effect
Encourage kindness: praise kind and compassionate behaviour	The facilitator can do this, this was also done during the sessions in this research
Different perspectives: be open to discussions on different (cultural) perspectives in order to create understanding.	This was not where the focus was on in this research; it could thus be brought forward in a game designed for developing empathic behaviour

Feedback and reflection: provide opportunities to give and receive feedback on oneself and others.	There are some possibilities to practice with giving feedback in the right or wrong way in the game that was used. The debriefing was very short in the setup of this research. To learn to be more empathic, more (personal) feedback could help, also guided reflection on the group and individual behaviour could help in confronting, showing the urgency and possibilities of behaving more empathic

Upon reflection of the quasi-experiments conducted in this study, it is evident that more effort could have been put into the (re)design of the game to test the theory that serious games can enhance empathy. The game used was not specifically designed for empathy training. Table eight presents various suggestions. The most crucial aspects are the feedback provided by the facilitator and the reflection of the participants to each other, particularly on empathic and non-empathic behaviour, to benefit from the iterative learning cycle. The importance of empathy can be explained to improve the motivation of participants who may initially be sceptical about engaging in a serious game. It may be beneficial to have an observer who can share noteworthy observations during a break, which can then be used for reflection and feedback.

In the game, the facilitator can encourage empathetic behaviour through compliments, rewards (such as coins), or reflective questions or conversations with the group. The theory of cyclic learning requires the presence of reflection or feedback to iterate and improve behaviour. Without feedback and reflection, learning remains unconscious, which can slow the process as the person cannot focus on what they are trying to learn. In this research, the questionnaire was used solely as a test to determine if playing the game changed the individual empathy of the participants. The questionnaire could also be used as a basis to inform participants about their level of empathy and its potential implications in their professional context.

According to research, learning or adjusting behaviour takes time. However, a serious game can initiate change by raising awareness of one's behaviour and fostering empathy and interest in others according to this research. It is important to note that this research emphasises the need for a sustained effort to maintain this behaviour change. The benefits of this new behaviour can be experienced and reinforced by explaining its effects and benefits. During an interview, a project manager stated, “I always prefer to have a collaboration expert on a project. Not having one when you need it is worse than having one and not needing it. And perhaps the reason you didn't need one was because you had one.”

Novel experience

The theory of Heyes (2018) suggested that empathy can be developed or broken by social change and novel experiences. It is difficult to determine whether playing the game was a novel experience for the participants, as the researcher cannot know what they have experienced before. However, it is safe to assume that none of the players had played the game prior to the sessions, and that the facilitator was not familiar with the participants beforehand. It is possible that all participants had some new experiences.

Empathy

To determine whether the serious game influenced, taught, or developed empathy, it is necessary to clearly operationalise the concept of empathy. However, as demonstrated by the anecdote at the

beginning of this paragraph and in chapter two, this is not a simple task. In this study, empathy is operationalised in two ways. Firstly, at the individual level, empathy can be measured with a questionnaire. This questionnaire is divided into different constructs that describe various aspects of empathy. The concept being referred to here is a form of empathy that is more closely related to group dynamics, openness, and cooperation. This type of empathy is observable through people's interactions with each other, but it is less directly replicable and scientific due to its person-dependent nature.

The concept of empathy thus stayed multi-interpreted in this report, resulting in the presence of related concepts such as collaboration, communication, and openness. But also listening and asking questions, placing yourself in the shoes of another and trying to understand the other person's interest are mentioned in the interviews and observations. However, these concepts are not clearly defined or linked to empathy. To improve clarity, it is necessary to provide clear definitions for each related concept and their relationship to empathy. While playing the game, several concepts were found to have improved. However, it is not possible to directly link this to an increase in empathy. The diversity of concepts arises from differences in frames of reference among individuals, which can cause the same words and concepts to have different meanings.

Suitability of the respondents

Another aspect that deserves reflection is the fact that the game was played in real teams working on a project from both client and contractor side. Theoretically they are working for the same goal in that project, however you always have the possibility of fear of what others think if one shows their vulnerabilities, you don't know how empathic the others will react and what the effect will be on the image of your company, or the teamwork in that specific project. The fact that it isn't clearly stated that empathic behaviour will be stimulated and practiced could have contributed to a less safe environment in which due to fear or insecurities people had a less effective learning situation. The fact that they are a team already also provides an incentive because they know they will have to be collaborating together, this is an incentive to work on improving collaboration. The game did result in an improvement in their collaboration and openness during the session but it is hard to tell whether or not that progress can directly be linked to a growth in empathy or due to other factors that might or might not be related to empathy. The moment of conducting the research was different in both the test-sessions and, concluding form one of the test sessions that was a part of the pre study for this research, seems to be having an effect. In one of the test sessions the game was played at the end of a Friday afternoon, the participants kept asking if they could have a beer and were clearly more into starting the weekend than playing a game. The atmosphere was less open and the examples used were less personal.

To make this research feasible for real teams of CE professionals working on a project, the serious game was played as part of already planned PSU and PFU sessions. As previously mentioned, this approach has some limitations, but it also provides a real-life situation that is convenient for research purposes. The aim of this research was to investigate whether empathy can be improved through playing a serious game. This differs from the typical goal of those sessions that usually are aimed at improving project collaboration between parties and aligning interests and goals. For future research, it would be beneficial to align the goals of the research with those of the PSU and PFU teams to establish appropriate expectations. To investigate the trainability of empathy, a research environment that is more controlled may be preferable.

7.3 Recommendations

The results of this study can be used in practice right away in the sense that it has been found useful to play a serious game at the beginning of a PFU or PSU session to improve the collaboration between contractor and client in the construction sector. Playing a serious game seems to make it easier for CE professionals to take part in a discussion and try their best because of the competitive element in the game. People that are not necessarily eager to win can still be motivated because in the introduction it is mentioned that the main goal of playing the game is of course the insights they will take away from the examples and conversations that will be held during the game. The way *Fouten maken Moed* was played in this research was during real sessions of contractors and clients, examples and cases discussed were their real issues and the team members their real project partners and colleagues. This means the behaviour is real life practice, confrontation and experience with their own behaviour.

Another field that could be useful to further research in the construction sector is the empathy within the design process, empathy towards the likes and needs of the future users of what is being designed. Like Kouprie and Sleeswijk Visser say: “This led to the view that designers should be more sensitive users, be able to understand them, their situation, and feelings: to be more empathic. In the book ‘Empathic Design’ (Koskinen et al., 2003), several design practitioners discuss the role of empathy in design. All indicate that empathy is a necessary quality for developing products that meet customer needs. The need for qualitative research is stressed to inform and inspire designers to create ‘more useful and enjoyable things for people [they] may never meet’. Empathy supports the design process as design considerations move ‘from rational and practical issues to personal experiences and private contexts’.” (Kouprie & Sleeswijk Visser, 2009).

