Serious Gaming in road infrastructure projects:

Towards a better understanding of stakeholders' interests

Master Thesis Report

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Serious Gaming in road infrastructure projects:

Towards a better understanding of stakeholders' interests

Thesis

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in

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By Alexandra Raluca Ganceanu

Preface

This thesis report is the result of the graduation project, carried out at VolkerInfra, to fulfill the Master of Science Construction Management and Engineering (CME) at Delft University of Technology.

The graduation committee consisted of three people, prof. dr. ir. A.R.M. Wolfert, dr. ir. G. Bekebrede and dr. ir. H.K.M. van de Ruitenbeek, whom I would like to thank sincerely for their valuable comments, their assistance throughout the research, and their believe in a good outcome of this ambitious project.

Next to this, I thank all interviewees who were willing to share their knowledge and experience with me. I am grateful for their openness and willingness to be part of this research. Furthermore, I thank to my colleagues from VolkerInfra who made my experience in the company much nicer, and enjoyable.

Special thanks to Alfredo, who has always believed in me and whose passion for gaming turned out to be very valuable during the design of the game. Furthermore, I would like to thank Vlad for his support offered throughout this period and his honest friendship. I would also like to thank all my friends who helped me enjoy my time in the Netherlands during this research. Last, but not certainly not least, I would like to thank my family for being always there for me, for their kindness, understanding and encouragement to keep on going even when everything seemed to fall apart.

Executive summary

Tendering for road infrastructure projects

The first phase of procuring any road infrastructure project is the identification of needs. During this phase, the contracting authority tries to understand what and why there is a need for a new project. During the identification of needs, external stakeholders are consulted so that they can express their own needs and interests regarding the new road project. Based on the information accumulated during this phase, the contracting authority formulates the functional requirements the road project should fulfill. These requirements represent the contracting authority translation of the needs and of the reality surrounding the project. Through the formulated requirements, the contracting authority provides their own interpretation of stakeholders' wishes. The functional requirements are incorporated in the tender documents. The tender documents represent the basis for the preparation of the tender proposals provided by the contractors. The contracting authority selects the contractor with the best proposal to execute the project.

Not understanding the stakeholders' interests

In the current legal framework of tendering, the contractor is not allowed to interact with the stakeholders, while working on the proposal. Therefore, the contractors develop the tender proposals using only the information provided by the contracting authority. Once again, the stakeholders' interests disguised among the functional requirements are subjected to the interpretation of another party, the contractors. The contractors, while trying to understand and extract the real meaning of each requirement provided by the contracting authority, should also grasp the stakeholders' interests from the information received.

The existing procurement methods may involve dialogues between the contractor and the contracting authority before the award, giving both parties the chance to exchange ideas (within the legal boundaries) and clarify misunderstandings. Nevertheless, contracting authority answers are still based on its perception and may not encompass all relevant back ground information. Therefore, in the current situation of tendering for road infrastructure projects, the contractor finds himself in the position of not completely understanding the stakeholders' interests.

Capturing stakeholders' interests is a crucial component of a successful project development (Cleland, 1995). Not being able to do that often leads to conflicts and controversies between the stakeholders and the project owner, causing cost overruns and exceeded time schedules due to reworks, disputes, poor communication, or failure of the supply chain (Olander, Landin, 2005; Barlow, 2000).

Serious Gaming – a possible solution

Since dialogues with the contracting authority are not enough in understanding stakeholders' interests and there is no legal possibility to interact with the stakeholders during the tender, the solution to solve this problem should come from the contractor's side. The contractor should train its tender team members on how to better understand the stakeholders' interests.

Traditional classroom lectures are not effective enough since this method has proved to lead to putting the training materials on a shelf back at the office, never to be looked at again and thus all the information is easily forgotten (Darnell, 2014).

A new method is proposed to solve this problem – serious gaming. Serious games are games that contribute to the achievement of a defined purpose, formulated by the game's designer, other than pure entertainment (whether or not the user is consciously aware of it) (van Os, 2012).

The aim of this research is to investigate whether serious gaming can help engineers to improve their understanding of stakeholders' interests during the tender phase of road infrastructure projects. The main research question is:

In which way can serious gaming improve the contractors' understanding of the stakeholders' interests during the tender phase of road infrastructure projects?

Methodology followed

To be able to generate the required data to answer the research question, different methods of research were performed for providing different input. Firstly, 18 experts from a contractor organization were interviewed in order to identify the needed improvements for better understanding the stakeholders' interests. The experts were part of tender teams, either as tender managers, stakeholder managers or project leaders. Then a literature study on serious gaming was conducted based on which the properties of serious gaming which could support the needed improvement points were identified. Defining the needed improvements points as the objectives of a new serious game, *Someone else's shoes* game was developed accordingly to the game design methodology of Duke and Geurts (2004). Furthermore, an experiment of learning from playing *Someone else's shoes* game was conducted. The experiment was conducted in a constructed environment, but with a high number of respondents. The participants were engineer students from TU Delft, with similar academic background of tender team members. The students are considered to be the future engineers of road infrastructure projects. The choice of doing an experiment is based on the short duration of the master thesis and on the fact that the game was developed at the prototype level. By means of statistical analysis a measurement if the game designed according to the rules extracted from the theory has supported the improvement points about understanding stakeholders' interests. The qualitative data for this measurement was based on the students' feedback, researcher's and facilitators' observations.

Results – from theory to practice

The outcome of the experts' interviews was that:

- tender team members should raise their awareness about stakeholders' interests and influence – become more aware that the stakeholders' interests might be different than the ones of the contracting authority or their own and that stakeholders have an impact on the project development, either positive or negative, depending on the solutions proposed;
- tender team members should increase their willingness to identify win-win solutions for stakeholders while brainstorming, developing solutions, and taking decisions.
- tender team members should increase their willingness to think from the point of view of stakeholders while brainstorming, developing solutions, and taking decisions.

These three improvement points are all related to each other. Being aware of stakeholders' interests influences the awareness about stakeholders' influence on the project. Moreover, both of these influence the increase in willingness to think from the point of view of stakeholders and to identify win-win solutions.

The outcome of the literature study on serious gaming was materialized in a new serious game. A board game with role-playing was developed, called *Someone else's shoes.* The objective in the game is to refurbish a motorway with as little money and time possible, and by taking into account stakeholders' interests. The team with the best offer wins the game. The best offer should contain the lowest time and cost, and high stakeholder satisfaction. The participants form teams of five persons and roles are given to each other. The roles represent one contractor and four stakeholders (local authority, nearby residents, railroad company, environmentalists). The game-play consists of four rounds and the players have to solve one dilemma regarding the project per round. The

dilemmas are typical for road infrastructure projects: round 1 - the renewal of the paving, round 2 – the refurbishment of the existing crossings, round 3 – the reduction of noise on the motorway, round 4- the safe crossing for slow traffic. Each dilemma has three possible solutions, and the players have to select the best one they consider. After the game, a debriefing session takes place with all the participants where they discuss the game experience, approach, collaboration, decision making and final outcomes. Furthermore, lessons are drawn and connected to the real world situations.

The objectives of *Someone else's shoes* game are to raise tender team members' awareness about stakeholders' interests and influence, to increase their willingness to identify win-win solutions for stakeholders and to increase their willingness to think from the point of view of stakeholders. A game with these objectives would be most useful if played at the beginning of the tender process. In this way, the tender team members have sufficient time to make use of their improved understanding of stakeholders' interests exactly after the game and during the entire tender process.

Someone else's shoes game offers the opportunity to the tender team members to experience roles which are different than their day to day working roles. By playing the role of stakeholders, participants challenge their engineering way of thinking to react in accordance to the objectives and resources given by the role from the game. The game offers a safe learning environment where the players experience the trade-offs between cost/time/quality/stakeholders' interests without the fear of real consequences. Communicating, interacting and negotiating with each other, the participants become aware about the differences in their interests and decide on a solution according to that. Based on the game outcomes, the players reflect on what happens if win-win solutions were identified or not, and how their decision affected the outcomes. Furthermore, a player engaged into the game is more connected to the role, and he tries to understand the stakeholder and "fights" for achieving his objectives. As a result, he/she is more willing to think from the point of view of his/her role - the stakeholder. Being part of a meaningful experience, the participants will remember it back in the real world situations. Remembering the game experience facilitates the thinking from the point of view of stakeholders in real situations by letting the participants to think back and remember what the stakeholders "were thinking", what were their interests, how did they "feel" when their interests were not fulfilled during the game.

The outcomes of the experiment with the students show that *Someone else's shoes* game achieved its objectives, in the constructed environment. By playing the game *Someone else's shoes* the students raised their awareness about stakeholders' interests and influence. That means that after playing the game, the participants agreed they were more aware about what kind of interests stakeholders could have and more aware about the influence they could have on the project. Lastly, they agreed they were more aware of what kind of interests contractors could have. By playing the game *Someone else's shoes* the students agreed that they increased their willingness to identify win-win solutions. Furthermore, by playing the game *Someone else's shoes* the students increased their willingness to think from the point of view of stakeholders. That means that after playing the game, the participants agreed that they will better think from the point of view of stakeholders, they will pay more attention to stakeholders interests and that they were more aware of the importance of adopting a stakeholder perspective on projects.

The outcome of the implementation of the learning outcomes shows that not all the players managed to successfully apply the knowledge gained from playing the game, since the responses were spread out over a large range of value.

Serious Gaming for understanding stakeholders' interests

The theoretical findings and the positive preliminary results obtained from the experiment with the students show that the research should be continued and further development and testing of *Someone else's shoes* game with tender team members will increase the benefits of serious gaming in the tender process of road infrastructure projects. After this step is accomplished, a more sounded conclusion can be drawn regarding the way in which serious gaming can improve contractor's understanding of stakeholders' interests during the tender process.

However the findings of this research (theoretical and empirical) serve as expectations of the ways in which serious gaming could improve the contractors' understanding of stakeholders' interests:

- tender teams could increase their awareness about stakeholders' interests and their influence on projects – by this, they could understand that stakeholders have different interests than contractors or contracting authority and that they, by the power they have, can influence the project development and outcomes;
- tender teams could increase their willingness to identify win-win solutions for stakeholders and contractor – by this they could look for solutions satisfying the stakeholders, while including the time and money aspects;
- tender teams could increase their willingness to think from the point of view of stakeholders while brainstorming, developing solutions, taking decisions. This attitude could increase the possibilities to obtain solutions in accordance to what stakeholders want.

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Chapter 1
Introduction

1. Introduction

Road infrastructure projects contribute in both positive (increasing the economy of an area, raising the quality of life) and negative (social and environmental impacts) ways (Ng, Li, and Wong, 2012). Their significant impact upon the lifestyle of a community could last for varying periods of time (Koehn, 1993).

Due to their role in society, road infrastructure works are publicly procured on behalf of a public authority such as a governmental authority (hereafter: contracting authority). Moreover, transport infrastructure projects such as roads require large investments, which are mainly financed by the taxpayers. Therefore, it is important to ensure an open and fair procurement, with focus on best values for money.

1.1. Tendering for road infrastructure projects

The procurement of road infrastructure is often carried out by the process of tendering, rather than buying products directly from a seller. According to various authors, the procurement process of road infrastructure projects is organized into phases which although are named in different ways, they are generally known as (Weele, 2008; Lennartz & Veeke, 2007; Wijnberg et al, 1997; Ehlermann-Cache, 2007; Gelderman & Albronda, 2005):

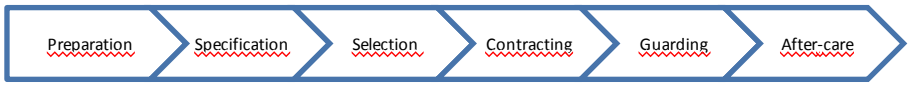

Figure 1 Procurement process for road infrastructure projects

The first phase of procuring any road infrastructure project is the identification of needs. During this phase, the contracting authority tries to understand what and why there is a need for a new project. During the identification of needs, external stakeholders are consulted so that they can express their own needs and interests regarding the new road infrastructure project. Based on the information accumulated during this phase, the contracting authority formulates the functional requirements the road should fulfill.

The formulation of the functional requirements is the second step in the procurement process. These functional requirements represent the contracting authority translation of the needs and of the reality surrounding the project. The translation of stakeholders' needs and interests into functional requirements is subjective, since the information is filtered through the interpretation of the contracting authority. Therefore, the stakeholders' interests and needs on the project might not be completely reflected by the requirements.

The functional requirements are incorporated in the tender documents and the third phase of the procurement takes place – the selection phase. The tender documents represent the basis for the preparation of the tender proposals provided by the contractors. The contracting authority selects the contractor with the best proposal to execute the project. This is the fourth phase from the procurement process – contracting.

The last two phases – guarding and after-care – are related to the execution of the project and the learning process for the procuring parties.

1.2. Not understanding stakeholders' interests

During the selection phase, the bidding parties are not allowed to interact with stakeholders. Their only interaction is with the contracting authority, even for stakeholders' related matters. Therefore, the contractors develop the tender proposals using only the information provided by the contracting authority. Once again, the stakeholders' interests disguised among the project specifications are subjected to the interpretation of another party, the contractor. The contractor, while trying to understand and extract the real meaning of each requirement from the contracting authority, should also grasp the stakeholders' interests from the information received.

There are procurement methods which may involve dialogue sessions between the contractor and the contracting authority before the award (Valkenburg, Lenferink, Nijsten, Arts, 2009). These dialogue sessions give both parties the chance to exchange ideas (within the legal boundaries) and clarify misunderstandings. Nevertheless, contracting authority answers are still based on its perception and may not encompass all relevant back ground information. Therefore, in the current situation of tendering for road infrastructure projects, the contractor finds himself in the position of not completely understanding the stakeholders' interests.

Capturing stakeholders' interests is a crucial component of a successful project development (Cleland, 1995). Not being able to do that often leads to conflicts and controversies between the stakeholders and the project owner, causing cost overruns and exceeded time schedules due to reworks, disputes, poor communication, or failure of the supply chain (Olander, Landin, 2005; Barlow, 2000). These problems usually happen during the fifth phase of the procurement process – guarding or execution.

The problem statement therefore is:
In the current situation of tendering for road infrastructure projects, the contractor finds himself in the position of not completely understanding the stakeholders' interests.

1.3. Serious gaming: a possible solution

Since dialogues with the contracting authority are not enough in understanding stakeholders' interests and there is no legal possibility to interact with the stakeholders during the tender, the solution to solve this problem should come from the contractor's side. The contractor should train its tender teams on how to better understand the stakeholders' interests.

The traditional methods of training in construction companies are informational and event based (attending conferences, classroom lectures etc.) which in most cases lead to putting the training materials on a shelf back at the office, never to be looked at again and thus all the information is easily forgotten (Darnell, 2014). Therefore a traditional classroom lecture about the understanding stakeholders' interests will not be effective enough to make engineers to actually change something in their understanding of stakeholders' interests.

Technical people tend to be highly kinesthetic and visual learners. They also love the challenge of a game or competition (Darnell, 2014). Experiential learning is effective for technical people because it engages them in physical activity. Experiential learning focuses on letting the participants learn through experience and through the reflection on doing (Kolb, 1984; Patrick, 2011). Interactive methods, such as games, support the experiential learning method (Duke, 1998; Mayer & Veeneman, 2002) by letting players to learn while experiencing the game.

A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome (Salen & Zimmerman, 2004). The definition adopted for this research states that serious games are games that contribute to the achievement of a defined purpose, formulated

by the game's designer, other than pure entertainment (whether or not the user is consciously aware of it) (van Os, 2012).

By being actively involved in a game, the players are more conscious about their decisions and consequences, and they have higher retention of their experience (Bekebrede, 2010). The story, the dramatization, the simulations, the exercises and the personal involvement make the experience of a game more meaningful and difficult to forget (Garcia-Barrios, Speelman, Pimm, 2010). Unlike traditional training techniques, employees retained more information from serious games based activities. Employees will usually retain only about 4 percent of what they have learned after about six weeks with traditional learning techniques. With serious games, however, participants retain 40 percent of what they have learned after six weeks – 10 times more knowledge (Kimball and Thiagaran, 2003). Another research (Sitzmann, 2011) found that trainees who used the game-based learning approach had 20% higher confidence that they had mastered the learning and could perform the tasks on the job. In short, as Stuart Brown (2010) states, people learn more when they are having fun.

Altogether, these remarks lead to the hypothesis that serious gaming can help engineers to improve their understanding of stakeholders' interests during the tender phase of road infrastructure project.

1.4. Report outline

The present research is structure in the following way:

- Chapter 2 presents the research design which includes the main and sub research questions, the general research approach, the scientific, societal and commercial relevance of the research, the research boundaries, the methodology followed, and last, but not least the personal challenges of the researcher.

- Chapter 3 presents the improvement points needed for the contractors to better understand stakeholders' interests during the tender phase of road infrastructure projects. First the concept of procurement of infrastructure is further detailed, with focusing on the second and third steps. Then, the contractor's view on the tender process is assessed by conducting and analyzing experts' interviews. Finally, a relationship model is used to support the relations between the identified improvement points which influence the understanding of stakeholders' interests.

- Chapter 4 continues on the concept of serious gaming by first providing a detailed explanation of the definition of serious games and describing the elements of a game. Then, it elaborates on the properties which make serious gaming a suitable activity for supporting the needed improvements.

- Chapter 5 describes the development process of the serious game *Someone else's shoes* is by discussing the design decisions taken, together with their arguments, and presenting the resulted prototype.

- Chapter 6 analyzes the quantitative and qualitative data obtained from the evaluation phase. First the players, their background and pre-knowledge and attitude about stakeholders' interests are described. Then three hypotheses about the game outcomes are developed and tested. Lastly, the factors which influence the learning outcome of the participants are analyzed.

- Chapter 7 provides the conclusions and recommendations for the executed research. Based on the results obtained, the expectations are that by playing *Someone else's shoes*, tender teams could experience how it is to be a stakeholder in a project. They could gain insights about the stakeholders' importance, their influence in the project, and could become more willing to identify win-win solutions and to think from the point of view of stakeholders.

Chapter 2
Research design

2. Research design

The aim of this research is to explore the possible ways in which serious gaming can improve contractor's understanding of the stakeholders' interests during the tender phase of road infrastructure projects.

In the following sections the entire research design set up is presented.

2.1. Research question

The defined objectives lead to the following main research question:

- In which way can serious gaming improve the contractors' understanding of the stakeholders' interests during the tender phase of road infrastructure projects?

For clarification, "In which way" refers to the possible improvement points that serious gaming could support in order to contribute to the improvement of the contractors' understanding of the stakeholders' interests during the tender phase of road infrastructure projects.

To answer this question the following sub-questions were formulated.