In this research the experiment was held according to the design and setup amongst existing project teams within the CE sector. When looking at the research question strictly it is however not necessarily needed that the participants form a team to be able to learn behaviour through playing the game. At least it is not known what the effect of this is or was. For future research it would be interesting to use a game designed even more specifically towards the development of empathy and play this with professionals that are not necessarily related to each other in a same project team. The day-to-day collaboration and contact between the participants in this case will not have an effect on the perceived empathic abilities. This however requires professionals not working on a project at the moment of the research.

Another recommendation is to set up an experiment in which PSU/PFU sessions are held with and without the, or a, serious game in the program and see what it does to either the empathy or the collaboration within the team. As mentioned in chapter two, in this research it is assumed that “the more empathic the better”. However, some researchers mention that getting the job done should stay the main goal and not all attention should go to achieving good collaboration. Similarly, it can be stated that more empathy is not necessarily unlimited better. This research is conducted to say something about a professional environment in the construction industry. It is important that people understand each other and can collaborate productively, too much empathy could however result in too many emotions, people taking over feelings of others or focus so much on the wellbeing and feelings of their colleagues that the work does not benefit from this anymore. This implies there might be an optimal level of empathy, something that could be further researched. For this it is again of importance to have a clear operationalisation of what is meant by empathy.

Even though the game didn’t result in an improvement on the account of the empathy level of the people playing it. It did have an impact in a sense that from the game sessions it became clear that after the game people were more eager to speak to each other and had (started to) build relations

with each other. At the beginning of the session people were looking on their phone, talking only a little bit to each other. After the session people were ready to work out some problems that arose and some that were already part of the planning. In another project follow up on the 12th of October the game was mainly used in a session as an extensive ice breaker. Here lies, at least for this game the biggest value at this point. Although it might be so that the game couldn't flourish in its totality since time was always very limited during the sessions. And as it is proposed to make collaboration part of the iron triangle, it would be worth it to really take the time to be able to recognise work habits from colleagues etc. The balance should be found between both the collaboration and the triple constraints.

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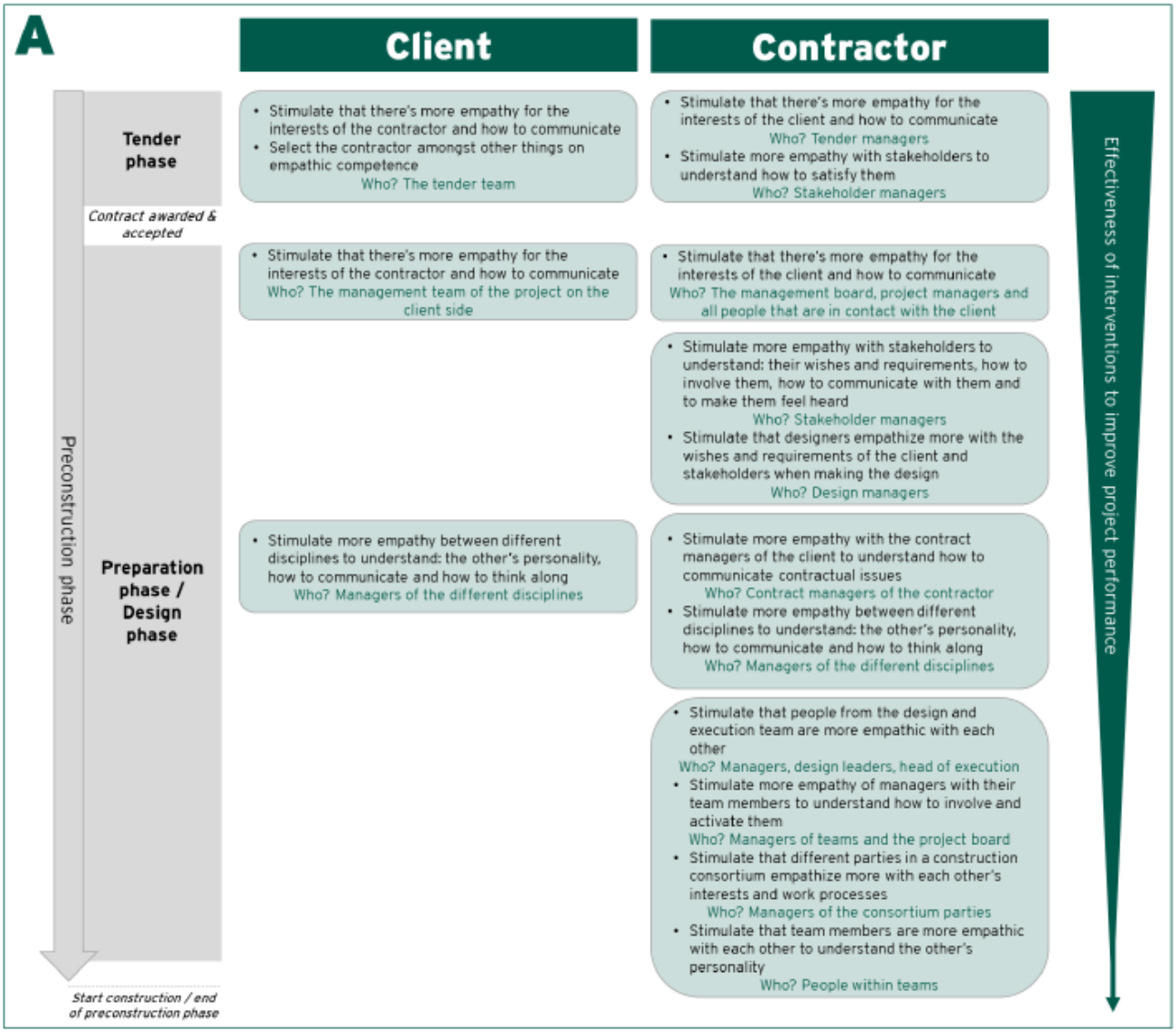
Appendices

Appendix A - Empathy Framework

The Empathy Framework by Batelaan (2021) focuses on where in the tender and design phase empathy should/could be stimulated in order to improve project performance. In part B of the framework, it is suggested to stimulate empathic behaviour of people. This is suggested through workshops, trainings, team building activities. But also, by making people experience parts of other people's work and by facilitating interaction between people.