- RQ1: What do contractors need to improve to better understand stakeholders' interests during the tender phase of road infrastructure projects?

- RQ2: What properties make serious gaming suitable for supporting the needed improvements?

An empirical study will be conducted on the development and use of serious gaming which will help answering the last sub-question. Taking into account the objective of developing a prototype game and the short time dedicated for this master thesis, the game will be tested in a constructed environment, only with students from Technical University of Delft. The description of the constructed environment and the argumentation for the selected players can be found in section 2.4.

- RQ3: What do students improve regarding their understanding of stakeholders' interests through serious gaming?

2.2. Relevance

Scientific relevance

There is a literature gap in the field of stakeholder management, since not much can be found on this subject specifically for tender teams of road infrastructure projects. The present research contributes to the field of stakeholder management by:

- providing a list of improvement points for better understanding stakeholders' interests by conducting and analyzing expert interviews
- testing whether serious gaming is an appropriate tool for tender team members by conducting and analyzing a game with a large number of students

Societal relevance

The better and earlier contractors and stakeholders arrive at a mutual understanding the fewer conflicts will arise during subsequent phases. Ultimately, society will benefit from preventing unnecessary waste – both environmental and economically.

Although the serious game will be designed for the VolkerInfra organization, it will also be tested in an educational setting. In this way, students may change their attitude towards the incorporation of stakeholders' interests in projects and benefit society in a very early stage.

Commercial relevance

The new serious game can be further improved based on the recommendations. The recommendations will refer to the following aspects:

- improvements for further development of the game
- advices concerning the application of serious games in the tender process of road infrastructure projects
- suggestions for obtaining better learning outcomes

2.3. Research boundaries

In order to make the research feasible, a list of the research boundaries including argumentation is presented below.

- Since there is a need for a tool from the inception of projects, the focus of the research is only on the tender phase of projects. As a consequence, the implication of the tool on other project phases is not researched.

- The demarcation within construction projects is road infrastructure projects. This distinction has been made since each sector has its own system characteristics – stakeholders and needs. As a consequence the results of this research are valid only for road infrastructure projects. In order to expand the results to other type of transportation projects, further research is needed on the comparison between the tender process of road infrastructure projects and other transportation infrastructure projects.

- There is no delimitation between the different procurement methods. As consequence the tool can be applied without considering the contractual agreement of projects.

- The research focus is on the external stakeholders of road infrastructure projects only. External stakeholders are affected by the project in a significant way, but they do not actively take part in the execution of the project (they can be neighbors, the community, the general public, as well as trade and industry). As a consequence the contractor's understanding of internal stakeholders is not investigated and as well the solution proposed is valid only for external stakeholders' matters.

- The focus of the research is on the tender teams from the contractor side, and does not investigate the problem from the perspective of the contracting authority. As a consequence the solution proposed is approached from one direction - the contractor.

- The context of the research is the VolkerInfra organization. As a consequence the research might suffer of generalization. However, VolkerInfra is one of the biggest organizations from the construction industry in the Netherlands and has a vast experience in transport infrastructure projects, which makes it a good representative of contractors.

- The testing of the game prototype is done with students from the Technical University of Delft. The students are mainly from Civil Engineering and Geosciences Faculty, representing the future engineers of road infrastructure projects. The group of students selected is considered to be a good representation of tender team members, as argue in section 2.4. As

a consequence of this boundary, the external validity of the research is not fully achieved – there are no test sessions with the tender team members.

- The research does not include a comparative study with other possible tools. As a consequence the research investigates strictly the contribution of serious gaming for the identified problem.

- Taken into account the available time for the research, it was decided to develop a low tech game at the level of a prototype. As a consequence this research should be regarded as a starting point for exploring the possible benefits of introducing serious gaming in the tender process of road infrastructure projects. The evaluation of the prototype will provide input for further development and arguments for real implementation within the context of tender process.

- The game had to be designed without a budget. As a consequence the game is designed with affordable materials.

- The results are based only on one experiment with one serious game. As a consequence the external validity of the research is not fully achieved - being impossible to generalize the results. However, this is an exploratory research and it is intended to explore the contribution of serious gaming in understanding stakeholders' interests in the tender process.

- The actual implementation and integration of serious gaming into the contractor's environment is out of scope. As a consequence no specifications are made about how to best integrate serious gaming in an organization.

2.4. Research approach

The research approach is a combination of qualitative and quantitative approaches. For each sub question, different methods of research were used.

The methodologies used are presented according to the three sub-research questions.

RO1: What do contractors need to improve regarding their understanding of stakeholders' interests during the tender phase of road infrastructure projects?

Methods: Conduct an analysis of the current situation in the tender phase of road infrastructure projects

- Execute interviews with experts from VolkerInfra

Result: identification of the improvement points regarding contractor's understanding of stakeholders' interests during the tender phase of projects.

RQ2: What properties make serious gaming suitable for supporting the needed improvements?

Methods: Conduct research on serious gaming theory relevant for the topic

- Execute a literature study

Results: provision of theoretical arguments for using serious gaming as a method for improving the understanding of stakeholders' interests during the tender phase of projects.

RQ3: What do students improve regarding their understanding of stakeholders' interests after playing a serious game?

Method: Conduct an experiment of learning from playing a serious game

- Develop a serious game following the methodology from "Policy Games for Strategic Management" by Duke and Geurts
- Run a test session with students
- Evaluate the game: collect data using questionnaires and conduct a statistical analysis; back up and confront the results with qualitative data obtained from observations

Result: a measurement if the game designed according to the rules extracted from the theory supports the improvement points about understanding stakeholders' interests

The game session is integrated as part of a Technical Project, from the Project Management: From Nano to Mega course. The assignment central to this Technical Project is the development and partial execution of a plan for a multidisciplinary building project in which functional, technical, economic, legal and sustainability aspects are addressed and integrated.

The assignment and organizational aspect of the course are very similar with a real tender process.

- The client is represented by the lecturers and representatives from a Dutch construction company.
- The bidders are represented by 13 teams of students which play the role of engineering companies. The teams act as management teams of their own company while preparing the project plans.
- The competitive dialogue is represented by two meetings with the client, when the teams have to present their outcomes and are allowed to ask for clarifications.

The assignment is divided in 6 phases:

1. User Needs and Business Plan (2 weeks)

- Identification of User Needs belonging to the chosen theme for this course.
- Development of a Business Plan. With the business plan, student teams can act as commercial companies, operating in competition with each other trying to win contracts (projects).

2. Preparation of a Project Plan (2 weeks). Teams are also asked for pre-advice about the evaluation method that must be used by the client in order to assess the actual advice. In this stage all information relevant for the composition of the plan is gathered by the project teams. Not only design aspects are relevant, but also all other aspects that belong to the "system" in which the project is taking place, in order to enable simulation of the procurement process in the next stage.
3. Preparation of a Sketch Design (2 weeks), to be presented in a midterm presentation. The outcome of this stage is the first design proposal for the project.
4. Teamwork (2 weeks): all students follow three one-day workshops with a number of instructions, exercises, assignments and a written exam

5. Preparation of a Tender Package, based on the winning Project Plan from phase 2. The tender package contains a set of submission documents that should enable the client to select a company for realization of the project. (5 weeks).
6. Finally, the focus will be on the (simulated) Realization of awarded projects in order to guide the construction processes in the right direction (3 weeks).

Taking into account the course and the thesis timelines, the game session is incorporated before the end of the Preparation of Sketch Design. This stage is considered to be representative for the beginning of a tender process.

Most of the students are from the Faculty of Civil Engineering and Geosciences (41.8%), followed by the students from Faculty of Mechanical Engineering (17.7%). On the third place are the students from the Faculty of Technology, Policy and Management (12.7%). These three backgrounds could be also recognized in tender teams. The multidisciplinary characteristic of the student teams is similar with that of real tender teams. Furthermore, the students represent future engineers who might become part of real tender teams.

2.5. Personal challenges

The researcher encountered several personal challenges throughout this research which are worth mentioning:

- The researcher had no experience in game design before starting the research. To deal with this challenge, an extensive theoretical study on game design was conducted throughout the research and advices from game designers were asked. As a consequence, the prototype developed will need further improvements in quality.

- Game design should be a team work exercise, but for this research it was individual tasks so the researcher's opinion and preferences had a high influence. To deal with this challenge, experts in game design were consulted and feedback from people was gathered. As a result, the researcher tried to reduce the bias and increase the creative process.

- The researcher's limited experience in facilitation and debriefing might have influence the game session. To deal with this, materials on game facilitation and debriefing were consulted. Also, professionals from the field of infrastructure helped partially with the debriefing. However, as a consequence, the validity of the outcomes might have been influenced.

- The context of the research was a Dutch company, where most of the documents are in Dutch, language different than the native language of the researcher. To deal with this challenge, information was translated online or, when possible, English documents were provided. As a result, the analysis of existing project documents was cumbersome.

- The researcher had limited knowledge in statistical analysis. To deal with this challenge, books about statistical analysis were read. SPSS software was learnt by self-studying (books and tutorials). As a result, the analysis could be performed, but it took more time.

Chapter 3
Tender process

3. Tender process

Road infrastructure projects still suffer of cost and time overruns. One of the recognized causes is the failure of addressing the needs and concerns of external stakeholders (Olander, Landin, 2005; Barlow, 2000; Cleland, 1995). The contractor who is responsible of designs and implementation of the project is focused on technical details rather than on public debate (Enserink, 2000). The engineers tend to approach problems from the technical and economical perspectives, which may not be enough in understanding and taking into account the needs and concerns of external stakeholders (Olander, 2006).

The objective of this chapter is to present the improvement points needed for the contractors to better understand stakeholders' interests during the tender phase of road infrastructure projects. First the concept of procurement of infrastructure is introduced, with focusing on the steps related to tender process. Then, the contractor's view on the tender process is assessed by conducting and analyzing experts' interviews. Finally, a relationship model is used to support the relations between the identified improvement points which influence the incorporation of stakeholders' interests.

This chapter answers the first sub-research question:

- RQ1: What do contractors need to improve to better understand stakeholders' interests during the tender phase of road infrastructure projects?

3.1. Tender process – contracting authority story

This section provides general information about the tendering process of infrastructure projects organized by the contracting authority. These two steps are related to the tender process. The second step refers to the specification of criteria and award system which will be used in the tender phase and the third step is the selection of the contractor who took part in the tender process.

According to Weele (2010) procurement is "the acquisition of goods, services or works from an outside external source. It is favorable that the goods, services or works are appropriate and that they are procured at the best possible cost to meet the needs of the acquirer in terms of quality and quantity, time, and location." If the procurement of goods and services is done on behalf of a public authority such as a governmental authority, then it is called public tendering or public procurement. Infrastructure works are typical examples of structures that will be publicly procured because of their role in society, which is to enable, sustain, or enhance societal living conditions. Moreover, transport infrastructure projects such as road, bridges and tunnels require large investments, which are mainly financed by the taxpayers. Therefore, it is important to ensure an open and fair procurement, with focus on best values for money.

According to various authors, the public procurement process is organized into phases which although are named in different ways, they are generally known as (Weele, 2008; Lennartz & Veeke, 2007; Wijnberg et al, 1997; Ehlermann-Cache, 2007; Gelderman & Albronda, 2005):

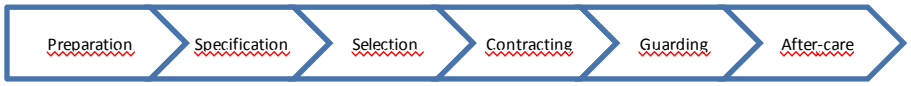

Figure 2 Procurement process

- Preparation
    a. identification of needs: project owner tries to understand what and why there is a need
    b. set up procurement strategy: project owner decides which procurement strategy to follow
- Specification
    a. specification of criteria: criteria based on which the proposed solutions will be assessed
    b. specification of the award method and calculation: how the project owner select the solution
- Selection: contractors provide a proposal on how to execute the road infrastructure project and then one of them is selected
- Contracting: a contract between the procuring party and building contractor is signed
- Guarding: the execution by the building contractor should be guarded In order to verify whether acts according to the contract
- After–care: encapsulate the learning process for the procuring parties

Regarding the type of procedure, there are several procedures for road infrastructure projects. The following EU procurement procedure exists (Valkenburg et al., 2009):

1. Open procedure (no pre-selection);
2. Restricted procedure (with pre-selection, pre-qualification);
3. Negotiated procedure without prior publication, very strict applications thresholds;
4. Negotiated procedure with prior publication - applied when the nature of the project is such that specifications cannot be drawn up with sufficient precision to permit awarding the contract by means of the open or restricted procedure
5. Competitive dialogue with pre-qualification, dialogue with competitors before bidding, specifically introduced for complex projects and applicable when:
    - Procuring a particularly complex contract; and
    - The contracting authority finds it impossible to objectively define the means of satisfying its needs or to assess the technical, financial and/or legal solutions which the market has to offer.

The procurement process of infrastructure projects consists of six steps. In this process, the tender phase starts with the third step – the selection. The prior two step contribute to the development of the tender documents by the contracting authority. The purchasing of road infrastructure can be done through five different procedures, depending on the size , complexity, nature of the project and purchaser's preference. For this research, it is not relevant which procedure is adopted.

3.1.1. Specification phase

The contracting authority has to specify the criteria which will be used in the assessment of the proposal received from the contractor (Bruggemen, Chao-Duivis & Koning, 2010). There is a clear distinction between selection criteria and award criteria, both of them governed by different rules.

Selection criteria focus on the bidder and are used to select the parties invited to tender, based on a qualitative assessment of their ability to perform the proposed contract (for example, in terms of experience, economic standing and qualifications). Selection criteria are applied only during the pre-qualification stage in order to cut down the numbers of bidders invited to tender. Selection criteria may not be used during the award phase (DIRECTIVE 2004/18/EC).

Award criteria refer to the tender and are used for the identification of the cheapest or the most economically advantageous (DIRECTIVE 2004/18/EC). In case of MEAT, sub award criteria called "aspects" need to be developed (Bruggeman et al., 2010).

In simple terms, selection criteria aims to establish "can they do it?" and award criteria "how will they do it?".

Specification of award mechanism

The last aspect which needs to be specified by the contracting authority is the award mechanism used in choosing to whom the contract should be awarded. The traditional method implies an exact prescription of how the road infrastructure project should look like and be executed. The bidding parties prepare the proposal and the contractor who offers the design for the lowest price wins the tender and gains the contract.

Another method used in infrastructure projects is Best Value for Money. In this type of tender not only price, but also quality plays a role. Best value for money method awards projects on the base of the "Economically Most Advantageous Tender" (EMAT). Quality criteria cover several aspects such as functionality, risk, esthetics, sustainability, speed, nuisance prevention, delivery time etc (Bruggeman, Chao-Duivis, Koning, 2010). This research will focus on the EMAT procedure due to its high applicability in the current situation of infrastructure industry (van de Rijt & Witteveen, 2011).

Type of EMAT award mechanism

The preference ranking of the bidders is established through evaluation techniques which use some mathematical formulas and assigned value price to the award criteria defined by the procurer (Dreschler, 2009).

The evaluation techniques have similar characteristics as Multi Criteria Evaluation techniques. However, the difficult part in the EMAT mechanism is how to combine price information with qualitative criteria by respecting the legal criteria that apply in the procurement processes:

- transparency (objectivity of criteria)
- proportionality (balance of the weighting criteria so that the value which is attached to performance remains economically realistic)
- equal treatment (not making distinctions on criteria) (Dreschler, 2009).

According to Doornbos (2005), three main EMAT forms of evaluation techniques can be applied: the point system, the ratio system and the price correction system. Their characteristics are presented in the Table 3.1.

Table 1 Types of EMAT award mechanisms

Type of mechanism	Evaluation technique
Point System	Both the price and the quality of the bids are expressed in points. The bid with the best combined score wins the tender.
Ratio System	The total value of the bid is expressed in a number which is divided by the price. The bid with the highest ratio wins the tender.
Price Correction System	Extra performance of the bid is rewarded with an added value which is subtracted from the initial tender price. The bid with the lowest fictitious tender price wins the tender. (Based on the tender instructions, there is also the alternative of adding the added value to the initial tender price).

In the Netherlands, Rijkswaterstaat (RWS, 2005b) prescribed the use of the price correction system as the main EMAT award mechanism, due to some limitations of the point system and the limited applications of the ratio system (Dreschler, 2009). In the price correction system, the contracting authority assigns a value price and weight to each award criterion (DIRECTIVE 2004/18/EC). The scores obtained for the award criteria are used together with the bid price in the evaluation technique to establish the ranking of the bids.

The implication of the EMAT award system for the contractor is the opportunity to provide added value on bid documentation and increase the chances of winning the tender. The added value is represented by switching the focus from developing the best solution at the lowest costs, to qualitative, technical and sustainable aspects such as quality, technical merit, aesthetic and functional characteristics, environmental characteristics, after-sale service and technical assistance, delivery date and delivery period or period of completion.

Project requirements

Part of the specification phase is also the formulation of the project requirements. The contracting authority formulates functional requirements the road should fulfill. The project requirements concern aspects concerning capacity, availability, design, construction, temporary measures during construction, communication with stakeholders and procedural integration of the infrastructure and real estate (N33 Assen – Zuidbroek, 2012; Rotterdamsebaan, 2014; Eisendeel Hoornbrug, 2013; Eisendeel Haagweg, 2013). Based on these requirements, the contractor elaborates the tender proposal.

The project requirements are formulated based on the identified needs from the preparation phase. Also, on the environmental impact assessment results and on the external stakeholders needs and concerns. The latter, are firstly negotiated between the contracting authority and the stakeholders (Valkenburg et al., 2009). The translation from needs and concerns into functional requirements is subjective, since the information is filtered through the interpretation of the contracting authority. Therefore, the perspective of stakeholders on the project might not be reflected by the project requirements.

3.1.2. Selection phase

The selection phase is the actual start of the tender process for the contractor. Contracting authority announces the project under tendering and provides the necessary information and forms to the bidding parties.

The duration of a tender process depend merely on the type of project under tendering and the deadline from the contracting authority. Usually a tender can be between 3 months and 1, 5 year. From the last moment of contact with the contracting authority, the contractor has approximately 6-8 weeks for submitting the final proposal.

During the tender process, the bidding parties are not allowed to interact with the external stakeholders. Their only interaction is with the contracting authority, even for stakeholders' related matters. Therefore, what the contractor knows about the stakeholders needs and interests come from the information provided by the contracting authority. The contractor has no possibility to increase its knowledge about stakeholders through direct contact with them.