Appendix B - Interpersonal Reactivity Index (IRI)

In this first appendix the original English and Dutch version of the IRI questionnaire are shown. The IRI is a self-report measurement questionnaire on empathy and defines empathy as the "**reactions of one individual to the observed experiences of another**" (Davis, 1980). This was chosen due to its wide use in literature, despite being 40 years old. As an extra check the EQ short was added to the empathy questionnaire for this research, those questions can be found in the next appendix. The IRI originally has 28-items that can be answered on a 5-point Likert scale that ranges from "Does not describe me well" to "Describes me very well". The measure has 4 subscales, each made up of 7 different items. The Fantasy subscale was removed in this research since it doesn't suit the empathy definition and the means of this research. Next to this it also helped to reduce the length of the questionnaire.

A growing movement is observed that supports a view of empathy as a multidimensional construct. The IRI captures four separate aspects of empathy, their relationships with measures of social functioning, self-esteem, emotionality, and sensitivity to others was assessed. Each of the four sub scales present a distinctive and predictable pattern of relationships with these measures, as well as with previous unidimensional empathy measures. *"These findings, coupled with the theoretically important relationships existing among the four subscales themselves, provide considerable evidence for a multidimensional approach to empathy in general and for the use of the IRI in particular"* (Pulos et al., 2004).

The original IRI questionnaire can be found in the report of Davis (1980).
In this appendix the Dutch version of the IRI is shown as presented in the validation paper of De Corte et al. (2007), the FS scale has already been deleted in this version since it will not be used in this research.

1. Ik heb vaak tedere, bezorgde gevoelens voor mensen die minder gelukkig zijn dan ik EC
2. Ik vind het soms moeilijk om dingen te zien vanuit andermans gezichtspunt PT*
3. Soms heb ik niet veel medelijden met andere mensen wanneer ze problemen hebben EC*
4. In noodsituaties voel ik me ongerust en niet op mijn gemak PD
5. Ik probeer naar ieders kant van een meningsverschil te kijken alvorens ik een beslissing neem PT
6. Wanneer ik iemand zie waarvan wordt geprofiteerd, voel ik me nogal beschermend tegenover hen EC
7. Ik voel me soms hulpeloos wanneer ik in het midden van een zeer emotionele situatie ben PD
8. Ik probeer mijn vrienden soms beter te begrijpen door me in te beelden hoe de dingen eruitzien vanuit hun perspectief PT
9. Wanneer ik zie dat iemand zich bezeert, ben ik geneigd kalm te blijven PD*
10. Andermans ongelukken verstoren me meestal niet veel EC*
11. Als ik zeker ben dat ik over iets gelijk heb, verspil ik niet veel tijd aan het luisteren naar andermans argumenten PT*
12. In een gespannen emotionele situatie zijn, schrikt me af PD
13. Wanneer ik zie dat iemand unfair wordt behandeld, voel ik soms weinig medelijden met hen EC*
14. Ik ben meestal behoorlijk effectief in het omgaan met noodsituaties PD*
15. Ik ben vaak nogal geraakt door dingen die ik zie gebeuren EC
16. Ik geloof dat er twee zijden zijn aan elke vraag en probeer te kijken naar hun beide PT
17. Ik zou mijzelf beschrijven als een vrij teerhartig persoon EC
18. Ik neig ertoe controle te verliezen tijdens noodsituaties PD
19. Wanneer ik overstuur ben door iemand, probeer ik mijzelf meestal voor een tijdje "in zijn schoenen" te verplaatsen PT
20. Wanneer ik iemand zie die zeer hard hulp nodig heeft in een noodsituatie, ga ik kapot PD

21. Alvorens iemand te bekritiseren, probeer ik mij voor te stellen hoe ik mij zou voelen mocht ik in hun plaats zijn PT

Note. The item order of the Dutch version of the IRI is in accordance with this of the original IRI. The asterisk sign (*) indicates reversed items. PT = Perspective Taking; EC = Empathic concern; PD = Personal distress.

A = 0, B = 1, C = 2, D = 3, E = 4

Except for reversed-scored items, which are scored:

A = 4, B = 3, C = 2, D = 1, E = 0

Appendix C - EQ Short

Due to the fact that empathy is often defined in different ways, the more modern questionnaire that measures the empathy quotient was looked into. In this appendix the Dutch version of the questionnaire is presented. Originally the Empathy Quotient questionnaire consisted of 40 questions. Wakabayashi et al. (2006) found that a shorter version of this questionnaire could still give a reliable impression of the empathy quotient of a person. This is now called the EQ Short, the 22 from the original 40 questions of this version are depicted below in Dutch and were added to the questionnaire for this research.

1. Ik kan gemakkelijk zien of iemand anders een gesprek wil beginnen.

2. Ik vind het echt leuk om voor andere mensen te zorgen.

3. Ik vind het moeilijk om te weten wat ik moet doen in een sociale situatie. *

4. Ik vind het vaak moeilijk om te beoordelen of iets onbeleefd of beleefd is. *

5. In een gesprek heb ik de neiging om me te concentreren op mijn eigen gedachten in plaats van op wat mijn luisteraar zou kunnen denken. *

6. Ik heb het snel door als iemand iets zegt maar iets anders bedoelt.

7. Ik kan moeilijk inzien waarom sommige dingen mensen zo van streek maken. *

8. Ik kan me gemakkelijk in iemand anders verplaatsen.

9. Ik kan goed voorspellen hoe iemand zich zal voelen.

10. Ik heb snel in de gaten wanneer iemand in een groep zich ongemakkelijk voelt.

11. Ik kan niet altijd zien waarom iemand zich beledigd zou moeten voelen door een opmerking. *

12. Ik heb niet de neiging om sociale situaties verwarrend te vinden.

13. Andere mensen zeggen dat ik goed kan begrijpen hoe ze zich voelen en wat ze denken.

14. Ik kan gemakkelijk zien of iemand geïnteresseerd of verveeld is door wat ik zeg.

15. Vrienden praten meestal met mij over hun problemen omdat ze zeggen dat ik heel begripvol ben.

16. Ik kan voelen of ik stoor, zelfs als de ander me dat niet vertelt.

17. Andere mensen zeggen vaak dat ik ongevoelig ben, hoewel ik niet altijd zie waarom. *

18. Ik kan me snel en intuïtief inleven in hoe iemand anders zich voelt.

19. Ik kan er gemakkelijk achter komen waar een ander over wil praten.

20. Ik kan zien of iemand zijn ware emotie verbergt.

21. Ik kan goed voorspellen wat iemand gaat doen.

22. Ik heb de neiging om emotioneel betrokken te raken bij de problemen van een vriend.

The asterisk sign (*) indicates reversed items.

Appendix D - Empathy questionnaire

Figures 8a and 8b are photo copies of the final questionnaire that has been used, it shows the Dutch introduction to the questionnaire, based on the original English introduction of the IRI by Davis, (1980). The first 21 questions are the original IRI questions from the constructs, perspective taking, empathic concern and personal distress. The following 22 questions are the translated questions from the EQ short questionnaire. The 9B at the top of the page is an example of a version number that was used to match the t1 and t2 questionnaires to each other and at the same time make sure that anonymity was taken care of.

9B

De volgende stellingen gaan over je gedachten en gevoelens in allerlei verschillende situaties. Ga bij iedere stelling na in hoeverre die jou beschrijft door de juiste letter uit onderstaande schaal van A tot en met E te kiezen. Schrijf je gekozen letter voor het stelling nummer aan de linkerkant van de pagina. Lees de stellingen alsjeblieft goed voor je antwoord geeft. Antwoord zo eerlijk mogelijk (let op: deze pagina heeft 2 kanten).
Dankjewel.

ANTWOORD SCHAAL:

A	B	C	D	E
IK HERKEN MIJ NIET IN DEZE BESCHRIJVING				IK HERKEN MIJ VOLLEDIG IN DEZE BESCHRIJVING

1) Ik heb vaak tedere, bezorgde gevoelens voor collega' die minder geluk hebben dan ik.

2) Ik vind het soms moeilijk om dingen te zien vanuit het gezichtspunt van collega's.

3) Soms heb ik niet veel medelijden met andere collega's wanneer ze problemen hebben.

4) In noodsituaties voel ik me ongerust en niet op mijn gemak.

5) Ik probeer naar ieders kant van een meningsverschil te kijken alvorens ik een beslissing neem.

6) Wanneer ik een collega zie waarvan wordt geprofiteerd, voel ik me daar nogal beschermend tegenover.

7) Ik voel me soms hulpeloos wanneer ik in het midden van een zeer emotionele situatie ben.

8) Ik probeer mijn collega's soms beter te begrijpen door me in te beelden hoe de dingen eruit zien vanuit hun perspectief.

9) Wanneer ik zie dat iemand zich bezeert, ben ik geneigd kalm te blijven.

10) Andermans ongelukken verstoren me meestal niet veel.

11) Als ik zeker ben dat ik over iets gelijk heb, verspil ik niet veel tijd aan het luisteren naar andermans argumenten.

12) Het schrikt me af in een gespannen emotionele situatie te zijn.

13) Wanneer ik zie dat een collega unfair wordt behandeld, voel ik soms weinig medelijden met hen.

14) Ik ben meestal behoorlijk effectief in het omgaan met noodsituaties.

15) Ik ben vaak nogal geraakt door dingen die ik zie gebeuren.

16) Ik geloof dat er twee zijden zijn aan elke vraag en probeer naar beide te kijken.

17) Ik zou mijzelf beschrijven als een vrij teerhartig persoon.

18) Ik neig ertoe controle te verliezen tijdens noodsituaties.

19) Wanneer ik overstuur ben door toedoen van een collega, probeer ik mijzelf meestal voor een tijdje "in zijn schoenen" te verplaatsen.

20) Wanneer ik een collega zie die zeer hard hulp nodig heeft in een noodsituatie, ga ik kapot.

Deze vragenlijst gaat verder op de andere kant van de pagina.

Figure 8a. Questionnaire side a

ANTWOORD SCHAAL:

A	B	C	D	E
IK HERKEN MIJ NIET IN DEZE BESCHRIJVING				IK HERKEN MIJ VOLLEDIG IN DEZE BESCHRIJVING

21) Alvorens collega's te bekritiseren, probeer ik mij voor te stellen hoe ik mij zou voelen mocht ik in hun plaats zijn.

22) Ik kan gemakkelijk zien of iemand anders een gesprek wil beginnen.

23) Ik vind het echt leuk om voor andere mensen te zorgen.

24) Ik vind het moeilijk om te weten wat ik moet doen in een sociale situatie.

25) Ik vind het vaak moeilijk om te beoordelen of iets onbeleefd of beleefd is.

26) In een gesprek heb ik de neiging om me te concentreren op mijn eigen gedachten in plaats van op wat mijn luisteraar zou kunnen denken.

27) Ik heb het snel door als iemand iets zegt maar iets anders bedoelt.

28) Ik kan moeilijk inzien waarom sommige dingen mensen zo van streek maken.

29) Ik kan me gemakkelijk in iemand anders verplaatsen.

30) Ik kan goed voorspellen hoe iemand zich zal voelen.

31) Ik heb snel in de gaten wanneer iemand in een groep zich ongemakkelijk voelt.

32) Ik kan niet altijd zien waarom iemand zich beledigd zou moeten voelen door een opmerking.

33) Ik heb niet de neiging om sociale situaties verwarrend te vinden.

34) Andere mensen zeggen dat ik goed kan begrijpen hoe ze zich voelen en wat ze denken.

35) Ik kan gemakkelijk zien of iemand geïnteresseerd of verveeld is door wat ik zeg.

36) Collega's praten meestal met mij over hun problemen omdat ze zeggen dat ik heel begripvol ben.

37) Ik kan voelen of ik stoor, zelfs als de ander me dat niet vertelt.

38) Andere mensen zeggen vaak dat ik ongevoelig ben, hoewel ik niet altijd zie waarom.

39) Ik kan me snel en intuïtief inleven in hoe iemand anders zich voelt.

40) Ik kan er gemakkelijk achter komen waar een ander over wil praten.

41) Ik kan zien of iemand zijn ware emotie verbergt.

42) Ik kan goed voorspellen wat iemand gaat doen.

43) Ik heb de neiging om emotioneel betrokken te raken bij de problemen van een collega.

Bedankt voor je deelname!

Einde.

Figure 8b. Questionnaire side b

Appendix E - Interviews

This appendix contains the questions that have been used for the semi structured interviews of this research. The interviews have been conducted in Dutch; the English translation is added here as well. It can be seen from the star notations that some of the questions had been slightly changed to make them applicable for the 4th interview with the collaboration advisor.