In the previous section was mentioned that before the selection step, the contracting authority interacts with the stakeholders for needs identification. Also, the contracting authority incorporates in the project requirements only the negotiated needs. Therefore, the contracting authority has more information about the stakeholders' needs and interests than the bidding parties. In contract theory this is known as information asymmetry. This situation creates an imbalance of power between the parties (Wilson, 2008) and causes misinforming which hinders the communication process (Christozov, Chukova, Mateev, 2009).

3.2. Tender process – contractor's story

The previous section introduced the tender process as organized by the contracting authority. This section will present the tender phase as experienced by the contractor. The literature on tendering is very limited when it comes to the contractor perspective. Therefore, interviews with experts – tender managers, stakeholder managers and project leaders – were conducted. Since the context of the research was the VolkerInfra organization, all the persons interviewed were from there. The complete list of experts can be found in Appendix 1.

3.2.1. Organizing a tender

The tender process represents a set of steps followed by the tender team of VolkerInfra for each road infrastructure project they bid. As provided by the company, the 14 steps are described in summary below:

1. General

In consultation with the executive board, the Head of Tender Department appoints a provisional Tender Manager who will be responsible for the management of the tender team and of the tender process.

Depending on the type of tender, if there is a pre-selection phase, the contractor first fills in the necessary forms for the Request for Qualification (for example regarding experiences, turnover, and references) and submits them to the contracting authority. In case of a positive outcome, the bidding parties receive the tender guidelines and the tender process continues with the next steps. Otherwise, if there is no pre-selection phase, the tender process starts immediately.

2. Kick off meeting

This is the first meeting when the tender is discussed, by taking into consideration the tender presentation, tender documents from the contracting authority, outstanding issues and additional

project information. At the kick off meeting the tender manager and the initial tender team are present. The outcome of this meeting is a division of tasks needed for preparing the tender. The tasks concerned going the division of the project requirements, analysis of the requirements, identification of the team's limitation for realizing the tender etc.

3. Go/No-go decision

Upon receipt of the tender documents from the client the tender manager prepares detail presentation about the score of the project, the competitive environment, the licensing criteria and the possible ways of winning the tender. The executive board decides whether the tender is continued or terminated on the basis of the tender information sheet (contains the tender strategy concept). Relevant changes and / or other insights are discussed in the tender board. If necessary, it can lead to reconsideration.

4. Assessing the Tender Instructions and Contract Documents

The Tender Instructions helps the bidders to organize their proposal by providing information about:

- the description of the tender with the tendering instructions
- the schedule of the tender
- the documents to be executed by the contractor
- the award criteria
- the ceiling price
- the competitors
- the communication channels with the client
- other relevant aspects for the tender

Besides the Tender Instructions, the contract documents are also assessed by the contractor. They provide extensive information about each party's obligations, financial aspects, set of requirements and other informative documents (e.g. drawings, diagrams, etc.)

5. Tender Management Plan

Based on the analysis of the tender instructions and contract documents, the tender team prepares a Tender Management Plan which comprises the actions needed for a successful tender. Therefore, the Tender Management Plan includes the tender team's strategy to address the most important strategic issues, the tender process (budget, plans, necessary people, risk management plan, stakeholders and competitors analysis).

6. First potential options

During this phase of the tender process an initial effort is made in order to develop the first concepts of ideas and designs for the project. This is succeeded by two steps:

- A brainstorming session of the potential solutions to the client's statement of requirements
  - By using a Trade-off Matrix, the feasibility of all the proposed ideas is assessed
  - The results of this sessions are documented, and in particular the risks, forecast and the degree to which the requirements are met
- Development of a Design Plan

7. Develop first ideas at high level

Based on the trade-off matrix outcome, a couple of solutions, in general three are worked out in detail. For each alternative a global Work Breakdown Structure is developed, and then an initial draft in broad detail is developed, addressing the following aspects:

- forecasted work costs

- global construction schedule
- brief work methods description
- project-related risks

Each solution is reviewed within the tender team but also by an independent panel, assessing aspects like design, methodology and costs estimates. The conclusions from this step are documented in a Review Report.

8. Select most favorable solution(s)

During this phase, the possible solutions are cut down to one or two. This selection requires to have a clear view on the initial cash flow estimation, internal and external financing, price escalations. All of these are assessed together with the available information about the project, evaluation criteria, tender strategy and previous reviews from the trade-off matrix analysis. All the arguments and considerations for the chosen solution(s) are documented in a report.

9. Develop selected solution(s)

In this stage, the selected solution(s) are developed in details together with a provisional cost estimate.

10. Final selection of design proposal

After a detailed development, the solution(s) are again reviewed. The decision factors in this stage are the design itself, the provisional cost estimate and the proposed work methods (engineering techniques). The outcome of this selection is the final solution which will be further on developed. All the arguments and considerations for the chosen solution are documented in a Review Report.

11. Develop design proposal

Once the final solution is chosen, the Design Proposal is executed including the final development and other relevant documents needed based on the specification of requirements. The final deliverables are:

- Design proposal, including management and work preparation plans
- Final Cost Estimate
- Personnel Assignment Schedule
- Production Personnel Assignment Schedule
- Cash Flow
- Financing Proposal
- Risk Management Plan

12. Final review

A final review is given to the selected design, to its associated work methods and cost estimate. Furthermore, an internal assessment on completeness is provided to the cost estimate. Everything is documented in the Review Report.

13. Assemble proposal

The final proposal and the supporting internal documents are assembled into a Proposal Package and submitted to the client.

14. Tender evaluation

At the end of the tender, the entire process is evaluated. The evaluation includes a description of all the steps followed and the lessons learnt from each of them. The evaluation document is archived and can serve as inspiration for future tenders.

The tender phase is an extensive process with 14 steps, all followed regardless the duration of the tender (between 3 months and 1, 5 year). Throughout the tender phase, the tender managers together with the team members take decisions which lead to the final proposal. These decisions are based on what they are required to develop, on what they understand they have to develop and on what they are able to develop.

In the next subsection the decision making process and the consideration given to stakeholders' interests is assessed.

3.2.2. Decision making

Three important decisions are taken during the development of solutions: choosing first potential options (step 6), selecting most favorable solutions (step 8) and selecting the final proposal (step 10). In all these three moments the tradeoff matrix is used as a decision making tool. The outcomes of these decisions influence the path of development of the solutions and the final proposal.

From the interviews conducted, all three tender managers, seven stakeholder managers, and five project leaders/coordinators admitted that stakeholders' interests are not included as a criterion in the trade off matrix (Interview list - Appendix 1). The same conclusion was also draw from analyzing trade of matrixes from previous projects (Interview list – Appendix 1).

The criteria used in trade off matrixes are cost and time drivers, aspect (design and execution), risks, and other EMAT criteria (if there are). These criteria are in line with the award criteria mentioned in the tender documents. The award criteria does not include explicitly satisfy stakeholders' interests. The projects are either awarded on the lowest prices or on the economically most advantageous tender. The latter includes a quality criterion which covers several aspects such as functionality, risk, esthetics, sustainability, speed, nuisance prevention, delivery time etc. (Bruggeman et al., 2010). Therefore, the tender does not offer incentive to take stakeholders' interests into account since the proposals are not scored on how much the stakeholders interests will be fulfilled with the solution found.

Not including stakeholders as a criterion in the trade off matrix means that the tender team does not think from the perspective of stakeholders when taking decisions. Also, the influence of the decision on the stakeholders is ignored, and the influence of the stakeholders on the solution chosen.

This means not looking for win-win solutions for stakeholders. When asked about this, 7 out 15 experts agreed that tender team members try to find win-win solutions for the contractor and the contracting authority, rather than for the stakeholders. The other half of experts is divided into people who stated the tender teams are willing to find win-win solutions for stakeholders to a limited extent, but do not always do it and people who didn't have an opinion about this aspect.

To conclude:

- the tender does not offer incentive to take stakeholders interests into account when taking decisions
- tender team members do not think from the point of view of the stakeholders when taking decisions
- there is an overlooking how stakeholders interests could influence the project
- tender team members do not look for win-win solutions for stakeholders in the decision process

3.2.3. Tender teams' perception on stakeholders' interests

The previous sub-section showed that the stakeholders' interests are not a criterion when taking decisions. In this sub-section, a deeper look is taken into understanding the perception of the tender teams regarding the stakeholders' interests.

From the beginning of the tender process, the tender team starts working with the project requirements. The first action of the tender team is to read the project requirements and to understand them. Then they think of the first possible solutions to accomplish those requirements. While working on the tender, the project requirements are constantly checked.

The project requirements are based on the needs of the contracting authority and interests and needs from the external stakeholders. The requirements are formulated by the contracting authority, representing therefore its own perception on stakeholders' interests. The expert interviews revealed that because of this filter, the information provided does not encompass all relevant background information is missing. This background information is about the explanation why certain requirements are asked, what the story behind them is. The engineers agreed that this makes it harder for them to get the real meaning of the requirements and see stakeholders' interests behind the words written.

Another aspect revealed from the interviews is the inconsistency between the project requirements and the stakeholders' interests and needs. Based on their experience, three tender managers, three project leaders and four stakeholder managers mentioned this aspect. The requirements provided to the contractor are not aligned appropriately with the one from the stakeholders. The parties have different expectations which are not shared between them. The tender managers also stated that there are times when stakeholders would have hidden requirements which the contracting authority didn't accept them at the beginning. They will try to enlarge the scope of the project, by demanding more from the contractor in the execution phase. This issue is also known as "political influence" - e.g. not issuing a permit until issue is solved. The inconsistency between the project requirements and stakeholders interests and needs, leads to an incomplete overview about what stakeholders want.

It could be argued that, communicating openly and directly with the stakeholders, the contractor could have a clear view and understanding about stakeholders' interests and needs. However, the legal framework of tendering does not allow any interaction between the contractor who bids for the project and the external stakeholders of the project. Therefore, the only option is to rely on the information provided from the contracting authority and previous experiences of tender team members.

To conclude, there is a lack of awareness about stakeholders' interests which is reflected by the following facts:

- it is hard to get the real meaning of the requirements and see the stakeholders interests behind the words written
- they have an incomplete overview about stakeholders interests and needs

3.2.4. Improvements needed for better understanding stakeholders' interests

The previous sections provided an elaboration on the decision making process of tender teams and on their perception of stakeholders' interests. This section will try to identify if there are any relations between the findings from the previous two sections.

Olander (2006) proposed the following relationship model between stakeholders' needs and concerns of stakeholders, evaluation of alternative solutions, level of acceptance and stakeholder impacts analysis

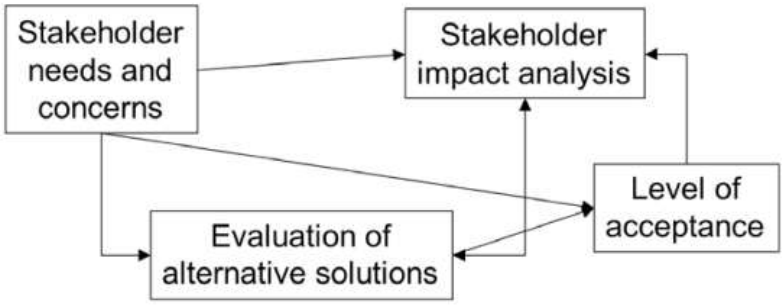

Figure 3 Relations between stakeholders' needs and concerns of stakeholders, evaluation of alternative solutions, level of acceptance and stakeholder impacts analysis

Olander (2006) argued that in the various projects studied, it became evident that "the needs and concerns of stakeholders and the choice of alternative solutions affect the level of acceptance that each stakeholder has about the project. Depending on how the needs and concerns are fulfilled, and on how they are addressed and acknowledged, each stakeholder will choose to accept or not accept project decisions. The acceptance level also determines to a large extent the position that each stakeholder (of being an opponent or a proponent) takes towards the project, and thus the impact each stakeholder imposes upon the project".

The relations identified by Olander (2006) are based on theoretical findings about the influence of external stakeholders in construction projects and on empirical study of existing transport infrastructure projects. Based on this, the relationship model is applicable in road infrastructure projects. Therefore, the findings from the previous two sections of this report can be related.

First the concepts are explained:

- stakeholders needs and concerns = stakeholders' interests and needs
- stakeholder impact analysis = analysis of how the stakeholders could influence the project
- evaluation of alternative solutions = thinking from the point of view of stakeholders and identifying win-win solutions

Then the relations are identified:

- Not thinking from the point of view of stakeholders and not looking for win-win solutions are resulted from the lack of awareness about stakeholders interests and needs and from overlooking how the decisions taken impact the stakeholders and vice versa (stakeholders impact analysis).
- Because there is a lack of awareness about stakeholders' interests, their influence on the project is overlooked

Identification of stakeholders, their power and interests, and the accommodation of their needs and interests is known as stakeholder analysis. The stakeholder manager is in charge of conducting the stakeholder analysis (Chinyio, Olomolaiye, 2009).

A stakeholder manager is appointed from the tender phase. The stakeholder manager is responsible of everything regarding the environment of the project (surroundings, stakeholders, risks, permits, traffic, cables, explosives, archeological findings etc.). The stakeholder analysis is conducted in the beginning of the tender because it helps identifying possible risks coming from various stakeholders. It also serves for finding out if there are any specific demands and regulations that cost money (for instance costs of permits, placing bypasses) (Interviews list – Appendix 1). Moreover, the stakeholder analysis contains also information about how the project impacts the stakeholders. Stakeholder analysis is updated throughout the tender process whenever new information is provided (Interviews list – Appendix 1). Involving a stakeholder manager and conducting stakeholder analysis prove that the tender teams acknowledge the existence of stakeholders, their interests and needs and impact.

However, the seven stakeholder managers interviewed agreed that the stakeholder analysis suffers of limitation. The stakeholder analysis might contain inaccuracy and/or important stakeholders and interests can be skipped. This comes from the impossibility to contact directly the stakeholders in the tender phase and from the ambiguity of project requirements, as described in section 3.2.3. Therefore they have to rely on their own interpretation of the project requirements.

To deal with this limitation, the stakeholder managers make use of his or others' experiences from previous projects in the area. Moreover, the contractor has the possibility to ask questions or clarifications to the contracting authority about certain requirements which are not clear or ask for additional information (www.constructiondb.com). The client then will reply to these queries but not only to the contractor who put forward the query, but to all the tenderers to avoid any competitive advantage. There is no defined moment when the contractor can make queries to the client. However, according to project leaders' and tender managers' opinions (Interview list - Appendix 1), the answers from the client might not always clarify the ambiguity. His answers to questions are often short and based on his own perception.

Despite the fact that the tender teams work on improving their awareness about stakeholders' interests and their influence by

- appointing a stakeholder manager
- conducting a stakeholders analysis where stakeholders interest, needs and impact are identified (to a limited extent)
- asking for clarifications from the contracting authority about stakeholders

the tender team members still find it difficult to understand the stakeholders' interests. Therefore these measures are not considered enough to solve the problem.

The tender managers and project leaders stated there is no drive for the engineers to take stakeholders into account. The drive comes from the award criteria of the tender. That is why the tender team will rather focus on technical innovation, money, time, quality etc. than on stakeholders' interests. Satisfying stakeholders' interests is not found among award criteria (Bruggeman et al., 2010). Therefore they do not consider important to think from the point of view of stakeholders or to find solutions for their needs. As a consequence, tender team members need to increase their willingness to think from the point of view of stakeholders and to find solutions for their needs, independently.

Therefore, the improvements needed for better understanding stakeholders' interests are:

- raise awareness about stakeholders' interests and stakeholders' influence on projects
- increase willingness to identify win-win solutions between contractor and stakeholders
- increase willingness to think from the point of view of stakeholders

Based on a relationship model of Olander (2006), the relations between these three improvements point is explained in figure 4:

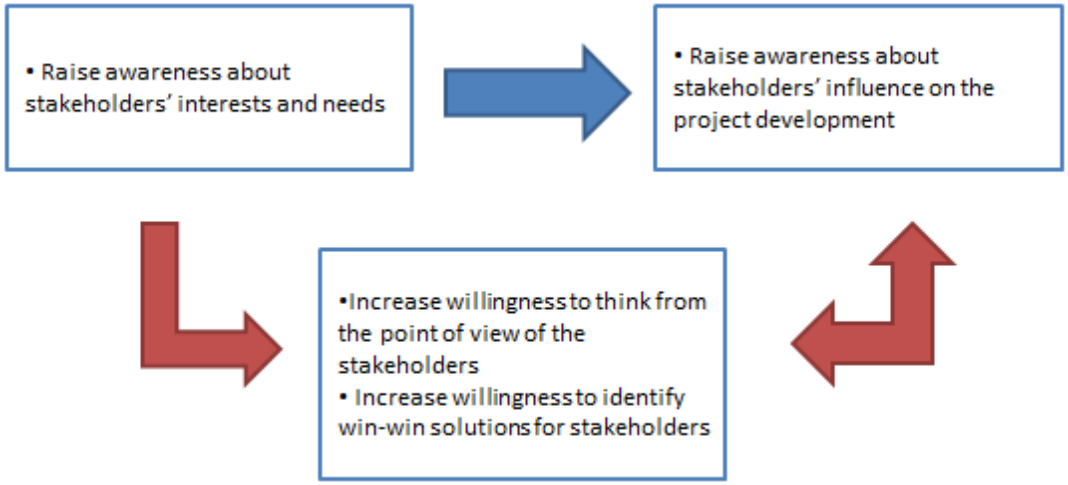

Figure 4 Relations between raising awareness about stakeholders' interests and influence, and increase willingness to think from the point of view of stakeholders and to identify win-win solutions for them

The four improvement points are all related to each other. Being aware of stakeholders' interests influences the awareness about stakeholders' influence on the project. Moreover, both of these influence the increase in willingness to think from the point of view of stakeholders and to identify win-win solutions.

3.3. Chapter conclusion

In order to find out the needed improvements for a better understanding of stakeholders' interests, 18 experts from VolkerInfra organization were interviewed. The experts were part of tender teams, either as tender managers, stakeholder managers or project leaders.

In their opinions, the requirements provided to the contractor are not aligned appropriately with the ones from the stakeholders. The parties have different expectations which are not shared between them. The inconsistency between the project requirements and stakeholders' interests leads to an incomplete overview about what stakeholders want. Although the stakeholder manager conducts a stakeholder analysis, it was concluded that this is not enough. The analysis might be incomplete because the input for it comes from the ambiguous requirements from the contracting authority, or from the previous experiences of the stakeholder manager. Therefore the contractor needs to increase its awareness about stakeholders' interests. The contractor should be aware that a requirement could mean something else for the stakeholders, or that the stakeholders' interests might be different than the ones of the contracting authority or their own.