Wat vond je van de serious game die we speelden tijdens de PFU/PSU?
What did you think of the serious game we played during the PFU/PSU?
Wat heb je geleerd van het spelen van de serious game?
What did you learn from playing the serious game?
**What did the players learn?*
Heb je binnen je team de afgelopen tijd een situatie meegemaakt waar het schuurde/ niet lekker liep in de samenwerking?
Have you experienced something in your team in the recent past in which something in the collaboration didn't go fluently?
**Have you experienced a situation in one of the teams*
Hoe ben je daar mee omgegaan?
How did you cope with this situation?
Hoe zie je dat in relatie tot de lessen die uit het spel geleerd zijn?
How do you see this in relation to the lessons learnt from the game?
Heb je die inzichten ook op andere gebieden toegepast?
Did you use this also in other circumstances?
Hoe zou je het begrip empathie definiëren?
How would you define the concept of empathy?
"De reactie van de persoon op de geobserveerde ervaringen bij de ander. In hoeverre ben je instaat je te verplaatsen in de ander/ in het perspectief van de ander en daarmee begrip opbrengen."
"In my thesis I defined empathy as the response of a person on the observed experiences with the other and into what extent you are able to put yourself into the other persons shoes/ relate to the other and thus gain understanding."
Ben je bewust van hoe empathisch je bent en hoe je dat inzet tijdens je werk?
Are you aware of your own empathy? And how you do or do not use this in your job?
In welke mate zou je jouw team als empathisch omschrijven?
How Empathic would you describe your team to be? (on a scale from 1 to 10)
**To what extend would you call the different teams empathic?*
Zit er een verschil tussen het team vanuit je eigen organisatie en het andere team?
Do you see a difference between the empathy in your own company and that of the other party?
Zo ja wat is dat verschil en hoe denk je dat komt?
If yes, how would you explain this difference?
Hoe zou je de ontwikkeling van je team omschrijven van het begin van het project tot aan nu?
How would you describe the development of your team from the start of the project until this moment?
**Since the start of your involvement to the projects*
Hoe zou je die ontwikkeling verklaren?
How would you explain that development?
Denk je dat jouw idee over de mate van empathie binnen jullie team en de samenwerking overeenkomt met wat je collega's zouden zeggen?
Do you think that your opinion on the level of empathy in your team and the collaboration within you team resembles what your colleagues would say?
***Wat vond je specifiek van het spelen van de serious game als onderdeel van een PFU of PSU?**
What specifically did you think of playing the serious game as a part of a PFU or PSU?

***Wat voor invloed had het spelen van de serious game op de rest van de dag of sessie?**
What did you consider the effect or influence of the serious game to be on the rest of the day/session?

***Veranderingen in de vragen ten behoeve van het interview met de adviseur samenwerking die de sessies vanuit dpi begeleide.**
changes made for the interview with the collaboration advisor of the sessions from dpi.

Due to Privacy considerations no summaries or transcriptions are present in this report. As an addition to the quotes mentioned in the results chapter some of the original Dutch quotes are listed in this appendix.

Interviewee: “En in, dit gaat heel veel over het hebben en creëren van een goede band en. En nou ja, dan denk ik van nou, Ik denk dat ik wel redelijk weet hoe ik ben, maar heel veel andere mensen hebben er best nog wel eens een keer de baat bij. Nou.”
Interviewer: “hoe empathisch ben jij?”
Interviewee: “dat hangt helemaal van de andere persoon af”
Interviewee: “Kijk, Er is voor mij één ding belangrijk en dat is gewoon het project nou en dan gaan we daar weer aan de slag en dan als het niet linksaf wil, dan gaan we rechtsom. We werken nou meer als een jaar samen. Daardoor, Ja ken je mekaar een beetje beter en dan weet je van joh nou als ik op dat knopje van jou druk, dan ga jij zo reageren.
Interviewee: “Maar ach, nog een paar maanden zijn we ervan af, joh.”
Interviewee: “We hebben in dit project gewoon een coach gemist.”
Interviewee: "Het plan kan echt wel veranderen, als je met zijn allen besluit dat we het plan gaan veranderen, maar dan moet het ook een gedragen, besluit zijn."
Interviewee: “heel erg leuk”
Interviewee: “Je moet heel vaak goed luisteren, zegmaar dat is ten eerste. En ja, ik leg het dan bij iemand neer en dan vraag ik daar terugkoppeling over. Maar ik kan niet zelf gaan oordelen, zeg maar, dus dat probeer ik dan ook niet te doen.”
Interviewee: Ja, Omdat je elkaar niet kent en ook wel leeftijdsverschillen hebt, zit normaal niet zo bij elkaar, maar misschien heb je wel een beetje dezelfde interesses, dus je gaat wat meer denken van wat hebben wij dan gemeen? Dus daar moet je dan eigenlijk wel beter over nadenken, Maar dat is denk ik ook wel goed om te doen, want het kan wel zijn dat je een gemeenschappelijke deler vindt en dat is dan wel mooi.”
Interviewee: "Misschien dat mensen wel heel serieus lijken op het eerste gezicht, maar als je dan zoiets doet dat mensen wel wat losser worden en wat makkelijker in omgang daarna, dat denk ik"
Interviewee: “Dat heb ik eerlijk gezegd niet toegepast toen tijdens de situatie.”
Interviewee: “Ze zijn denk ik heel erg onderbezet, dat maakt het contact met hen ook heel ingewikkeld aan het begin, dus als je iemand mailt ja dan, dat bleek dus ook in het spel dat zij zeiden, we willen liever gebeld worden. Nou ja, dat soort uitspraken dat dat je dat weet is fijn, dus Ik denk dat die PSU heel erg heeft bijgedragen. Maar ik denk wel dat het belangrijk is om het ook weer op te volgen op den duur.
Interviewee: “Maar ik vond het over het algemeen dat Mensen best wel open waren, best wel eigen voorbeelden aan durfde te dragen. En dat geeft dus ook wel aan dat ze zich daar op hun gemak voelden.”
Interviewee: “Veel mensen kennen elkaar nog helemaal niet, wel mooi om te zien dat mensen dat toch wel durven te doen, want na zon snelle tijd, was denk ik een uur ongeveer. Misschien ook wel door het spel had je zelf ook het idee dat je kon zeggen wat je wilde. Ja eigenlijk wel.
Interviewee: “Dat iedereen er heel veel meer energie van kreeg, zeg maar. En ook in de spelvorm wat meer stilstond bij de antwoorden die gegeven werden. Terwijl normaal gesproken als je op een andere manier het gesprek voert, dan is er wat minder geduld en ook wat minder lol. Dus die plezier