Furthermore, from the interviews conducted, all three tender managers, seven stakeholder managers, and five project leaders/coordinators admitted that stakeholders' interests are not included as a criterion in the trade off matrix (Interview list - Appendix 1). The same conclusion was drawn from analyzing existing trade of matrixes (Interview list – Appendix 1). The criteria used in trade off matrixes are in line with the award criteria mentioned in the tender documents. These

criteria are cost and time drivers, aspect (design and execution), risks, and other EMAT criteria (if there are). The award criteria do not explicitly include the satisfaction of stakeholders' interests. Therefore, the criteria used does not offer incentive to take stakeholders' interests into account since the proposals are not scored on how much the stakeholders' interests will be fulfilled with the solution found.

Trades off matrixes are decision making tools. Since stakeholders or their interests are not part of the criteria used, there is no incentive to think from the point of view of stakeholders while taking decisions. The tender teams do not balance the fulfillment of stakeholders' interests from each alternative. This translates also in not looking for win-win solutions for stakeholders. When asked about win-win solutions, 7 out 15 experts agreed that tender team members try to find win-win solutions for the contractor and the contracting authority, rather than for the stakeholders. The other half of experts is divided into people who stated the tender teams are willing to find win-win solutions for stakeholders to a limited extent, but do not always do it and people who didn't have an opinion about this aspect.

In addition, the lacks of awareness about stakeholders' interests and not using stakeholders' interests as a criterion in the trade off matrixes lead to overlook how the stakeholders could influence the project development, if their interests are not fulfilled. Therefore the contractor needs to increase its awareness about the stakeholders' influence on projects – becoming more aware that stakeholders' have an impact on the project development, either positive or negative, depending on the solutions proposed.

In short, the contractor should improve the following in order to better understand stakeholders' interests:

- raise awareness about stakeholders' interests and stakeholders' influence on projects
- increase willingness to identify win-win solutions between contractor and stakeholders
- increase willingness to think from the point of view of stakeholders

Based on a relationship model of Olander (2006), the relations between these three improvements point is explained in figure 4: The four improvement points are all related to each other. Being aware of stakeholders' interests influences the awareness about stakeholders' influence on the project. Moreover, both of these influence the increase in willingness to think from the point of view of stakeholders and to identify win-win solutions.

Chapter 4
Serious Gaming

4. Serious Gaming

Chapter 4 continues on the concept of serious gaming by first providing the definition of serious games and describing the elements of a game. Then, it elaborates on the properties which make serious gaming a suitable activity for supporting the needed improvements.

This chapter answers the second sub-research question:

- RQ2: What properties make serious gaming suitable for supporting the needed improvements?

4.1. Defining serious games

The literature on serious games and related concepts is quite vast, but doesn't clarify the ambiguity which surrounds this topic. There is, among other things, not a single generally accepted definition of serious games. In this section the relevant concepts related to serious games are described.

4.1.1. Serious games

Before defining serious games, a definition of game is required. Many attempts have been made to define a game, but it is still hard to find a general definition (Salen & Zimmerman, 2004; Schell, 2008). For this thesis, the adopted definition is provided by Salen and Zimmerman (2004):

A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.

The first to introduce the concept of serious game was Clark C. Abt who used it as the title of his book "Serious Games" (1970). He also defined serious games as having an explicit and carefully thought-out educational purpose and which are not intended to be played primarily for amusement. This does not mean that serious games are not, or should not be, entertaining (Abt, 1970, p. 9). This definition, however, narrows down serious games to educational purposes only. There are serious games without a direct educational focus, but which are still considered serious games. For instance, art games or games used to manage pain during undergoing therapies (Breuer, Bente, 2010).

A bit broader definition is given by Michael Zyda (2005) who states: "Serious games have more than just story, art, and software, however. […] They involve pedagogy: activities that educate or instruct, thereby imparting knowledge or skill. This addition makes games serious" (Zyda 2005). Once again, pedagogy should be considered as a flexible concept in order to be able to define the heterogeneous field of serious games. This would mean that pedagogy would represent any form of change in a person, stimulated by external measures such as (educational) games (Breuer, Bente, 2010).

In his paper on the potential of using digital games for policy making, Ben Sawyer (2003) coined the term of "serious games" for digital games. The paper represents a call to the use of technology and knowledge from the entertainment video game industry to improve game-based simulations in public organizations (Djaouti et al., 2011). However, by referring only to video game industry, this type of serious games implies only the use of computer games. This characteristic limits the definition of serious games. Non-digital games can also be considered as having a serious purpose, e.g. Hexagon (Duke, 1974). Depending on the situation, analogue games could be more appropriate than digital ones. For instance, a non-digital game favors the interaction between players; therefore it might be suitable for exchanging ideas and different point of views (Barreteau et al., 2001).

The definition provided by Michael and Chen (2006) encompasses several serious purposes, including also the non-digital games: "[serious games are] games that do not have entertainment, enjoyment, or fun as their primary purpose, ranging from anywhere between advertisements to military training exercises" (Michael & Chen, 2006). The ambiguity of this definition lays in the fact that it is not specified if the serious purpose is formulated by the designer or the player. Susi et al. (2007) offer a complete definition by mentioning the two perspectives from which the purpose of the game can be seen: "[serious games are] games that engage the user, and contribute to the achievement of a defined purpose other than pure entertainment (whether or not the user is consciously aware of it). A game's purpose may be formulated by the user her/himself or by the game's designer, which means that also a commercial off-the-shelf (COTS) game, used for non-entertainment purposes, may be considered a serious game"(Susi et al., 2007).

For this thesis it is only relevant whether the designer has formulated a serious purpose, since the game will be used as a tool to support the incorporation of stakeholders' interests by the tender teams. This goal requires a structured approach and cannot be reached when only the player has formulated a serious purpose. Therefore this will be removed from the definition.

Having said all of these, for this thesis, the following definition formulated by van Os (2012) in her research will be used:

Serious games are games that contribute to the achievement of a defined purpose, formulated by the game's designer, other than pure entertainment (whether or not the user is consciously aware of it).

The definitions provided in the previous section are just a snapshot from the theory behind serious games. The literature about serious games is abundant and still characterized of ambiguity. The terms serious games, simulation, game, simulation game, gaming simulation and gaming/simulation are all used interchangeably, according to circumstances and opportunity (Meijer, 2009). Throughout this report, the term used is serious games.

4.1.2. Elements of a game

Games can offer a simplified version of the reality without losing credibility or the player's sincerity towards the game (Lankford et al., 2004). They start from a given situation, which is almost always the present situation (or at least resembles it) due to human players interacting during the session (Meadows, 2001). Players can be represented by the actual stakeholders of the real-world system or by other participants (students, professionals etc.) (Barreteau, 2003).Mayer's (2009) assumption is that the various actors will bring their own mental maps or belief systems to the game (Sabatier & Jenkins-Smith, 1993). These are based on their own core values, problem perceptions, and interests. The players will enrich their mental maps through interaction with the mental maps of others in the game (Mayer, 2009).

According to Gibbs (1974) and later on reinforced by Meijer (2009), the structure of a game can be defined by four elements: roles, objectives, rules and constraints. According to Klabbers (2006), a game consists of three interconnected building blocks: actors, rules and resources.

The roles in a game, as presented by Meijer (2009) are divided into roles for players and roles for game leaders and refer to their positions or functions in the game. The players of the game represent the actors (Klabbers, 2006) and they can take up multiples roles in a game. Roles can be abstract interpretation of the roles from the reference system, or they can be brand new roles which do not exist in reality. Each role has its own objective or actions to perform or a combination of both.

The objectives expressed in the game refer to what participants need to do. The objectives can take the form of points or money to be earned. Objectives can be individual or designed for a combination of roles. There is a difference between the objective in the game which refer exclusively to what participants are striving for and the objective of the game which refer to what game leaders are interested in obtaining as learning point from the game.

The rules in a game shape the behavior of the participants by defining what is allowed or forbidden (Meijer, 2009). In this way, the game play is constructed. Rules can be specific for a certain role or generic for all the players. Moreover, rules can match the behavioral limitations from the reference system or they can be designed as artificial constructs in order to modify the participants' behavior. Salen & Zimmmerman (2004) defined the following rule characteristics: rules limit player action, rules are explicit and unambiguous, rules are shared by all players, rules are fixed, binding and repeatable.

The resources are the symbolic meaning of the pieces in the game space, referring to reality (Klabbers, 2006). They can vary from one role to another, in content and/or quantity. For this reasons they represent constraints during the game.

The constraints are used to limit the range of actions in a game, by shaping the value of punishments, the minimum and maximum value of time, money and points (Meijer, 2009).

To conclude, a game is structured around four elements (roles, objectives, rules, constraints/resources). The players, through the roles they play, interact with the other players, while applying rules and utilizing resources for reaching an objective.

Serious games can have different purposes which can be divided into learning, research and policy (Mayer & Veeneman, 2002; Meijer, 2009). Figure 7 shows the most important applications (Hijmans, Van De Westelaken, Peters, Heldens, van Gils, 2011). It is very well possible that a game has multiple serious purposes. In the next subsection we zoom in on the first category, to see what we can learn from them.



Figure 5 Different serious purposes of games

4.2. Serious gaming as a tool for incorporating stakeholders' interests

The main objective of this section is to define if, theoretically, it is possible to use serious gaming as a tool for supporting the incorporation of stakeholders' interests by tender team members. The previous chapter introduced the need of developing a tool which would stimulate tender team members to incorporate stakeholders' interests in the decision making process. As a result of using this tool, the tender teams members will be get the drive to take stakeholders' interests into account in their projects. This section starts with presenting general characteristics of serious gamin which make them suitable as a supporting tool. Next, three different objectives of serious gaming are further explored. The three objectives refer to:

- OBJ1: raise awareness about the stakeholders' interests and influence on project
- OBJ2: increase willingness to identify win-win solutions for contractor and stakeholders
- OBJ3: increase willingness to think from the point of view of stakeholders

The three objectives resulted from the relationship model defined in chapter 3.

4.2.1. Gaming as a supportive tool

Games are used for a variety of serious purposes (Hijmans et al., 2011) and for a long time. There are various reasons why games are considered to be suitable for serious purposes, but three main aspects recognized as general reasons (Bekebrede, 2010).

Motivation

Games are motivational tools by stimulating people to take action (Prensky, 2001). The motivating factors behind games are challenge, curiosity, and fantasy (Malone, 1981), structure of games, the uses of levels and an increasing difficulty (Gee, 2003) and last, but not least fun (Prensky, 2001). For instance, competition was proved to be very motivating for the game "Levee Patroller" (Hart eveld, 2007). The competitive atmosphere of the game was created by the scores, players wanted to beat their own score or those of others. The participants, who were professionals, even wanted to take the game home just to get a 100% score (Harteveld, 2011).

A good game is often characterized by how motivating it is (Bekebrede, 2010). When players feel motivated to continue playing a game they are attracted to play it, to get involved in it and spend more time on their tasks (Garris, Ahlers, & Driskell, 2002). According to Bekebrede (2010), there are two types of increasing the motivation of players: internal motivation – caused by the activity itself and external motivation – caused by the reward of doing that activity. The internal motivation is stimulated by the immersion of the player into the game.

According to Jennett et al. (2008) immersion is the ability of a game to draw in the players, to allow them to "lose" themselves in the game. Immersion is considered to be critical to game enjoyment, immersion being the outcome of a good gaming experience. In her dissertation, Jennett (2008) argues that by being immersed in a game, participants invest time, effort and attention into the playing, feeling engaged to it. Moreover, a higher immersion is represented by an affective connection between the player and the game (role in the game), ending with a total immersion when the player is cut off from reality. Although immersion is more likely to be related to video games, an engagement level exists also for low tech games. The engagement of the players is in direct relation to his/her performance in the game, to the challenge level of the game and the novelty factor of the game (Jennett, 2008). By being engaged in the game the players will be more captivated by the role they play and the attached objectives.

Safe learning environment

One of the main characteristics of games is the safe environment in which the players can "test new strategies, tactics, ways of thinking and attitudes" (Geurts et al., 2000). The safe environment is supported due to the fact that games create an experiential learning environment (Duke, 1998; Mayer & Veeneman, 2002). The safe environment refers mainly to the fact that that participants' behavior and decisions during the game do not have direct (negative) effects for real life situations (Hijmans et al., 2011). Testing different approaches within a safe setting help learning how to perform in the future (Wenzler, 2008).

Jan-Willem Huisman (in Serious Games, Playful Business, 2012) sees the potential of safe environment and experiential learning as one of the important benefits of gaming: "Take a bank. All kinds of interests play a role in a bank, from turnover to client friendliness, from professional quality to basic decency. By putting these elements together in a game, players are forced to observe the mutual relationships between these interests and to come to the crux of the management challenge they are dealing with. Someone might be able to tell you how a process generally takes place but by playing the process you are confronted with it hands-on. Games facilitate deep experiences". It is not only the safety provided by the game which contributes to the learning, but also the experience itself.

Higher retention

It is expected that a good level of engagement will increase the rate of remembering the learning points from the game. By being actively involved in a game, the players are more conscious about their decisions and consequences, and they have higher retention of their experience (Bekebrede, 2010). The story, the dramatization, the simulations, the exercises and the personal involvement make the experience of a game more meaningful and difficult to forget (Garcia-Barrios, Speelman, Pimm, 2010).

Unlike traditional training techniques, employees retained more information from serious games based activities. In their research about the learning outcomes from serious games, Wouters et al. found out that in four out of five studies, serious games were more effective in training cognitive skills than traditional instructional methods.

Furthermore, another research shows that employees will usually retain only about 4 percent of what they have learned after about six weeks with traditional learning techniques. With serious games, however, participants retain 40 percent of what they have learned after six weeks – 10 times more knowledge (Kimball and Thiagaran, 2003). Another research (Sitzmann, 2011) found that trainees who used the game-based learning approach had 20% higher confidence that they had mastered the learning and could perform the tasks on the job.

In short, as Stuart Brown (2010) states, people learn more when they are having fun.

To conclude, games are motivating, games provide a safe learning environment in which to experiment, and games yield in higher retention.

- the motivation factor influences the involvement and performance of the players
- the safe learning environment provides the opportunity to experience strategies, tactics, ways of thinking an attitudes without real consequences
- the high retention of knowledge leads to greater chances to use the lessons learnt in real-world situations

In the next section, these aspects will be connected with the specific game objectives of this research.

4.2.2. Properties of serious gaming for supporting the understanding of stakeholders' interests

The main objective of this research is to investigate in which way serious gaming can support the improvement of contractor's understanding of stakeholders' interests during the tender process of road infrastructure projects. The improvement of understanding stakeholders' interests refers to awareness about stakeholders' interests and influence, willingness to identify win-win solutions for the contractor and stakeholders and willingness to think from the point of view of stakeholders.

Serious games are motivating, they offer a safe learning environment and yield in a higher retention. Thus it is expected that a serious game is an appropriate tool to stimulate tender team members to incorporate stakeholders' interests in their decisions.

Having said this, the objectives of a game which could support the incorporation of stakeholders interests should be:

- OBJ1: raise awareness about the stakeholders' interests and influence on project
- OBJ2: increase willingness to identify win-win solutions for contractor and stakeholders
- OBJ3: increase willingness to think from the point of view of stakeholders

In this section, further properties of serious gaming for supporting those three objectives will be investigated.

OBJ1: Raising awareness about the stakeholders interests and influence

By taking part in a serious game, going through the rounds, roles and following the objectives in the game, participants can learn about their individual and collective roles and behaviors in the system – in the game, but also in the real-world (Mayer et al., 2010). This is explained by Sabatier and Jenkins-Smith (1993) who said that the players bring their own mindset and belief systems to the game. The interaction arisen from the game, gives them the opportunity to see other perspectives, values and beliefs, thus enlarging their individual point of view perception (Mayer, 2009). Burton (1989) also mentioned that gaming bring out the benefits of meaningful shared communication in reconciling differences in understandings and serve as a discussion support tool, revealing new ways of interaction (Barreteau et al., 2001).

Although Mayer, Burton and Barreteau refer to games which are played with the stakeholders themselves, the characteristics identified are still valid even if the stakeholders are played by other persons. Taking into account the legal context of tendering which implies no contact between the contractors and the stakeholders of the bidding project, the predefined roles of stakeholders from the game will be played by the contractor tender team members. Although the tender team members will not interact directly with the real stakeholders in the game, they will have the opportunity to challenge their engineering way of thinking to react in accordance to the objectives and resources given by the stakeholder role from the game. Reflecting on their own behavior in the game, participants will realize how their and other participants' decisions taken in the game affect the outcome of the game. The reflection on the experience is a characteristic of the experiential learning (Kolb, 1984; Patrick, 2011) supported by games.

In order to bring awareness about stakeholders a game should be buildup of multiple roles of stakeholders, and should correctly represent their interests and powers from the reference system. The actions and objectives of the players, rules and constraints of the game should be designed in

such a way to reflect the influence and interests of the stakeholders in the system, specifically for this thesis, road infrastructure projects. The interests could be represented by the individual objectives in the game or inserted in the role description. The influence of the stakeholders could be represented by giving certain powers to different roles. Playing the game should generate "intersubjective" information on the system and the role of the stakeholders within it: the perceptions and opinions of the actors arising from discussions, observations or questionnaires, etc. (Mayer et al., 2010). In this way, the players would discover by themselves the interests of their own role and of the others'.

OBJ2: Increase willingness to identify win-win solutions for contractor and stakeholders

The literature on serious gaming presents evidence of the use of games for the identification of win-win solutions. Hangman and Chuma (2002) argue that games enhance the experimentation process through exposure to options. Furthermore, Ubbels and Verhallen (2000) agree that serious gaming contribute to disclosure of management alternatives and potential win-win scenarios.

For instance, SprintCity lets the participants to experiment various scenarios and by this they learn to develop and validate alternative strategies and potential action options (Mayer et al., 2010). Also, the visual aids used in a game offer a straightforward description of the proposed ideas, providing thus visual, material and cognitive structure to the discussions between the participants (Morardet et al., 2012).

Games provide a safe learning environment in which the players can "test new strategies, tactics, ways of thinking and attitudes" (Geurts et al., 2000). Even though a game designed for the tender team will not benefit of the presence of real stakeholders, through role playing, the players will experience the trade-offs between cost/time/quality/stakeholders' interests without the fear of real consequences. By letting players to experience themselves which choices lead to a certain results, the players make their own conclusions (Copier, Koster, Pavloff, Uden, Vlaar, Wenzler, Zuurmond, 2012). The objective of identifying win-win solutions should not be explicit to the participants. Based on the game outcomes, the players should be able to see what happened in case win-win solutions are identified or not.

Identification of win-win solutions can be supported through communication with the other players and through negotiations. The interests of each player should be different, so that discussions and negotiations can arise. Furthermore, the possible solutions can be either provided in the game or developed by the participants during the game.