factor vond ik opvallend om te zien en het feit dat mensen toch elkaar wat meer over gingen halen in die vorm om wat meer van zichzelf bloot te geven."
Interviewee: "Ik denk dat ze hebben geleerd dat er verschillende perspectieven zijn, hoe men kijkt naar bepaalde situaties, bijvoorbeeld en hoe je daarmee omgaat."
Interviewee: "Nou, Ik denk dat een hele grote rol toch de begeleider kan spelen en ik denk dat dat wel een bepaalde indicator is. Hoeveel energieke begeleider daar bijvoorbeeld in moeten steken om die vragen door te pakken."
Interviewee: "Ik denk wel, dat als je het spel niet zou spelen dat je dan echt wat mist."
Interviewee: "De sessies zijn wel vergelijkbaar qua de randvoorwaarden die gecreëerd zijn, dus dat vind ik wel heel mooi om te zien. Je ziet wel echt dat samenstelling en een bepaalde fase in de samenwerking waarin ze zitten, dat speelt een rol."
Interviewee: "Het zou in mijn ogen wel echt een standaard onderdeel kunnen zijn van PFU's en PSU's.

Appendix F - Observations

This appendix provides additional information on the data gathering sessions, some notes and observations are included.

Observation Protocol

The objective of the observations is to examine the behaviours exhibited by CE professionals before, during, and after the game. Specifically, the aim is to identify manifestations of both empathetic and non-empathetic behaviours. The observations focus on various behaviours, including but not limited to:

1. **Showing an interest or asking each other questions:** Assessing the extent to which professionals engage in (reciprocal) questioning.
2. **Listening to each other:** Observing the degree of attentiveness demonstrated by professionals towards their peers.
3. **Allowing the other to finish speaking:** Examining whether individuals permit their colleagues to express themselves fully without interruption.
4. **Creating a sense of comfort for each other:** Investigating efforts made by the professionals to establish a comfortable environment for their colleagues.
5. **Assisting each other:** Evaluating instances of professionals providing support or aid to their colleagues.
6. **Expressing approval or mockery towards each other (for example through laughter):** Scrutinizing occurrences of individuals either positively acknowledging or ridiculing their colleagues.
7. **Engaging in physical contact:** Observing instances of physical touch among professionals.
8. **Non-verbal expressions of encouragement or disinterest:** Analysing non-verbal cues that convey either encouragement or disinterest in the interactions.

This protocol helps to guide the focus of the observers, it will not be filled out or present during the session due to the fact that the observers also have to guide the game and are therefore not able to write the observations down right away.

Appendix G - Serious Game, *Fouten maken Moed*

This appendix is added to provide more information on the SG that was used in this research. A description of the game and the goal of the original game is included, some changed that were made are described in the final part of this appendix.

Game description and materials

Due to plagiarism rules the full game manual is only available to the researcher and the thesis supervisors. This paragraph however does give a description of the game and how it was placed in a PFU or PSU session as the research intervention for the quasi-experiment. For research purposes, the complete game manual and questions can be requested from the researcher or the makers of the game (Goudvisie).

The game set consists of a manual/question book, a playing board, 4 coloured pillions, 2 dices, paper, pencil and "magic cards". With magic cards a team can either help or annoy another team. All teams have a secret mission that they have to complete in order to make their points count at the end of the game, if the secret mission fails the team cannot win anymore. The dices decide how many points can be made during a turn and next to that they decide which question will have to be answered or which task has to be fulfilled. Paper and pencils are provided, in some tasks they are needed but, they can also be used to write down themes that need further discussion or questioning after the game. The game guide or facilitator has the book with questions and tasks (30 in total), reads them out loud and judges whether or not extra points are awarded, for example when a team is placing themselves in a vulnerable position, or when a personal example has been shared. For the setting in session two see figure three.

Aim of the game

On the website of Goudvisie (https://goudvisie.nl/serious-gaming/fouten-maken-moed/), the makers of the game *Fouten maken Moed* (making mistakes is mandatory/courageous) the following description of the game is placed (the description is translated from Dutch to English):

"*Fouten maken Moed is a is a culture change game in which you and your team engage in various knowledge, action, and application tasks. The objective? Progress as far as possible on the game board and fulfil your secret mission. The underlying idea? Through the light-hearted nature of the tasks, gradually feel more comfortable making and sharing mistakes, and create a learning environment within your team. The dynamics of the game are about having fun, winning and most importantly the dynamics that emerge amongst the player about vulnerability, recognition and reflection on how to deal with the themes that come forward*" (Goudvisie, 2022).

What skills do you develop?

1. Dearing to make mistakes and share them with others
2. Dearing to show your vulnerability
3. Creating an open learning climate

Changes made to the game

Ideally a game especially designed to develop empathy would have been used or made for this research. Due to time and availability constraints the game *Fouten maken Moed* was used. After the trial game session in Amsterdam a few changes were made to the game and the game procedure. Slight changes were made again after the second trial. Below is described what changes were made and why:

After the test sessions it was mentioned a few times by players, and noticed by the researcher that the questions are quite extensive and difficult to concentrate on. Therefore, all quotations and

citations and names of famous people and researchers that are quoted in the game were removed in order to make the questions shorter and easier to concentrate on.
All reference to other people in questions were changed to either “colleagues” or “project team members”. References to specific work activities were changed to suitable terms, relating to the project background to make the examples more relatable.
Paper and pens were distributed over the tables and it was explained in the introduction that people could use those to write down subjects that would need more attention later on after playing the game, to either understand each other better or make agreements on how to approach certain situations in the future.
The game was played with two leaders/supervisors, being the researcher and one colleague from dpi. This approach was chosen after noticing that with only one supervisor les depth in conversations could be achieved since it is hard for one person to keep track of time, conversation and game rules/ progress at the same time.

Appendix H - Informed consent

Below the informed consent form is shown. This form was signed by all participants from both the test and official sessions that were held. In all cases prior to handing out the consent form participants were informed about the possibility to quit whenever they wanted to and the confidentiality of the research. The form is in Dutch since all participants are Dutch. At the bottom of the form the contact information is shown, this was not used apart from one participant that asked for the questionnaire questions, they have been sent to him per e-mail.

Beste Deelnemer,

Je wordt uitgenodigd om deel te nemen aan een onderzoek getiteld "Collaboration in the construction industry". Dit onderzoek wordt gedaan door mij, Janneke Ambagts student aan de TU Delft, in samenwerking met dutch process innovators.

Het doel van dit onderzoek is de samenwerking in projectorganisaties verder in kaart te brengen. Het invullen van de volgende enquête duurt ongeveer 7 minuten. Daarna neem je o.a. deel aan het spel Fouten Maken Moed. De gegevens worden gebruikt voor onderwijsdoeleinden en zullen geanonimiseerd worden beschreven in de master thesis. Deze zal uiteindelijk worden geüpload naar de TU Delft repository. Graag vraag ik je een aantal vragen te beantwoorden over je gedrag in het algemeen en zoveel mogelijk jezelf te zijn tijdens je deelname aan het spel.

Je antwoorden in dit onderzoek zullen naar mijn beste vermogen vertrouwelijk blijven. Ik zal eventuele risico's minimaliseren door de verzamelde gegevens geanonimiseerd op te slaan op de harde schijf van de TU Delft en ervoor te zorgen dat de gegevens een maand na afronding van dit onderzoek worden verwijderd. De hardcopy enquêtes zullen worden versnipperd en weggegooid direct nadat ze zijn gescand en op de beveiligde omgeving van de TU Delft zijn geplaatst, ook deze online bestanden zullen worden verwijderd na het afronden van de master thesis.

Door deel te nemen aan het spel en de volgende vragenlijst in te vullen ga je akkoord met het gebruik van de data voor mijn afstudeer onderzoek. Je deelname aan dit onderzoek is geheel vrijwillig en je kan je op elk moment terugtrekken. Je bent vrij om vragen weg te laten en/of je deelname aan het spel te beëindigen.

Hartelijk dank voor je deelname,
Bij vragen na afloop kun je mij bereiken:
j.ambagts@dpi.nu
Janneke Ambagts

Datum:
Naam Onderzoeker: Janneke Ambagts
Handtekening onderzoeker:

Datum:
Naam Deelnemer:
Handtekening deelnemer:

Appendix I - Interview results

Table nine shows the results from the interviews after coding the transcriptions in ATLAS.ti. As can be seen the subject of collaboration was often present 11 times in a negative context and 15 times in a positive context. It was mentioned 24 times that playing the game had in a sense a connection to getting to know each other better. 25 times the code empathy was used; this code was given to quotes/ answers that either literally say something about empathy development or show (parts) of the empathy definition through described behaviour. A good atmosphere and openness also stick out in this table (18, 22 times mentioned).

	Interview 1	Interview 2	Interview 3	Interview 4	CE-professionals	CE-professionals + advisor
Appointments	2	3	1	0	6	6
Bad collaboration	6	4	1	0	11	11
Game guidance	3	0	1	3	4	7
Understanding	0	0	0	2	0	2
Interests	2	3	4	4	9	13
Grade	1	3	1	1	5	6
Coach	5	0	0	2	5	7
Collaboration	6	9	0	0	15	15
Competition	0	1	0	1	1	2
Contribution	1	0	1	7	2	9
Time the game took	1	0	1	2	2	4
Lessons learned before	3	0	2	3	5	8
Effectiveness	6	0	3	16	9	25
Knowing each other/ relations	11	5	3	5	19	24
Empathy	10	9	5	1	24	25
Experience with the game	0	0	0	1	0	1
Game session	3	2	6	6	11	17
Lessons learned	3	2	2	3	7	10
Inlevings vermogen	3	2	2	1	7	8
Quality of the game	2	1	1	6	4	10
Listening	0	3	7	3	10	13
Motivation	4	0	0	6	4	10
Nothing Learned	2	2	1	2	5	7
Openness	0	3	8	11	11	22
Follow up	0	0	2	1	2	3
Person-dependent	5	7	3	3	15	18
Fun	0	2	4	7	6	13
Kind of people (ask for empathy)	5	3	1	3	9	12
Mood/ atmosphere	1	7	4	6	12	18
Trust	0	2	0	4	2	6
Totals	85	73	64	110	222	332

Table 9: *Original codes and counts*

Appendix J - Project failure, and success factors

This appendix shows a part of two of the tables resulting from the research into project failure and success by El-Sokhn, & Othman, (2014) in figure 9 a and b.

Project Failure Factors (PFFs)	Project Stages					
	Design	Bidding	Pre-Construction	Procurement	Construction	Post-Construction
Poor project management.	X	X	X	X	X	X
Poor planning and scheduling.		X	X			
Inaccurate cost estimation.		X	X			
Unclear scope and goals.	X	X	X	X	X	X
Inefficient resources allocation.		X	X			
Poor design, Frequent design changes, Design errors.	X					
Poor communication.	X	X	X	X	X	X
Lack of financial capacity.					X	X

Figure 9a. Project failure factors

PFF10	Leadership problems.	Winters (2003) Symonds (2011) Xaba (2011) Othman (2013)
PFF11	Lack of experience and knowledge.	Chitkara(2005) Luu et al. (2008b) Ling et al. (2010) Nguyen et al. (2013)
PFF12	Delays in payment.	Le et al. (2008) Luu et al. (2008b) Amponsah (2012) Nguyen et al. (2013)
PFF13	Lack of technical performance.	Rubin & Seeling(1967) Toader (2010) Othman (2013)
PFF14	Subcontractor failure.	Jackson (2004) Le et al. (2008) Luu et al. (2008a)
PFF15	Poor contractor performance.	Le et al. (2008) Ling et al. (2010) Nguyen et al. (2013)
	Project Failure Factors (PFFs)	**Source** **Literature review**
PFF16	Poor quality.	Jackson (2004) Young et al. (2009)
PFF17	Poor monitoring and tracking.	Burke (2007) Symonds (2011)
PFF18	Poor site management	Le et al. (2008) Ling et al. (2010)
PFF19	Cultural Differences in global projects.	Winters (2003) Symonds (2011)
PFF20	Poor management of expectations.	Winters (2003) Symonds (2011)
PFF21	Weather and social environment.	Nguyen et al. (2013)

PFF7	Poor communication.	Winters (2003) Burke (2007) Young et al. (2009) Xaba (2011) Symonds (2011) Otim et al.(2012)
PFF8	Lack of financial capacity.	Le et al. (2008) Luu et al. (2008a) Luu et al. (2008b) Ling et al. (2010) Nguyen et al. (2013)
PFF9	Bureaucracy and corruption.	Luu et al. (2008a) Ling et al. (2010) Amponsah (2012)

Figure 9b. Project failure factors

Appendix K - Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: Collaboration in the construction sector

Creator: Janneke Ambagts

Principal Investigator: Janneke Ambagts

Data Manager: Janneke Ambagts

Project Administrator: Janneke Ambagts

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2021)

Project abstract:
Thesis research for the master CME into the effect of playing a serious game on the amount of empathy that the players have and the expirienced collaboration.