The Urban Planning game (Cordaid, 2014) organization is an example of game designed to support the joint identification and planning of improvement projects for slum development. In the game, the participants are stimulated to come up with different project ideas and to persuade the other players in supporting them. The participants can support or not the new project ideas with coordination, money, labor or materials. By using inspirational cards, the players are stimulated to find innovative solutions as well. For instance, the evaluation of the game session held in Guatemala, showed that the game served as a basis for constructive dialogue and the participants were determined to continue the discussions after the workshop to find joint solutions for slums of Guatemala (Van Walsum, Vargas on Cordaid website, 2013).

OBJ3: Increase willingness of thinking from the point of view of stakeholders

Willingness to think from the point of view of stakeholder means for the engineers to have the motivation to change their technical thinking in projects towards one oriented also to stakeholders. It has been said before that games are motivational tools by stimulating people to take action (Prensky, 2001). The motivating factors behind games are challenge, curiosity, and fantasy (Malone, 1981),

structure of games, the uses of levels and an increasing difficulty (Gee, 2003) and last, but not least fun (Prensky, 2001).

The games can provide intrinsic motivation through immersion of the player into the game. Being immersed in a game, participants invest time, effort and attention into the playing, feeling engaged to it. By being engaged in the game the players will be more captivated by the role they play and the attached objectives. Furthermore, the level of involvement in the game, the story, the dramatization and the exercises (tasks, objectives) contribute to meaningful and a higher retention of the experience (Garcia-Barrios, Speelman, Pimm, 2010). This means, that an engineer playing the role of a stakeholder who feels engaged into the game, will be more connected to the role, will try to understand what he's going through and "fight" for achieving its objectives. Being part of a meaningful experience, he will remember it back in the real world situations.

Introducing the tender team members to a game which encompasses similar tender project requirements and similar roles of stakeholders as in real world, and which has an appropriate degree of engagement and motivation will help the participants to remember the experiences from the game, the actions and consequences, the roles, the interests and the influences of each of them and relate to these in real life situations. This will increase the chances that the tender team members will think from the point of view of stakeholders.

4.3. Chapter conclusion

The objectives of a game designated for better understanding stakeholders' interests are based on the improvement points identified from the interviews with the experts. Therefore the game objectives are:

- OBJ1: to raise awareness about the stakeholders' interests and their influence on projects
- OBJ2: to increase willingness to identify win-win solutions for contractor and stakeholders
- OBJ3: to increase willingness to think from the point of view of stakeholders

The properties which make serious gaming suitable for supporting these objectives are the following:

- Possibility to play the roles of stakeholders: Although the tender team members will not interact directly with the real stakeholders in the game, they will have the opportunity to challenge their engineering way of thinking to react in accordance to the objectives and resources given by the stakeholder role from the game. Reflecting on their own behavior in the game, participants will realize how their and other participants' decisions taken in the game affect the outcome of the game. This reflection on the impact of players' decisions leads to awareness about the stakeholders' influence on the project (from the game), but the role playing provides support for all the three objectives.

- A game contains tasks and objectives for players, rules and constraints. These can be designed in such a way to reflect the influence and interests of the stakeholders from road infrastructure projects. The interests can be represented by the individual objectives in the game or inserted in the role descriptions. The influence of the stakeholders can be represented by giving certain powers in the game to different roles. Playing the game should generate "intersubjective" information on the system and the role of the stakeholders within it: the perceptions and opinions of the actors arising from discussions, observations or questionnaires, etc. (Mayer et al., 2010). In this way, the players would discover by

themselves what the interests of their own role and of the others' are, supporting the objective of raising awareness about stakeholders' interests.

- Games provide a safe learning environment in which the players can "test new strategies, tactics, ways of thinking and attitudes" (Geurts et al., 2000). The players will experience the trade-offs between cost/time/quality/stakeholders' interests without the fear of real consequences. In this safe environment, the players can experience the identification of win-win solutions.

- A game can have multiple outcomes which may not be revealed from the start to the players. By letting players to experience themselves which choices lead to a certain result, the players make their own conclusions (Copier, Koster, Pavloff, Uden, Vlaar, Wenzler, Zuurmond, 2012). For instance, the objective of identifying win-win solutions should not be explicitly stated to the participants. Based on the game outcomes and reflection, the players should be able to see what happens if win-win solutions were identified or not identified.

- Games can offer the opportunity for communication and negotiations between players. By this, win-win solutions can be identified. If the interests of each player are different, discussions and negotiations can arise. Furthermore, the possible solutions or outcomes of the negotiations can be already part of the game or developed by the participants during the game.

- Games are motivating activities. The motivating factors behind games are challenge, curiosity, and fantasy (Malone, 1981), structure of games, the uses of levels and an increasing difficulty (Gee, 2003) and last, but not least fun (Prensky, 2001). By being motivated, the players keep on playing and they enjoy the experience. This property offers support for all the three objectives.

- Games can provide intrinsic motivation through immersion of the player into the game. Being immersed in a game, participants invest time, effort and attention into the playing, feeling engaged to it. By being engaged in the game the players will be more captivated by the role they play and the attached objectives. The level of involvement in the game, the story, the dramatization and the exercises (tasks, objectives) contribute to a meaningful and a higher retention of the experience (Garcia-Barrios, Speelman, Pimm, 2010). This means, that an engineer playing the role of a stakeholder who feels engaged into the game, will be more connected to the role, will try to understand what he's going through and "fight" for achieving his objectives. Being part of a meaningful experience, he will remember it back in the real world situations. Remembering the game experience will give the opportunity to the engineer to think back and remember what the stakeholder "was thinking", what were his interests, how did he "feel" when his interests were not fulfilled. By doing this, the engineer will be able to think from the point of view of stakeholders when working on tenders.

Chapter 5
Someone else's shoes game

5. "Someone else's shoes" game

In order to measure if a game designed according to the rules extracted from the theory supports the improvement points about understanding stakeholders' interests, an experiment of learning from playing a serious game was developed. For this, a new serious game was developed. The objective of this chapter is to describe the development process of a serious game *Someone else's shoes* by discussing the design decisions taken, together with their arguments, and presenting the game resulted.

5.1. Methodology

Duke and Geurts (2004) developed a design sequence composed of five phases for the development and implementation of (policy) games, within the field of strategic management. Since this methodology implies that real stakeholders contribute to the design of the game and it is focused on policy problems in an organization, an adapted version is proposed for this thesis as presented in Appendix 7b and elaborated in the following sections. The complete description of the original methodology can be found also in Appendix 7a.

The design process "combines logic and serendipity; creating the stimulated environment is an artistic challenge" (Duke & Geurts, 2004). Although the steps are formulated as sequential, in practice the designer may adopt a simultaneous solution, adapting the order of progression (Duke & Geurts, 2004). In the case of this thesis, the first two phase were done simultaneously while conducting the literature study of the research.

5.2. Setting the stage for the project

The objectives of the first phase are to identify the problem which prompts the need of a game, to decide whether a game is a suitable tool or not, to define the purpose of the game (including the constraints) and the expected end-result. These steps were followed throughout the work on the first chapters of the present report. Therefore, the identified problem is stated in the introduction. The theoretical argumentation for using serious gaming as a solving tool for the identified problem is presented in Chapter 4, together with the defined purposes of the game. Furthermore, other practical specifications are meant to be established in this stage. The timeline of the project was decided to be in accordance with the master thesis requirements and the budget of the game was zero.

Justification of a new serious game

The justification that still needs to be done is about the decision to develop a new serious game instead of using an existing one. The reason behind this choice was the impossibility to find a game fitted for the purposes of this research. The main criteria when searching for games were: to include role playing with/of stakeholders (thus, to be a multi-player game), from construction industry, to be analogue and to be about road infrastructure projects. The games found satisfied partially these requirements. For instance, Urban Planning game is a board game, with 2 players, each of them representing different stakeholders. However, the focus of the game is on slum development and it has as purposes only the joint identification of win-win scenarios and planning. Other analogue games with stakeholders roles were found, but they were meant for industries like natural resources management. It was important to find a game within road infrastructure industry in order to provide a realistic simulation of the reference system. Since this was not possible to accomplish, it was decided to build a new game which would fulfill the requirements from the problem analysis, from the characteristics of tender process and from games supporting the rai se of awareness about the stakeholders interests and influence, about the identification of win-win solutions between contractor and stakeholders and for supporting the thinking from the point of view of stakeholders.

5.1.1. The beginning

The idea of this game arose as part of a master thesis project commissioned at VolkerInfra organization, which in this case is considered to be the client. VolkerInfra is a multidisciplinary infrastructure organization which takes part in several and various tender projects within the context of road infrastructure. The client's objective is to increase its tender win rate and differentiate itself from the competition. After a thorough analysis of the tender process it has been acknowledged the problem of the tender team: they fail to give enough consideration to stakeholders interests when developing solutions. For this reason, a serious game was proposed as tool to bring incentive for incorporating stakeholders' interests in the tender phase of projects.

The game was developed only by one person, the researcher of this thesis. Without any previous knowledge in gaming or game design, more input from experts was needed. Besides studying game design literature, professionals from the field of serious gaming were contacted and interviewed. People from T-Xchange (Research Center on serious games from TU Twente), from Policy, Organisation, Law & Gaming department from TU Delft and other game designers contributed with ideas and advices for the design of this game. Moreover, professional from the client's side were also involved in providing information, ideas and testing the game.

General requirements for the game

- game objective: to improve the understanding of stakeholder perspectives by the tender teams in road infrastructure projects
- number of players: 10 (in two teams)
- time for playing: 1.5h
- total time for game session: 3h (including briefing and debriefing)
- target audience: tender team members of transport infrastructure company
- number of facilitators: 2
- budget: 0 euro

5.1.2. Timeline

The development of the game started in June 2014, with the study of the theoretical context. During this time, information about the system was gathered, while learning also about game design theory. Several drafts of the prototype were created, but only in the month of August the run of tests began. There were two test sessions, and the participants were three employees of VolkerInfra, but not tender team members and two master students from TU Delft. The evaluation of both sessions was done through direct feedback from the players (feedback was done by team) – impressions about the game play, rules, suggestions for improvement. It was an iterative process, through trials and errors. Regular meetings were held with the direct supervisor from VolkerInfra in order to check if the ideas are satisfying the expectations. Also, for specific game design feedback and revisions, meetings with the committee supervisor from Policy, Organisation, Law & Gaming/TU Delft were held. The end of the prototype culminated with a big testing session, organized at TU Delft on 14th of October 2014, where 82 master students took part.

5.2. Clarifying the problem

In the second phase of the game design process, an analysis of the problem is conducted. The main goal is to create a cognitive map of the reference system. Defining the system requires a good understanding of its actors and elements, the relations between them and establishing the boundaries of the system. It is important to have a complete description of the reference system, because based on the outcomes of this phase, design choices are later on made. As a follow-up of this step is the creation of a graphic representation of the system. The system analysis has been done in Chapter 3 of this report, where the tender process is presented, briefly from the side of the

contracting authority and more in depth from the bidder (contractor). The stakeholders view on the tender process was out of the scope of this research. However, stakeholders interests, values, powers were identified based on the input from VolkerInfra employees and literature study.

5.3. Designing the game

The goal of the third phase is to create a blueprint or concept report for the game. That means translating the outcomes from the previous phase into a game. First of all it is important to reduce the number of elements identified in the reference system in order to be able to create a manageable, but still realistic game. The key characteristics of the reference system must be integrated into the game so that the validity is ensured. Morardet et al. (2012) argued that a trade-off between the game complexity and its playability need to be done. A complex game can provide a very realistic representation of real life situations, but it can also be more difficult to play. Therefore, while deciding what to select from the reference system, a high consideration should be given to the goal of the game. Once the gaming elements are chosen, their format and the game as a whole have to be defined. In gaming "language", elements refer to scenario, events, roles, decisions, format, rules, scoring, and steps of play, indicators, visuals and paraphernalia. During this step, it is important to think what is possible to do and what is appropriate for the given purpose. The choice for the format of the game is influence by several variables such as group size, goals and objectives, organizational context, time available to play, character of the participants and substantive content. All the decisions taken at this stage are incorporated in the concept report which will serve as documentation for the development of the game.

During the design of the game, the reference system of tendering had to be translated into game elements. It is important to incorporate the key characteristics of reality in order to create a realistic simulation of it. In the same time, the number of elements and their relationships from real world had to be reduced so that the game is playable. Therefore decisions had to be taken. This section presents the design of the game based on the information from the reference system and provides arguments for the decisions made.

5.3.1. Tender process

The first idea was to simulate entirely the tender process of infrastructure project, in a simplistic way. After some game drafts, it was decided that it would take too much time to play a game like this. Also, the complexity would have been high and the playability of the game would have suffered. Therefore, the next idea was to simulate just one part of the tender process. In reality the part intended to be represented in the game, would fit somewhere between developing the first ideas and final selection of design proposal. So, the moment when tender team is working on the possible solutions, but still hasn't decided which one to select for the final proposal. The ideal situation in this phase of the tender would be that contractor could interact with the stakeholders in order to grasp their ideas, interests and opinions. Therefore, the decision to simulate this ideal situation was appropriate. The final idea was to create a game environment where the contractor sits at the same table with the stakeholders and have to collaborate. The game itself would be a competition for the best tender proposal, designed by the contractor and stakeholders.

The main storyline of the game became: In an imaginary country, a contracting authority offers for tender the refurbishment of a national road. The contractors bidding for this project have to come up with a proposal to improve the road with as little money and time possible, and taking into account stakeholders' interests. The proposal is developed together with the stakeholders of the project.

5.3.2. Roles

As described in section 3.2.1, road infrastructure projects are characterized by a variety of actors. However, for this game, the number of actors represented as roles should be reduced and the decision was to keep it at five. Five roles represent a good number of players for a board game. With less than five players the interaction between the players is reduced, and with more than five, it can become chaotic. One of the roles was definitely the contractor. Then four stakeholders needed to be chosen. The decision which stakeholders should be played in the game was based on a general stakeholder analysis. The factors which influence the decision were the power and resources of the stakeholders. Therefore, the list of stakeholders played in the game was cut down to: regional government, local government, nearby residents, environmentalists and depending on the story in the game railroad company/land owners/farm owners/ business owners. Furthermore, the contracting authority (RWS), although it has a major role in real tenders, for the simplicity of the game, it was decided to make it a contextual player, meaning that it wouldn't be played by anyone, but it would be present in the game scenario. For the story of the game, the roles chose were: contractor, local government, nearby residents, railroad company, and environmentalists.

5.3.3. Dilemmas

In order to stimulate discussion and interaction between the players, several dilemmas were needed to be exemplified in the game. After researching on typical dilemmas between contractor and stakeholders, was decided to incorporate dilemmas regarding objects of a road project which could raise conflicts in interests. For suitable play duration, four dilemmas were incorporated. In the game, these dilemmas represent also the rounds of the game. The difference of interests, opinions, expectations regarding the dilemmas was not explicitly given to the players; in the game each player receives a role description where his/her background story in the game is presented together with the individual objective. Moreover, in order to properly simulate the information asymmetry characteristic to tender process, the information provided to players was different and some of them had more or less. Through discussions, the players are stimulated to find each other's interests and then challenged to find a common solution.

The dilemmas incorporated in the game are inspired from a real road project and are about the renewal of the paving, refurbishment of the existing crossings, reduction of noise on the motorway and safe crossing for slow traffic. It was important to include dilemmas in which all of the stakeholders will have an interest. However, for each of the dilemmas, there was only one or maximum two stakeholders with the highest interests. For instance, in choosing the safe crossing for slow traffic the most interested would be the nearby residents and the local authority.

5.3.4. Requirements

Since any project has its own requirements, it was clearly that a list of requirements had to be incorporated into the game. These are represented by the objective in the game which refers to the realization of the best proposal by taking into account the time, cost and stakeholder interests. The requirements of time and stakeholders' interests came from the fact that more and more projects are awarded not only on the price criterion, but also on quality aspects. Moreover, the quality criterion had to be further elaborate with more specific requirements, for each dilemma. During the design of the game, there was a discussion to incorporate also the EMVI award mechanism, since in reality, project with quality criterion are awarded based on it. However, after a research on the mechanism and discussion with professionals from VolkerInfra, it was concluded that the method might be too complex and confusing for a game. Also, the focus of players would switch from interaction and discussion, to understanding the gamified version of EMVI mechanism. Therefore, it was decided to not include it in the game.

The quality criterion was represented by the next five specifications. All of these specifications come from the real project used as inspiration case.

- distance between rail tracks and construction site
- level of noise and air pollution during the execution
- incorporation of slow traffic lines
- green surfaces affected
- overall quality of the alternative

For each of these specifications, the stakeholders had different levels of interests. Also, for each alternative proposed for solving each dilemma, the specifications were rated with stars, signifying how well the alternative is fulfilling the respective specification.

5.3.5. Decision making process in the game

In real tenders, the team decides the solutions/ideas to work further, based on a trade-off matrix. First, the possibility to integrate trade-off matrix as decision making tool for the players came up. However, this method requires extensive information, which was not possible to provide in a game environment. Moreover, imposing a certain way to make decisions could influence the fun of the game. Players could feel constrained that they have to follow a specific method, and this could affect the level of communication between them. The more freedom the participants have, the more decisions are taken by discussion. Thus, the decision was not to incorporate the trade-off matrix, and leave the players freely discuss how they want to choose their solutions.

5.3.6. Performance indicators

The performance of the players will be analyzed based on the money they spent on the solutions, time allocated, and the extent to which the stakeholders are satisfied.

- money: represents the cost of each alternative
  - fictional currency is used
  - each alternative, for each dilemma has different costs
  - for each dilemma there is the cheapest, the most expensive and the moderate alternative
  - the sum of all the four alternatives chosen at the end of the game represent the final cost of the project

- time: represents the duration of the execution of each alternative
  - fictional time unit is used
  - each alternative, for each dilemma has different duration
  - for each dilemma there is the fastest, the longest and the moderate alternative
  - the sum of all the four alternatives chosen at the end of the game represent the final duration of the project

- stakeholders satisfaction: represents how satisfied are the stakeholders with the final project
  - each player has a different color of tokens (contractor 50 red tokens, local authority 18 orange tokens, nearby residents 12 yellow tokens, rail road company 14 black tokens, environmentalists 6 green tokens)
  - the different number tokens represent the different power of the actor from reality
  - at the end of the game, the stakeholders should have exchanged all of their tokens with the same number of tokens from the contractor
  - for dilemma, the stakeholders have to vote their preferred alternative by putting down a number of tokens (how much they want)

- when there is an agreement between the stakeholders and the contractor, the tokens of the stakeholders are exchanged with red tokens from the contractor and vice versa
- the total number of red tokens obtained by one stakeholder from the contractor represent his/her level of satisfaction

5.3.7. Other design requirements

The game should incorporate role playing simulation

Role playing implies taking on the role of specific characters in contrived setting. In this way the participant is representing an experiencing some character type known in everyday life (Scarcella & Oxford, 1992). All of the games used as references for this research are based on role playing and its benefits turned to be beneficial also for the purpose of this thesis. Moreover, role playing is a team exercise and through the interaction arisen from the game, the participants have opportunity to see other perspectives, values and belief (Mayer, 2009). Role playing simulation is an important characteristic because it will give the opportunity to the tender team members to experience roles which are not the same with their day to day roles when working on projects. By this, the participants are challenged to adapt their own way of thinking to the role they are playing and to its objectives and resources available in the game, and take actions accordingly. Based on their role playing, the participants can assess after the game their own behavior and how it influenced the game outcomes.

The game should be developed with low technology

Although Sawyer (2003) coined the term of serious gaming for digital applications, for the purpose of this research a low tech game is recommended. A board/card game offers more personal interaction between the players, supporting thus discussions and exchanging of ideas and perspectives. This characteristic of analogue games will give the chance to the tender team members to interact with their colleagues in a different context than work, compare their own interpretation of the roles given with the ones of their colleagues, and to see the differences in perspectives. All of these will be enhanced by the multidisciplinary aspect of tender teams. Moreover, with the proper visual materials, an analogue game can offer a straightforward description of the debated subjects and a cognitive structure to the discussions between the participants (Morardet et al., 2012).

The game should be short

Due to the fact that the game is designed to be played by professional, attention should be given on the duration length of the game. Harteveld (2007) noticed that for the game "Levee Patroller" a big constraint was the time available for the game session because it was part of training curricula for professionals. Furthermore, for this research, the limited time for tender processes has to be taken into account. Therefore, duration of 3h is considered to be enough for reaching the objectives. The integration of the game within the working curricula is out of the scope of this research.

The game play should be followed by a debriefing session

A serious game implies automatically a follow up session right after end of the game play. Debriefing is an activity for the reflection on and the sharing of the game experience in order to turn it into learning, it is then when things really "gets serious" (Crookall, 2010). During these group discussions, the outcomes of the game are connected with the real situations and ideas applicable in the real world are formulated.

The game should be played in the beginning of the tender process

As Knowles (1973) said, a game is motivating if it is of immediate value. That means that a game is more valuable if the players can apply the learnt lessons in their day to day activities as soon as possible. Therefore, a game which has as purposes to raise awareness about the stakeholders

importance and the identification of win-win solutions, and to support the adoption the "stakeholder glasses" should be integrated at the start of tender processes in order to leave time to the tender team members to apply the experience from the game and the learning points throughout the work on the tender proposal.

5.4. "Someone else's shoes" game

During this phase, the prototype of the game is build, tested several times and then modified accordingly until the game is completely calibrated. However, depending on the primary purpose of the game and system characteristics, a game may be continuously subjected to modifications and never be entirely finished.

Part of the development is the specification of all relevant details of the game elements (role descriptions, stories, instructions and other paraphernalia) (Bekebrede, 2010). For this thesis, the story of the game and the roles were developed by analyzing documents from existing road infrastructure projects (tender guidelines, tender contracts, stakeholder analysis tables, project requirements) and input from professional was also obtained (opinions about the major dilemmas encountered in infrastructure projects, important stakeholders, relevant examples of infrastructure projects). In the end a case about the refurbishment of a highway was selected, but for the purpose of information privacy, the official project requirements and the stakeholders were redesigned.

After designing the game elements, the prototype had to be built. This involved choosing a story inside the game, finishing the roles' descriptions, objectives, and resources, clarifying the actions and rules and design other paraphernalia needed. At the beginning, this process was a bit chaotic, but in the end the game prototype was created, resulting in "Someone else's shoes".

5.4.1. Game set-up

The participants form teams of five persons and roles are given to each other. Each team is placed at a table, around the game board. The game is compounded of a board, role description papers, tokens, rules file, and the scoring table. Appendix 8 shows a typical setting of "Someone else's shoes" and all the game materials used in a game session.

The roles in the game are divided into one contractor and four stakeholders:

- Contractor: you are one of the most successful construction companies in the country, with a lot of experience in road infrastructure projects, from the most complex ones to the simple and easy refurbishments projects.
- Local authority: you are the local authority. The local authority is appointed by political nomination (this could include the Mayor, Local Councilor etc).The local authority is responsible for the respective governing area
- The new district community: you are the representative of The New District Community (TNDC) Organisation. The TNDC Organisation serves the interests of the residents from the new district built in the eastern part of the road.
- Railroad company: you are representing the RailRoad company. You own the rail tracks which pass westerly to the highway and it I your main priority to keep the available for operations.
- Environmentalists: you are the representative of the NGOs responsible for protecting the environment, fauna and flora. You are responsible to make sure that environmental laws are respected in the respective area.

The story in the game can be summarized as follow:

- National motorway M12 is a 2-lane road north- south orientated on which a traffic safety problem has arisen and traffic flow could be improved.
- This situation occurs on the section crossing a dense municipality.
- There is also a nearby railway running partly adjacent and crosses a very heavily used municipal road for combined traffic (cyclists, pedestrians and motorized traffic).
- With the refurbishment of the M12 the traffic conditions will be improved, reducing thus the high rate of accidents.
- The refurbishment involves also the upgrading of the current infrastructure intersections, ensuring thus safety for all the type of traffic (cyclists, pedestrians and motorized traffic) and will provide a strong economic impetus to the region and enhance regional accessibility.

The objective in the game is to improve a motorway with as little money and time possible, and by taking into account stakeholders interests. The team with the best offer wins the game – lowest time and cost, and high stakeholder satisfaction.

The game commences with an introduction given by the game leader, who presents to the audience the purpose of the game session, explains the objectives, rules and tasks, and answers any questions from the participants. Before staring the actual play, time is allocated for studying the role descriptions and individual objectives. The game is structured in four rounds, each of them following the same steps. During each round, the players are faced with the challenge of finding the solution for a particular object of the motorway (round 1: renewal of the paving; round 2: refurbishment of the existing crossings; round 3: reduction of noise on the motorway; round 4: safe crossing for slow traffic). The possible solutions are presented in the form of alternative cards, each of them describing the cost, time and quality aspects of the solution. By discussing and negotiating with tokens, the players have to reach a decision and put down on the board the preferred alternative. At the end of round 4, the scoring table is finalized the total time, cost and tokens/person are calculated. The game session ends with a debriefing. In this part, the players share their experience, approaches and results. Based on this input, the game leader connects the gaming experience with reality.

Introduction: Game leader presents the objectives, rules and tasks – 25 minutes
Game play – 90 minutes
Round 1: Renewal of the paving – 23 minutes
Round 2: Refurbishment of the existing crossings – 22 minutes
Round 3: Reduction of noise on the motorway – 23 minutes
Round 4: Safe crossing for slow traffic – 22 minutes
Final score: filling in the team scoring table
Debriefing: Group discussion about the game experience, approach, collaboration, decision making and final outcomes. Lessons are drawn that can apply to the real world – 45 minutes

5.4.2. Rounds

Since the gameplay is the same throughout the all four rounds, this section describes the play in general. After the players get familiar with their role descriptions and objectives, the game starts.

In each round the contractor is responsible to initiate the discussion of each object. The alternatives for each round are on the board, faced down. During each round, they are showe d to all the players.

Each alternative card shows how much does that option cost, what is the duration of execution and how are the other specifications rated(*** = very good; ** = medium; * = very low). In most of the cases the contractor will look primarily at the cost, then time and after that at the quality

specifications, because his individual objective is to respect the cost and time constraints. On the other hand, the stakeholders have different objectives, and these are related to their own interests in the project.

Discussion

The start of the discussion is raised by the alternatives and the different interests of the players. The alternatives are discussed one by one, while the participants will try to find out each other's opinion and interests. There are no rules regarding the communication between participants, they are free to choose their own facilitator, to interrupt or respect each other, impose or hide their opinions. All of these will be analyzed in the debriefing part. There is time limit of 5 minutes for discussing the alternatives on the table. After this, each player is required to express his preference by putting down a number of tokens (the total number of tokens/person differs and this difference represents the power of the role).

Negotiation

Selecting the same alternative from the first will be something rare. Therefore, negotiations will take place. In this part of the round, the players are trying to convince each other about the best option. The persuasion should be done using arguments based on the individual's interests, but also on the team's objective to win the tender. However, the persuasion techniques are let at the player's choice.

Decision

Reaching an agreement will be represented by an exchange of tokens between the contractor and each stakeholder. This exchange will represent the idea that the contractor becomes responsible to execute the alternative chosen. Rules are given for finalizing the negotiation. These rules are made to challenge the player to decide if he/she puts above the individual gain over the team. In Appendix 9 the description of the rules is provided.

5.4.3. Results

After each round, the players have to fill in their individual score table. This table includes the number of tokens received from the contractor/stakeholders, time and cost of the chosen alternative. At the end of round 4, they are summed up. The game leader ranks the teams with the help of an excel form (Appendix 10). The results obtained by each team will show the lowest time score, the lowest cost score, the lowest time and cost of one team, plus different stakeholders' satisfaction levels, represented by the amount of tokens gained. The discussion during the debriefing will focus on what were each team's approaches during the game and how did they influence the final outcome.

5.4.4. Game validation

The technical evaluation step from this phase refers to the validation of the game. By validating the game, the designer checks the reliability of the game, the verisimilitude or the realism of the behavior of the game and the playability or usefulness (Bekebrede, 2010).

- reliability criteria is used in answering the question "is the game built properly and is it playable?". For this, verification of model construction, rules, materials for the players, the balance of tasks, and the speed of the game (Duke, 1974).
- verisimilitude criteria refers to the extent to which the game simulates the reference system (Peters et al., 1998)
- playability criteria measures the quality of gameplay

Reliability

The reliability validation is done through verifying the implementation of the elements and the relations in the game. It is more important for computer-based games for validating the computer model. Since the game didn't require high technology, the materials were easily verified and improved when necessary (board, cards, tokens). For the calculation of the final scores, each performance indicator score was ranked between the others and then for each team the ranks were added, giving the final score of rank for the team. The winning team was the one with the lowest score of ranks. This method ensured that the performance indicators are expressed in the same unit. Detail presentation of the method and the results can be found in Appendix 10b.

Other game requirements which need to be checked are:

- The game should incorporate role playing simulation: this requirements was accomplished, by creating a role playing game with four stakeholders roles and one contractor
- The game should be developed with low technology: the game developed was a paper-based game, at the level of a prototype
- The game should be short: the game duration is 3h, but from the participants' feedback it should be shorter
- The game play should be followed by a debriefing session: there were 45mins allocated for the debriefing session
- The game should be played in the beginning of the tender: since it was played in an academic context, it was not possible to check this requirement. However, the game was incorporated in the curricula of an assignment which simulated the tender process of a construction project. The game was played at the end of the first phase of the assignment. From the feedback received it was still too late. This will be elaborated in the result section.

Realism of the game

In order to check if the game is an accurate representation of the reference system two types of validation were done. First, the realism of the story (the infrastructure project) is validated and then the realism of the tender.

- Representation of a road infrastructure project

The story inside the game is inspired from a real infrastructure project. The actors and their background story and interests, project description, project requirements, dilemmas are kept the same, just simplified for an easy understanding and for fitting in a the game materials. Professionals were consulted for the creation of the game story and for the validation of the final choices. By this, the realism of the content was ensured. However, from the participants' feedback, the alternatives proposed in the game for the four project objects should be more detailed and better explained. Also the specifications mentioned on the cards were too brief and the star system didn't properly describe the difference between the alternatives.

- Representation of the real world system

The accurate simulation of the tender process can be determined by three criteria. The first one is that the game has to represent a multi-actor context, where the diversity and variety of interests can be observed. "Someone else's shoes" was developed as a multiplayer game, with five roles, and it is recommended to be played by at least ten people in order to have teams competing. Moreover, each role has its own interests and objectives, but there is also a common objective for all the players to challenge them to weigh the individual gains against the team's achievement. From the participants' feedback (17 persons out of 32 who expressed feedback), the game was a good and simple representation of a real life project, including the stakeholders and the decisions making.

Secondly, the game should simulate the information asymmetry that characterizes the tender process. This aspect has been accomplished by providing different and unequal information in the role descriptions and also different objectives for each role. The role of the contracting authority, although it was present only at a conceptual level, was designed as having all the information about the project and about the stakeholders and contractor. Furthermore, the contractor was given the project description, project requirements, and parts of the background story. No information about the stakeholders involved or their interests was provided. Moreover, the project requirements were not aligned with the needs of the stakeholders. The stakeholders received their own background story regarding the project, and what they want from it. They did not receive information about the other stakeholders and their connections with the contracting authority. Also the real intentions of the contracting authority with respect to certain requirements from the stakeholders were not given to them. By discussing and interacting the participants are be able to identify the differences in what they know about the project and what they want from it.

The next criterion refers to the players' behavior in the game. For a good representation of the real world, the game should offer the opportunity to act as in real life situations. By giving different amount of tokens, the players realized after the first round, that they have different power in the negotiations and act accordingly. This led to many situations when stakeholders with more tokens successfully managed to accomplish their interests. This is similar with reality, where the actors with higher power can better influence the decision making. However, to increase the simulation of this characteristic of reality, the role the client should actively be involved in the game. The communication and interaction between participants differ from group to group.

One big difference between the reality and the game is the stakeholders – contractor interaction which is not possible in real world. This situation is the main characteristic of tender processes which causes the difficulties in understanding stakeholders' perspective on projects. Changing this situation in real life is not under the power of the researcher. However, in games any situation can be represented. Thus, the game gives the opportunity to bring at the same table the contractor and stakeholders, during a tender phase, with the help of role playing. Although it is not a realistic situation, it is a desired ideal situation from reality. Reflecting on their own behavior in the game, participants will realize how their and other participants' decisions taken in the game affect the outcome of the game. The reflection on the experience is a characteristic of the experiential learning (Kolb, 1984; Patrick, 2011) supported by games.

Fulfilling the three criteria of representing the real world system, it can be concluded that the circumstances to simulate the context of tender processes in infrastructure are available in "Someone else's shoes" game.

Playability of the game

Game playability includes the validation of game materials and concept. This validation is based on the statistical results from the final game session and on the feedback and observations received from the participants.

Table 2 Descriptive Statistics for game quality

	N	Mean	Std. Deviation
The game was fun.	76	3,5	,91
The game was challenging.	76	2,6	,93
I liked the team objective in the game.	76	3,4	,89
I liked the individual objective in the game.	76	3,5	,85
The game materials were understandable and clearly written.	76	2,8	1,11
The tasks in the game were understandable and clearly formulated.	76	2,6	1,02
The tasks in the game were too easy.	76	3,3	,83
The tasks in the game were too difficult.	76	2,3	,73

With scores not very high, but still above an average of 3, the game can be characterized as fun, nice the team and individual objectives, but with tasks too easy. The participants were neutral towards the following: the challenging aspect of the game (m=2.6, s=.93), the game materials (m=2.8, s=1.11), the tasks (m=2.6).

However, due to the large standard deviations for two indicators –game materials (s=1.11) and understandable and clearly formulated tasks (s=1.02) - the means for these indicators are not an accurate representation of the data, meaning that the participants' opinions about these two aspects differed widely.

These quantitative results are backed up also by the feedback from the participants. Most of them considered the game as a fun activity, they enjoyed the concept, and find the game as being interactive and stimulating. Indeed, the rules were recommended to be improved, and the tasks a bit harder and complex.

The outcome of the game quality offers input for the improvements needed in the further development of the game:

- clearer rules and tasks
  - the rules needs to be revised and structured in a better way, in order to stimulate better the competition in the game
  - recheck what happens for every rule and task, what is the effect, if it is playable or not
  - simplify the way rules and tasks are expressed in the materials
- clearer instructions
  - prepare succinct instructions so that players understand what they have to do
  - include a short preview of one round

- more information about the dilemmas and alternatives presented in the game (the star system was a bit confusing)
    - the dilemmas should be presented on additional cards, so the players get a better understanding about what they have to decide upon.
    - the alternatives proposed should contain a short description of the alternative and what it implies.
    - the start system for the evaluation of each alternative could be replaced by letting the players to evaluate for themselves the alternatives. In this case, more knowledge about the alternatives is needed. This could work with professionals.
    - ensure a clear connection between the alternatives and the different interests coming from the stakeholders and contractor

- shorter rounds
    - the duration for playing each round could be reduced to 15 minutes;
    - however it has to be evaluated what happens if the alternatives contained more information and if the players have the possibility to develop their own alternatives. In this case it is expected that the current duration of playing per round (22 minutes) shouldn't be too much.

Nevertheless, the game was playable and the participants enjoyed taking part in it. Furthermore, the scope of this research was to develop a game prototype and prove that the concept works and can add value to the tender processes of road infrastructure projects. The feedback received from participants, researcher's and supervisors' observations and the quantitative analysis will contribute to further improvements to the game regarding the design, content, and mechanisms. Therefore, the game used for this research should not be seen as an end product, but at as a basis tool for investigating the contribution of serious games in the context of tendering for road projects.

5.5. Reflection on game design

The development of the serious game "Someone else's shoes" turned out as a very challenging and demanding process, especially when it is an individual project and the designer's knowledge about game design is limited. During this process, many ideas were tried out and decisions needed to be taken.

The main purposes of the game were decided to be about raising awareness about stakeholders' interests and influence, win-win solutions and thinking from the point of view of stakeholders. With these in mind, the best format for the game was analogue and including role plays simulations. These decisions were based on the idea that participants will experience the role of someone different than their role in real life and the low tech environment will give the opportunity to directly interact and communicate with the other participants. In the end, this type of game was considered a success, because it indeed led to teamwork, group discussions and interactive and stimulating activity. In order for players to take up the role they are playing, the game environment needs to provide intrinsic motivation to them. This motivation came from the story built in the game, for the background story created for each role, and from the interests and objectives given to each role. A lot of effort was put in creating all of these, and especially in making them realistic, but also easy to identify with. Due to this focus, the decision making process and negotiation inside the game were decided to be simplistic and game elements and mechanics were used. In reality, decisions between different alternatives are not taken by how many tokens you bet or how persuasive you are. Real decisions making tools are used, such as trade off matrix. However, a game needs to be enjoyable and fun, even serious games. The observation related to this aspect is that the game didn't contain the best rules on how decisions can be made and participants were partially distracted by this.

5.6. Conclusion

This chapter provided the insights into the development of "Someone else's shoes" game. This development consisted of five phases, based on the methodology of Duke and Geurts (2004). It resulted in a game prototype which has as objective the improvement of a motorway with as little money and time possible, while taking into account stakeholders' interests. The game is designed for groups of five people, each of them playing a certain role (stakeholder or contractor) and together they have to decide on the best solution for four dilemmas regarding the project.