ID: 125927

Start date: 11-11-2022

End date: 01-12-2023

Last modified: 18-10-2023

Collaboration in the construction sector

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

The TPM faculty data steward,Nicolas Dintznery, has reviewd this DMP on june 20th 2023.

2. Date of consultation with support staff.

2022-06-20

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Qualitative interview data	transcript	ms teams transcript	To be able to draw conclusions about the expirienced collaboartion in the teams	TU Delft one drive	myself and First supervisor
Email addresses and/or other addresses for digital communication	text	through a contact preson from the project teams	communication for data gathering and contacting possible teams to play the game with and collect data from.	TU Delft one drive	myself and First supervisor
quantitative pre/post survey data	Excel	face to face and later by email	answering the research questions on the amount of empathy prior to and after the game session	TU Delft one drive	myself and First supervisor
interview quotes	text	derived from transcript	In order to avoid presenting all the interview data in the thesis while this is not necessary for the research.	TU Delft one drive	myself and supervisors
Serious game session notes	text	paper and pencil, word	to see weather or not participants behave empathic during the game session and wether or not their behaviour changes.	TU Delft one drive	myself and first supervisor

4. How much data storage will you require during the project lifetime?

- < 250 GB

II. Documentation and data quality

5. What documentation will accompany data?

- Methodology of data collection

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- OneDrive

TU delft Onedrive

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, first ask your Faculty Data Steward for advice. You can also check with the privacy website . If you would like to contact the privacy team: privacy-tud@tudelft.nl, please bring your DMP.

- Yes

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- No, I will not work with any confidential or classifie i data/code

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question. If this is not the case, you can use the example below.

All the personal data after being fully de-identified or(and) other non-personal data that support my master thesis will be included as an appendix in my thesis. My work is framed in a contract between TU Delft, Dutch proces innovators and myself.

10. Which personal data will you process? Tick all that apply

- Email addresses and/or other addresses for digital communication
- Data collected in Informed Consent form (names and email addresses)
- Other types of personal data - please explain below
- Names and addresses
- Signed consent forms

answers to questions in an empathy survey names hoewever can not be linked to this data

11. Please list the categories of data subjects

project employees from several companys that promised to participate in my research.

12. Will you be sharing personal data with individuals/organisations outside of the EEA (European Economic Area)?

- No

15. What is the legal ground for personal data processing?

- Informed consent

16. Please describe the informed consent procedure you will follow:

All study participants will be asked for their written consent for taking part in the study and for data processing before the start of the interview and/or survey.

17. Where will you store the signed consent forms?

- Same storage solutions as explained in question 6

18. Does the processing of the personal data result in a high risk to the data subjects?

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data during your research (check all that apply).
If two or more of the options listed below apply, you will have to complete the DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to receive support with DPIA.
If only one of the options listed below applies, your project might need a DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to get advice as to whether DPIA is necessary.
If you have any additional comments, please add them in the box below.

- Evaluation or scoring

19. Did the privacy team advise you to perform a DPIA?

- No

I have been in contact with Arvin Khozooei, privacy officer from the TU Delft. He concluded I will not be needing a DPIA.

22. What will happen with personal research data after the end of the research project?

- Anonymised or aggregated data will be shared with others
- Personal research data will be destroyed after the end of the research project

23. How long will (pseudonymised) personal data be stored for?

- Other - please state the duration and explain the rationale below

Only during the execution of my thesis research. One month after my graduation all data will be deleted.

24. What is the purpose of sharing personal data?

- Other - please explain below

I will not be sharing personal data

25. Will your study participants be asked for their consent for data sharing?

- Yes, in consent form - please explain below what you will do with data from participants who did not consent to data sharing

Data from people that do not give their consent will not be documented in the research and will be deleted.

V. Data sharing and long-term preservation

27. Apart from personal data mentioned in question 22, will any other data be publicly shared?

- All other non-personal data (and code) underlying published articles / reports / theses

- informed concent form,
- interview preparation document,
- the interview quotes,
- the survey questions,
- the opening statement of the survey.

29. How will you share research data (and code), including the one mentioned in question 22?

- My data will be shared in a different way - please explain below

only in the thesis document in the repoistory
(transcripts and questionaire data only available for supervisors)

30. How much of your data will be shared in a research data repository?

- < 100 GB

31. When will the data (or code) be shared?

- At the end of the research project

32. Under what licence will be the data/code released?

- CC BY-SA

the data will not be uploaded separately

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- Yes, leading the collaboration - please provide details of the type of collaboration and the involved parties below

Dutch Process Innovators (dpi) is the company for which i execute this research. Goudvisie is the company that provides the game that will be used. However no Data will be stored at this companies.

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

When i would Leave TU Delft prior to Finishing this project all data would be deleted by me.

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

no finincial means will be used. However some time will go into organising and keeping the data at the right places

Appendix L - List of attended events

As some background information in table ten below the attended events and meetings for this research have been listed and described. The first events and meeting have contributed to the knowledge and understanding of organised contractor client meetings for starting up projects and for aligning teamwork and evaluating processes etc.

Table 10: *Events and Meetings*

Event or meeting	Goal	My role
PFU and bouwteam evaluation Deventer	Getting a feeling for what a PFU entails	Helping out during the session by hanging posters and help answering questions from subgroups about the assignments
Online meeting Guus Keusters	Becoming up to date with the latest research on empathy	Interviewing/ talking to Guus in order to get an idea of the knowledge gap in empathy CE-sector research
PFU Performance contract	Building a relation with colleagues and getting acquainted with the way of working within dpi	Helping out when needed, observing, guiding an exercise on organisation culture
Test session 1	Getting to know the game *Fouten maken Moed* and testing the questionnaire	Introducing my research, providing the questionnaire and observing during the game
Test session 2 dpi	Showing the game to colleagues and practicing guiding the game myself, gaining feedback on my performance and the content of the game	Hosting the session and guiding the colleagues through playing the game and challenging them even more by asking questions. Asking for feedback
PFU session 1 and bouwteam evaluation preparation	Guiding the game/ co-hosting the PFU. Gathering data for this research	Co-hosting the session and being in the lead for gaining data through the questionnaire and playing *Fouten maken Moed*
PSU session 2 and short evaluation bouwteam phase	Guiding the game/ co-hosting the PFU. Gathering data for this research	Co-hosting the session and being in the lead for gaining data through the questionnaire and playing *Fouten maken Moed*
PFU performance contract	Guiding the game and experiencing the difference without questionnaire before and after playing.	Co-hosting, guiding the game