Based on the validation of the prototype, the game is considered to be valid for the purposes it was build. Although, it is still in the development phase, the game provides the circumstances to simulate the context of tender processes in infrastructure, the players enjoyed playing it and taking part in the game.

Chapter 6

Evaluation, data analysis and results

6. Evaluation, data analysis and results

After introducing the game *Someone else's shoes* and describing how it was developed, the research goes forward with analyzing the quantitative and qualitative data obtained from the evaluation phase. Taking into account the objective of developing a prototype game and the short time dedicated for this master thesis, the game will be tested in a constructed environment, only with students from Technical University of Delft. The description of the constructed environment and the argumentation for the selected players can be found in section 2.4.

Based on this empirical analysis, the last sub research question can be answered:

- RQ3: What do students improve regarding their understanding of stakeholders' interests through serious gaming?

The answer to this question will be given by first describing the players, their background and pre-knowledge and attitude about stakeholders' interests. Then three hypotheses about the game outcome were developed and tested. Lastly, the factors which influence the learning outcome of the participants are analyzed.

6.1. Methodology

In order to evaluate the game, a game session was organized with students from TU Delft.
The objectives of the game developed were:

- to raise awareness about stakeholders interests and influence in a road infrastructure project
- to increase willingness in the identification of win-win solutions for contractor and stakeholders in a road infrastructure project
- to increase willingness to think from the point of view of stakeholders

The evaluation was structured according to this model:

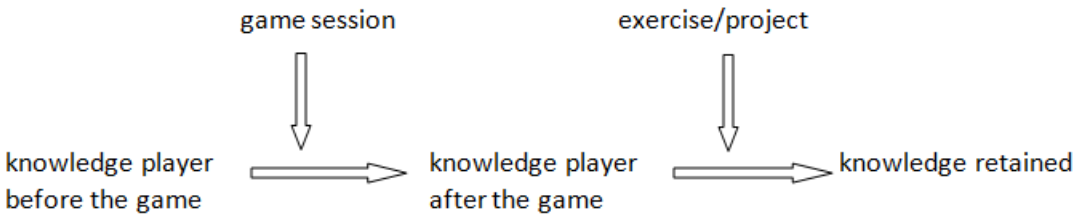

Figure 6 Model for evaluating player's learning

The evaluation contained the following steps:

1. Pre-game questionnaire
2. Play the game
3. Post-game questionnaire
4. Work on the project
5. One-week after questionnaire

The pre-game evaluation served for describing the participants – demographic information and their awareness about incorporating the stakeholders' interests in a road infrastructure project.

The post-game evaluation was meant to reflect the immediate outcomes of the game; what did the participants learn after playing the game. Also this evaluation helped to assess the game as a tool – elements like fun, engagement, tasks, objectives, motivation, and immersion were evaluated.

The one-week after game evaluation was designed to provide some insight into whether the participants retained the knowledge gained or not after playing the game. After playing the game, the students had to work on a project which required the incorporation of stakeholders' interests. Due to the time constraint it was decided to evaluate only after one week from the game session. For a long term evaluation of the game, the participants should be followed for a longer period. This was outside the scope of the research.

The data used in the empirical analysis was collected through questionnaires and reinforced with the observations of the facilitators. With the help of questionnaires, extensive quantitative information could be collected.

Three questionnaires were used: pre game, post-game and 1 week after game (Appendix 11). All three questionnaires contained different statements and the participants were asked to score them on a 5-point Likert scale from "strongly disagree" to "strongly agree".

- The first questionnaire contained demographic questions and statements related to the player's existing knowledge related to the objectives of the game.
- The post-game questionnaire focused on the quality of the game, player's experience and learning points. Moreover, there was also an open question for any comments about the game and the session.
- The purpose of the last questionnaire was to assess the application of the gained knowledge. The observations were gathered by the game leader, other two supervisors and facilitators of each group. Furthermore, the participants had the chance to express their personal feedback and observations on a big poster, given to each group, after the end of the game.

For the analysis of the data, SPPS was used as statistical software. The first part of the analysis was the statistical description of the variables. With this descriptive analysis, the answer to the question if and what did the participants learn could be given. In addition to the statistical results, qualitative data was also used, for strengthening or debating them. Qualitative data refers to observations (during the game and the debriefing) and theoretical background.

6.1.1. General data set

The game session took place on the 14th of October, 2014, where 82 students from TU Delft participated. The session was integrated as part of a Project Management: Technical Project course. The assignment that is central to this course is the development and partial execution of a plan for a multidisciplinary building project in which functional, technical, economic, legal and sustainability aspects are addressed and integrated. For this project, the students were divided in teams of six or seven persons, each team representing a different engineering company. The assignment and organizational aspect of the course were very similar with a real tender and with the multidisciplinary characteristic of tender teams.

The phase in which the game session was incorporated was dedicated to Sketch Design and it had as outcome the first design proposals for the building project.

The game was played in 13 groups of six or seven people, so that the groups formed for the project stayed the same. One person in the group didn't actually have a role in the game, but it was assigned the role of a facilitator. The groups with seven people had to play one role by two persons.

From 82 participants, 79 filled in the pre-questionnaire, 76 the post-game questionnaire and only 59 the questionnaire sent 1 week after the session. The differences in the response rates have multiple reasons. The pre and post questionnaire were handed in at the location of the game session and the participants had to fill it in directly. However, some of them either forget to hand it out or they left the location too soon. The 1 week after questionnaire was sent via internet and therefore the lower response rate. To increase this, three emails reminders were sent to the students.

6.1.2. Limitations

The limitation of the evaluation phase comes from the fact that it was not possible to evaluate the game effectiveness in a professional environment due to time constraint. Therefore it cannot be stated what would be the effects if introduced in a tender process. Also, no validated surveys were used. The results obtained are based only on the learning of students. However, since the scope of the research was to develop a game prototype, these results are an indicator of what the game could provide as learning points. Based on this evaluation and feedback received from the participants the game could be improved and new game sessions within the professional environments can be performed.

6.2. Introduction of the players

The average age was 21.0 years, with the youngest being 19.0 years old and the oldest 30 years old, and 86.1% were men. Most of the participants were students at the Faculty of Civil Engineering and Geosciences (41.8%), followed by the students from Faculty of Mechanical Engineering (17.7%). On the third place were the students from the Faculty of Technology, Policy and Management (12.7%). These three backgrounds could be also recognized in tender teams. The full representation of faculties can be seen in table 6-1. The multidisciplinary characteristic of the group shows that the participants were coming from different backgrounds, with different knowledge and way of thinking. This is similar to the tender team as well.

Table 3 Participants' field of study

	Frequency	Percent
CITG	33	41,8
Mechanical Eng	14	17,7
Industrial Design	3	3,8
TPM	10	12,7
Aerospace	9	11,4
Applied Earth Science	3	3,8
Business Administration	1	1,3
Maritime Engineering	2	2,5
Computer Science	1	1,3
Applied Physics	1	1,3
Architecture	2	2,5
Total	79	100,0

6.3. Pre-test results

The participants existing knowledge related to the topic and purposes of the game was divided in three parts: understanding of stakeholders' interests and influence, identification of win-win solutions and willingness to adopt a stakeholder perspective. The last two parts are referring to the players' attitude towards win-win solutions and the use of stakeholders' perspective.

Awareness of stakeholders' interests and influence

Three indicators were used to determine the participants' understanding of stakeholders' interests and influence in project. Based on their self-assessment (Table 6-2), the participants showed to be aware of the interests of stakeholders (μ=3.7; σ=0.85), their influence (μ=3.6; σ=0.77 and the interests of contractor (μ=3.6; σ=0.63).

Table 4 Descriptive Statistics for awareness of stakeholders' interests and influence

	N	Mean	Std. Deviation
1. I am aware of what kind of interests stakeholders.	79	3,7	,85
2. I am aware of the influence of stakeholders.	79	3,6	,77
3. I am aware of what kind of interests contractors could have.	79	3,6	,63

Identification of win-win situations

Table 6-3 shows that participants were already trying to find win-win solutions in the project they worked on, scoring μ=3.9, σ=0.88 at this indicator. However, taking into account the fact the players were students, their experience in working with real stakeholders and contractor is limited, or nonexistent. Therefore, their responses are most probably related to the assignments and the projects from university, where they were required or graded for good solutions for stakeholders.

Table 5 Descriptive Statistics for identification win-win solutions

	N	Mean	Std. Deviation
1. I try to find win-win solutions between contractors and stakeholders.	79	3,9	,88

Willingness to think from the point of view of stakeholders

The participants existing willingness to adopt a stakeholder perspective was assessed with three indicators. The scores from table 6-4 show that the participants did pay attention to the stakeholders interests (μ=3.7), and although with a lower score, but still above the average (μ=3.3), the students were thinking from the perspective of the stakeholders when working on projects. Moreover, they were also aware of the importance of adopting a stakeholder perspective, scoring 3,9 at this indicator.

Table 6 Descriptive Statistics for willingness to think from the point of view of stakeholders

	N	Mean	Std. Deviation
1. I pay attention to stakeholders interests.	79	3,7	,79
2. I think from the point of view of the stakeholders.	79	3,3	,92
3. I am aware of the importance of adopting a stakeholder perspective on projects.	79	3,9	,82

Conclusion

Based on this analysis, it can be concluded that the participants' knowledge related to the topic and purposes of the game was high, with all scores above the average of 3. One of the reasons behind these high scores is the fact that they already attended courses about stakeholder management where the theoretical aspects measured by the indicators from the questionnaire were alre ady delivered. Moreover, since the players were students, their practical experiences with real projects were limited. For this reason, their answers are mainly based on the theoretical knowledge they have acquired throughout the university years and also from the academic projects they were involved in. This means that students are instructed to pay attention to stakeholder, to find win-win solutions or to think from the stakeholder perspective.

The target group of the game is professionals from construction companies dealing with transport infrastructure projects who are part of tender teams. Although, it was not possible to obtain quantitative data about the professionals current understanding of stakeholders perspective in road projects, qualitative information was gathered from employees of VolkerInfra organization. The general idea is that tender team members pay attention to their own field of specialization, ignoring the stakeholders' interests, they look for win-win solutions, but in terms of money and time, putting stakeholders aspect on the last place or not taking into account at all. Tender team membe rs are not focused on thinking from the point of view of stakeholders while working on tenders. From the description of the target group and the participants from the evaluation sessions, it can be concluded that the initial knowledge of the players before playing the game is different. This influences the learning outcomes.

6.4. Post-game results

The post-game questionnaire included two parts of assessment: the game experience (including game quality, motivation during the gameplay, and identification with the role) and the knowledge and skills gained by the participants after playing the game. The latter part will help testing three hypotheses about the game:

- The game raises the awareness about stakeholders' interests and influence.
- The game increases the willingness to identify win-win solutions.
- The game increases the willingness of thinking from the point of view of stakeholders.

6.4.1. Game experience

The game experience was determined by three main aspects: how players perceived the quality of the game, how motivating was the game and how well did they identify with the role in the game.

A good game is often characterized by how motivating it is (Bekebrede, 2010). When players feel motivated to continue playing a game means that they are attracted to it, involved in it and spend more time on their tasks (Garris, Ahlers, & Driskell, 2002). According to Bekebrede (2010), there are two types of increasing the motivation of players: internal motivation – caused by the activity itself and external motivation – caused by the reward of doing that activity. The internal motivation is stimulated by the immersion of the player into the game. This immersion can happen through challenges, competition, and when the goals and activities are meaningful to the player.

Game quality

The game quality indicators were analyzed in the previous chapter. The conclusion was that improvements needed in the further development of the game:

- clearer rules and tasks
- clearer instructions
- more information about the alternatives presented in the game (the star system was a bit confusing)
- shorter rounds

Engagement

With scores not very high, but still above an average of 3 (table 6-5), the game can be characterized as fun, and according to the participants, the game wasn't challenging (μ=2.6). These results are reinforced by the feedback received from them, where some of them stated that "although they had fun, the game is missing more challenges as a team". Regarding the motivation expressed during the play of the game, participants had different views on how much the game hold their attention since the standard deviation is large (σ=1.02) and also about how much they wanted to win the game (σ=1.06). Both of these indicators have a large standard deviations comparing to the mean. With a result of μ=2.9, the participants didn't agree if the game hold or not their attention, and their opinions about the effort put into the game and the motivation while playing were neutral (μ=3.1). However, participants believed they performed well in the game and they really wanted to win the game (μ =3.5).

Overall, it can be concluded that the participants were neutral towards the engagement in the game.

Table 7 Descriptive statistics for engagement

		N	Mean	Std. Deviation
1.	The game was fun.	76	3,5	,91
2.	The game was challenging.	76	2,6	,93
3.	The game held my entire attention.	76	2,9	1,02
4.	I put a lot of effort into playing the game.	76	3,1	,85
5.	I felt very motivated while playing the game.	76	3,1	,84
6.	I believe I performed very well in the game.	76	3,5	,95
7.	I really wanted to win the game.	76	3,5	1,06

Role identification

The role identification was divided into five indicators, out of which for score above the average of 3 (table 6-6). The participants really put themselves into their character (μ=3.6) and they wanted their character to succeed (μ=3.8). Further on, the participants neither agreed or disagreed if they were able to understand the game from the perspective of their character (3.1) and they were neutral regarding their feeling of getting inside the character's mind (μ=3.2). The indicator with the lowest result (μ=2.9) represents the understanding the character's feeling at key moments (empathy from the participant's side). However, the standard deviation (σ=1.04) is high for the mean, indicating, that participants' responses varied significantly).

Table 8 Descriptive statistics for role identification

		N	Mean	Std. Deviation
1.	I really put myself into my character.	76	3,6	,90
2.	I was able to understand the alternatives in a manner similar to that in which my character might understood them.	76	3,1	,99
3.	I felt I could really get inside my character's head.	76	3,2	,82
4.	At key moments I felt I knew exactly what the character was going through.	76	2,9	1,04
5.	I wanted my character to succeed in achieving the goal.	76	3,8	,83

To conclude, the analysis of the game experience showed us that the game still needs some design improvements (in tasks, rules, challenges, and materials) and the players were neutral to how much they enjoyed it. With some differences in opinions, the game created in a competitive environment, making the players to want to win the game. Furthermore, the participants identified with the role they were playing by putting themselves into the character and in striving to achieve its goal. This means that the goals and activities in the game became meaningful to the players. Therefore, it can be said that the immersion in the game was partially.

6.4.2. Learning outcomes after playing Someone else's shoes

The game *Someone else's shoes* was developed with three clear purposes: to raise awareness about stakeholders importance, to support the identification of win-win solutions and to support the adoption of a stakeholder perspective. In order to asses if these three purposes were achieved, three hypotheses were developed:

- H1: The game raises awareness about stakeholders interests and influence
- H2: The game increases the willingness to identify of win-win solutions.
- H3: The game increases the willingness of thinking from the point of view of stakeholders

Each hypothesis is based on a number of indicators. The hypotheses can be rejected or not depending on the means of the indicators. If the mean is below 3, which is the average (neither agree nor disagree), the hypothesis will be rejected. If the mean is above 3, then the hypothesis cannot be rejected.

H1: The game raises awareness about stakeholders' interests and influence.

The awareness about stakeholders' interests and influence was based on three indicators. The results show that the participants agreed with all the statements in table 6-7. That means that after playing the game, the participants were more aware about what kind of interests stakeholders could have and about the influence they could have on the project. Lastly, they were more aware of what kind of interests contractors could have. In conclusion, H1 cannot be rejected.

Table 9 Descriptive statistics for post-game awareness about stakeholders' interests and influence

After playing the game…	N	Mean	Std. Deviation
1. I am more aware of what kind of interests stakeholders could have.	76	4,0	,34
2. I am more aware of the influence of stakeholders could have.	76	4,0	,34
3. I am more aware of what kind of interests contractors could have.	76	3,9	,30

H2: The game increases the willingness to identify win-win solutions.

With a score of 3.9 (σ=0.35), it can be said that the participants shared the same opinion about their increase in willingness to identify win-win solutions after playing the game. That means that again, H2 cannot be rejected.

Table 10 Descriptive statistics for post-game willingness to identify win-win solutions

After playing the game…	N	Mean	Std. Deviation
1. I will try more to find win-win solutions between contractors and stakeholders.	76	3,9	,35

H3: The game increases the willingness of thinking from the point of view of stakeholders.
Participants agreed that they are more aware now about the importance of changing their perspective towards stakeholders (μ=4.0; σ=0.36) and in future they will better think from the point of view of stakeholders (μ=3.84; σ=0.51) and they will pay more attention to stakeholders interests (μ=3.81; σ=0.55). In conclusion, H1 cannot be rejected.

Table 11 Descriptive statistics for post-game willingness of thinking from the point of view of stakeholders

	N	Mean	Std. Deviation
1. I will better think from the point of view of the stakeholders.	76	3,84	,51
2. I will pay more attention to stakeholders' interests.	76	3,81	,55
3. I am more aware of the importance of adopting a stakeholder perspective on projects.	76	4,0	,36

In conclusion, it can be said that, although the participants showed existing knowledge pertaining to the topic of the game, *Someone else's shoes* game successfully managed to increase their awareness about stakeholders' interests and influence, to support the identification of win-win solutions. Also the participants showed an increased willingness to think from the point of view of stakeholders in future projects and pay attention to their interests.

Furthermore, this outcome is reinforced by the feedback received from the participants. Some of the most concluding remarks and learning points were:

- "the game gave insight into the difficulties of keeping and staying with your principle" (Respondent Group 10)
- "it showed how difficult it is to get everyone on the same side" (Respondent Group 7)
- "the game showed the importance of prioritizing the stakeholders" (Respondent Group 1)
- "it also showed how different stakeholders can agree on some aspects and be opponents on others" (Respondent Group 6)

- "the game offered a good example for realizing the power of stakeholders" (Respondent Group 11)
- "it revealed the importance of the communication between contractor and stakeholders" (Respondent Group 10)
- "the game offered a good insight into the stakeholders needs and wishes" (Respondent Group 12)
- "I learnt about the complexity of negotiating with stakeholders" (Respondent Group 2)
- "I learnt that it is hard to keep everyone satisfied" (Respondent Group 13)
- "I learnt about the different situations in which a stakeholder can find himself in a project" (Respondent Group 13)
- "I learnt about the influence and relations between stakeholders and contractor" (Respondent Group 4)

6.5. Implementation outcomes

After the game session, the participants continued with their Project Management course. They had one week until the presentation of their first design proposals for the building project. A questionnaire was sent via internet to them, once the proposals were finished. This questionnaire was designed to provide some insight into whether the participants retained the knowledge gained or not or if there were any behavioral change after playing the game. All of these were assessed within the context of the course.

6.5.1. Use of knowledge

Awareness about stakeholders' interests and influence

While working on the first design proposals for the building project, the students were neutral towards their awareness about stakeholders' interests and influence, and contractor interests. However, the large standard deviations (σ=1.2; σ=1.1; σ=1.2) show that the responses varied from disagreement to agreement with these aspects. Although the game has increased their awareness about these three indicators, when coming back to reality and in the working environment, the students didn't show an application of the gained knowledge.

Table 12 Descriptive statistics for awareness about stakeholders' interests and influence during implementation

	N	Mean	Std. Deviation
1. I was aware of what kind of interests stakeholders while working on the different alternatives for the project.	59	3,0	1,2
2. I was aware of the influence of stakeholders while working on the different alternatives for the project.	59	2,9	1,1
3. I was aware of what kind of interests contractors could have in development of the different alternatives for the project.	59	3,2	1,2

Identification of win-win situations

With a score below the average of 3 (table 6-11), the participants were neutral about their identification of win-win solutions while working on the design proposals, although previously they agreed that they will better try to find win-win scenarios. This result might be influenced by the inexistence of actual stakeholders/contractors in the project (it was an academic activity) or other insufficiencies in students' capabilities of finding win-win solutions (lack of practical experiences). Moreover, the students were in the last part of the Sketch Design phase. In one week after the game, they had to deliver their proposals. Therefore, the designs were almost done when the game was played. This limited the possibilities to find win-win solutions. Nevertheless, the standard deviation is again large (σ=1.1), thus part of the students managed to find win-win cases, while others did not.

Table 13 Descriptive statistics for identification of win-win situations during implementation

	N	Mean	Std. Deviation
1. I found win-win solutions between contractors and stakeholders while working on the different alternatives for the project.	59	2,7	1,1

Thinking from the point of view of stakeholders

The results for the three indicators used for the thinking from the point of view of stakeholders show that the students were again neutral in their responses, however with large variations (σ=1.2; σ=1.1; σ=1.0). Therefore, some of the students agreed that they were aware about the importance of adopting stakeholders' perspective while working on the design proposal, and they also paid attention to stakeholders interests and adopt their point of views. On the other hand, there were also student who did not agree with these actions. These results are debatable since the students expressed a positive attitude towards these aspects, right after playing the game. Therefore, there is an inconsistency between the willingness of thinking from the point of view of stakeholders after the game and the actual application of this in real world.

Regarding the third hypothesis developed for the testing of the game, which stated that the game supports the adoption of stakeholders, the conclusion is that it cannot be rejected, because of the neutral responses. However, it is important to mention that the game it has indeed proved to increase the willingness of the participants to think from the point of view of stakeholders.

Table 14 Descriptive statistics for thinking from the point of view of stakeholders during implementation

	N	Mean	Std. Deviation
1. I paid attention to stakeholders interests while working on the different alternatives for the project.	59	3,0	1,2
2. I was thinking from the point of view of the stakeholders while working on the different alternatives for the project.	59	2,9	1,1
3. I was aware of the importance of adopting a stakeholder perspective while working on the different alternatives for the project.	59	3,0	1,0

The conclusion of the implementation evaluation is that not all the players managed to successfully apply the knowledge gained from playing the game, since the responses were spread out over a large range of value. The results presented in this section highlight the fact that the students were neutral towards their change of attitude with respect to the stakeholders' interests after playing the game.

6.6. Relations between variables

After concluding that the game reached its learning outcomes, it is interesting to see the relations between what the students learn, their existing knowledge, the game experience, and their behavior after playing the game. The first step was to perform a factor analysis to reduce the indicators used for describing several aspects. Then, based on this limited number of factors, a bivariate correlation analysis was executed, which revealed how large the relationships, if any, were between the variables.

6.6.1. Factor analysis

This section described the reduction of indicators for the four categories used in the evaluation: pre-knowledge of students, game experience, learning outcomes, and implementation.

Is it possible to extract a couple of factors which represent the game experience?

The game experience is described based on three components: game quality, engagement, role identification. From the 18 indicators used, the factor analysis gave six factors (Appendix 11a): liking of the objectives (F1), tasks (difficulty and understanding) (F2), fun and challenging (F3), attention, effort and motivation put during the game (F4), winning desire and performance during the game (F5) and role identification (F6).

The extraction of factors for pre-knowledge, learning outcomes and implementation was done by:

- firstly, the indicators from each questionnaire pre-knowledge, learning outcomes and implementation were split in three categories: awareness about stakeholders interests and influence, identification of win-win solutions and thinking from the point of view of stakeholders;
- secondly, the categories were checked to see if they could be extracted by one factor.

Is it possible to extract a couple of factors which represent the pre-test?
The pre-test of students was assessed with seven indicators, and after running a factor analysis, it resulted in three factors (Appendix 11b): pre_awareness about stakeholders' interests and influence (F7), pre_identification of win-win solutions (F8) and pre_thinking from the point of view of stakeholders (F9).

Is it possible to extract a couple of factors which represent the learning outcomes?
The seven indicators of the learning outcomes after playing the game can be represented by three factors (Appendix 11c): post_awareness about stakeholders' interests and influence (F10), post_identification of win-win solutions (F11) and post_ thinking from the point of view of stakeholders (F12).

Is it possible to extract a couple of factors which represent the implementation?
The implementation of the knowledge gained was assessed with seven indicators, and after running a factor analysis, it resulted in three factors (Appendix 11d): impl_awareness about stakeholders' interests and influence (F13), impl_identification of win-win solutions (F14) and impl_ thinking from the point of view of stakeholders (F15).

6.1.2. Correlations

Based on the correlation analyses conducted, the relations between the learning outcomes and the game experience proved to be significant. The relations between the factors of the same category (pre-test, game experience, learning outcomes and implementation) proved to be significant as well. In this section these correlations are further described and explained. The complete correlation tables for the other categories can be found in Appendix 9.

What is the size of correlation between the learning outcomes and the game experience?
From the correlation analysis (Table 0-38, Appendix 9A) it can be observed that the three learning outcomes factors are significantly correlated with some of the game experience factors.

Based on the book of Andy Field (2009), the correlations are defined as following: values of -/+.1 represents a small correlation, -/+.3 a moderate correlation and 0/+.5 a large correlation. This served for the interpretation of the identified correlations.

The participants' awareness about stakeholders interests and influence in a project was correlated with how much they liked the game objectives (corr.=.280, $p<.05$) (Table 0-38, Appendix 9A). The game objectives included the team objective and the individual objectives. It is interesting to mention that the individual objectives were designed in such a way to represent the stakeholders/contractor interests in the road project. Mayer et al. (2010) said that by taking part in a serious game, going through the rounds, roles and following the objectives in the game, participants can learn about their individual and collective roles and behaviors in the system – in the game, but also in the real-world. This correlation supports partially this idea, showing that the objectives, as an element of the game structure, contributed to the learning experience of players about the stakeholders' interests and influence.

Another significant correlation, but still moderate (corr.=.239, $p<.05$), was found between the participants' willingness to identify win-win solutions and the tasks in the game (Table 0-38, Appendix 9A). The tasks of game influence the actions taken by the players when playing. For this game, the tasks were: discuss the alternatives presented for every dilemma, negotiate, and decide on one solution. These three tasks let the participants to experiment, at a conceptual level, the different options possible for solving each dilemma. Therefore, the correlation shows that the tasks

chosen for this game were appropriate for the objective of increasing the willingness for identification of win-win solutions, and the learning outcome increases together with difficulty and understandability of the tasks. Based on the idea that visual aids provide a visual, material and cognitive structure to the discussion between the participants (Morardet, 2012), an expected correlation was to be found between the game materials and the identification on win-win solution. However no statistically correlation (corr.=.146, p=.20) was found between these two factors. The reason for this might be that the game materials were not sufficiently developed for supporting this objective.

The last correlations found was between the willingness thinking from the point of view of stakeholders and game objectives (corr. =.436, p=.000), fun and challenge factor (corr. =.246, p<.05), and role identification factor (corr. =.236, p<.05). The first correlation (Table 0-38, Appendix 9A) was above moderate and shows that the participants who liked more the game objectives were also more willing to think from the point of view of stakeholders in their future projects. Fun and challenge are two factors behind the motivating aspect of games. As Prensky (2001) said, games are motivational tools because they stimulate people to take action. Moreover, when participants have fun and are challenged in a game, the learning point is increased (Garris et al., 2002). The correlation (Table 0-38, Appendix 9A) highlights this idea. The players showed more willingness to think from the point of view of stakeholders, if they considered they had fun while playing and the game was challenging enough for them. Role identification factor was used to analyze how well the players managed to understand the role they played and if any affective connection was created between the player and its role. The last correlation (Table 0-38, Appendix 9A) identified expresses the idea that the learning outcome of thinking from the point of view of stakeholders is increased when participants showed a higher role identification (corr. =.236, p<.05). This is in accordance with Barrios' (2008) remark about the fact that the personal involvement of the players make the experience of a game more meaningful and difficult to forget.

What is the size of correlation between the game experience factors?

Four correlations were found between the factors which described the game experience (Table 0-42, Appendix 9E). The fun and challenge factor was small-moderate correlated (corr. =.71, p<.05) with the game objective factor. This means that either the objectives influence how fun or challenging the participants found the game, or the other way around. However, there was no correlation identified between the performance of the players and the challenge level of the game, although it was expected (Jennett, 2008). Furthermore, the moderate correlation (corr.=.296, p<.05) between the game objectives and the attention, effort and motivation put into playing, supports the idea that by being engaged in the game the players will be more attached to the objectives of the game (Jennett, 2008). Another moderate correlation was found between the tasks factor and the desire for winning and performance in the game (corr.=.361, p=.001). This shows if the tasks are too easy, the players are less interested in winning and their performance if low, while if the tasks are difficult, but still understandable, the players will express a stronger desire for competition and perform better. Last correlation between the factors of the game experience was the relation between the role identification and the level of attention, effort and motivation put into playing the game. Research shows that when people are engaged in the game, they spend more time, effort and attention into the playing (Jennett, 2008; (Garris, Ahlers, & Driskell, 2002). The identified correlation (corr.=.239, p<.05) supports this idea, and shows that people who connected with the role from the game, by understanding its objectives, interests, situation etc. were also more attentive, motivated and put more effort into the game.

What is the size of correlation between the pre-test factors?
The analysis between the factors of the pre-test (Table 0-43, Appendix 9F) revealed only one correlation which was between the participants' attitude towards thinking from the point of view of stakeholders and identification of win-win solutions (corr.=.245, p<.05). This correlation says that people, who tried to identify win-win solutions in their projects, were also thinking from the point of view of stakeholders while working. However, this correlation could be also the other way around. These results do not support the relationship model from chapter 3.

What is the size of correlation between the learning outcomes factors?
The factors describing the learning outcomes after playing the game are highly correlated, all of them (Table 0-44, Appendix 9G). This shows that if a player increased his/her awareness about stakeholders' interests and influence, he/she also increased the willingness to identify win-win solutions and he/she is more willing to think from the point of view of stakeholders. Nevertheless, the order of the correlation can be from any direction. Since, the direction cannot be established; the correlation identified is partially in accordance with the relationship model from chapter 3.

What is the size of correlation between the implementation factors?
The correlations for the implementation factors are also high, between all factors (Table 0-45, Appendix 9H). This situation is just like the one of the learning outcomes, the direction of the correlation can be from either way. Therefore, the correlation identified is partially in accordance with the relationship model from chapter 3.

6.7. Conclusion

In order to measure if a game designed according to the rules extracted from the theory supports the improvement points about understanding stakeholders' interests, an experiment of learning from playing a serious game was developed. For this, a new serious game was developed. The objective of this chapter was to analyze the quantitative and qualitative data obtained from the evaluation phase. This chapter answers the last sub-research question:

RQ3: What do students improve regarding their understanding of stakeholders' interests through serious gaming?

The general impression of the game session with the students is that players had fun, were enthusiastic to play and learn, and that *Someone else's shoes* was a successful learning tool.

After playing *Someone else's shoes*:

- OBJ1: The players' awareness about stakeholders' interests and their influence in projects was increased. The awareness about stakeholders' interests and their influence was based on five indicators. The results show that the participants agreed with all the statements in table 7-1. That means that after playing the game, the participants were more aware about stakeholders interests and their influence, about contractors interests and they could see the importance of adopting the stakeholder perspective.

Table 15 Descriptive statistics for post-game awareness about stakeholders' interests and influence in road infrastructure

After playing the game…	N	Mean	Std. Deviation
1. I am more aware of what kind of interests stakeholders could have.	76	4,0	,34
2. I am more aware of the influence of stakeholders could have.	76	4,0	,34
3. I am more aware of what kind of interests contractors could have.	76	3,9	,30

- OBJ2: The players were more willing to identify win-win solutions between contractor and stakeholders. With a score of 3.9 (σ=0.35), it can be said that the participants agreed about their increase in willingness to identify win-win solutions after playing the game.

Table 16 Descriptive statistics for post-game willingness to identify win-win solutions

After playing the game…	N	Mean	Std. Deviation
1. I will try more to find win-win solutions between contractors and stakeholders.	76	3,9	,35

- OBJ3: The players were more willing to think from the point of view of stakeholders in future projects. Participants agreed that they are more aware now about the importance of changing their perspective and in future they will better think from the point of view of stakeholders (μ=3.84; σ=0.51) and they will pay more attention to stakeholders interests (μ=3.81; σ=0.55).

Table 17 Descriptive statistics for post-game willingness to think from the point of view of stakeholders

After playing the game…	N	Mean	Std. Deviation
1. I will better think from the point of view of the stakeholders.	76	3,8	,51
2. I will pay more attention to stakeholders' interests.	76	3,8	,55
3. I am more aware of the importance of adopting a stakeholder perspective on projects.	76	4,0	,36

Therefore, the game reached its objectives.

To see if the learning outcome were applied in reality, an evaluation of the learning outcome was conducted one week after the game session. The conclusion is that not all the players managed to successfully apply the knowledge gained from playing the game, since the responses were spread out over a large range of value.

Chapter 7
Conclusions and recommedations

7. Conclusions and recommendations

In this chapter, conclusions are drawn and recommendations are provided based on the executed research. The main research question is:

- In which way can serious gaming improve the contractors' understanding of the stakeholders' interests during the tender phase of road infrastructure projects?

To answer the research question, three sub-research questions were developed. The answers to the defined sub-questions are divided into a theoretical exploration and an empirical exploration. This leads to the general conclusion. Following this, recommendations are stated.

7.1. Answering research questions

This section comprises the conclusions for the three sub-questions. First, two questions related to the theoretical exploration are answered. Then, in the second part, the next question of the empirical exploration is answered. The final conclusion is given at the end of the section.

RQ1: What do contractors need to improve to better understand stakeholders' interests during the tender phase of road infrastructure projects?

RQ2: What properties make serious gaming suitable for supporting the needed improvements?

RQ3: What do students improve regarding their understanding of stakeholders' interests through serious gaming?

7.1.1. Theoretical exploration

The first objective of the theoretical exploration was to analyze the current situation in tender phase of road infrastructure projects, from the perspective of the contractor regarding engineers' understanding of stakeholders' interests. This analysis contributes to the identification of the improvements needed regarding the contractors' understanding of stakeholders' interests. This first step will answer the first sub research question "What do contractors need to improve regarding their understanding of stakeholders' interests during the tender phase of road infrastructure projects?"

The second objective was to conduct a study on serious gaming literature to investigate the properties which make serious gaming suitable for supporting the needed improvements in the tender phase of projects. This will answer the sub research question "What properties make serious gaming suitable for supporting the needed improvements?".

<u>RQ1: What do contractors need to improve in order to better understand stakeholders' interests during the tender phase of road infrastructure projects?</u>

In order to find out the needed improvements for a better understanding of stakeholders' interests, 18 experts from VolkerInfra organization were interviewed. The experts were part of tender teams, either as tender managers, stakeholder managers or project leaders.

In their opinions, the requirements provided to the contractor are not aligned appropriately with the ones from the stakeholders. The parties have different expectations which are not shared between them. The inconsistency between the project requirements and stakeholders' interests leads to an incomplete overview about what stakeholders want. Although the stakeholder manager conducts a stakeholder analysis, it was concluded that this is not enough. The analysis might be incomplete because the input for it comes from the ambiguous requirements from the contracting authority, or

from the previous experiences of the stakeholder manager. Therefore the contractor needs to increase its awareness about stakeholders' interests. The contractor should be aware that a requirement could mean something else for the stakeholders, or that the stakeholders' interests might be different than the ones of the contracting authority or their own.

Furthermore, from the interviews conducted, all three tender managers, seven stakeholder managers, and five project leaders/coordinators admitted that stakeholders' interests are not included as a criterion in the trade off matrix (Interview list - Appendix 1). The same conclusion was drawn from analyzing existing trade of matrixes (Interview list – Appendix 1). The criteria used in trade off matrixes are in line with the award criteria mentioned in the tender documents. These criteria are cost and time drivers, aspect (design and execution), risks, and other EMAT criteria (if there are). The award criteria do not explicitly include the satisfaction of stakeholders' interests. Therefore, the criteria used does not offer incentive to take stakeholders' interests into account since the proposals are not scored on how much the stakeholders' interests will be fulfilled with the solution found.

Trades off matrixes are decision making tools. Since stakeholders or their interests are not part of the criteria used, there is no incentive to think from the point of view of stakeholders while taking decisions. The tender teams do not balance the fulfillment of stakeholders' interests from each alternative. This translates also in not looking for win-win solutions for stakeholders. When asked about win-win solutions, 7 out 15 experts agreed that tender team members try to find win-win solutions for the contractor and the contracting authority, rather than for the stakeholders. The other half of experts is divided into people who stated the tender teams are willing to find win-win solutions for stakeholders to a limited extent, but do not always do it and people who didn't have an opinion about this aspect.

In addition, the lacks of awareness about stakeholders' interests and not using stakeholders' interests as a criterion in the trade off matrixes lead to overlook how the stakeholders could influence the project development, if their interests are not fulfilled. Therefore the contractor needs to increase its awareness about the stakeholders' influence on projects – becoming more aware that stakeholders' have an impact on the project development, either positive or negative, depending on the solutions proposed.

In short, the contractor should improve the following in order to better understand stakeholders' interests:

- raise awareness about stakeholders' interests and stakeholders' influence on projects
- increase willingness to identify win-win solutions between contractor and stakeholders
- increase willingness to think from the point of view of stakeholders

Based on a relationship model of Olander (2006), the relations between these three improvements point is explained in figure7:

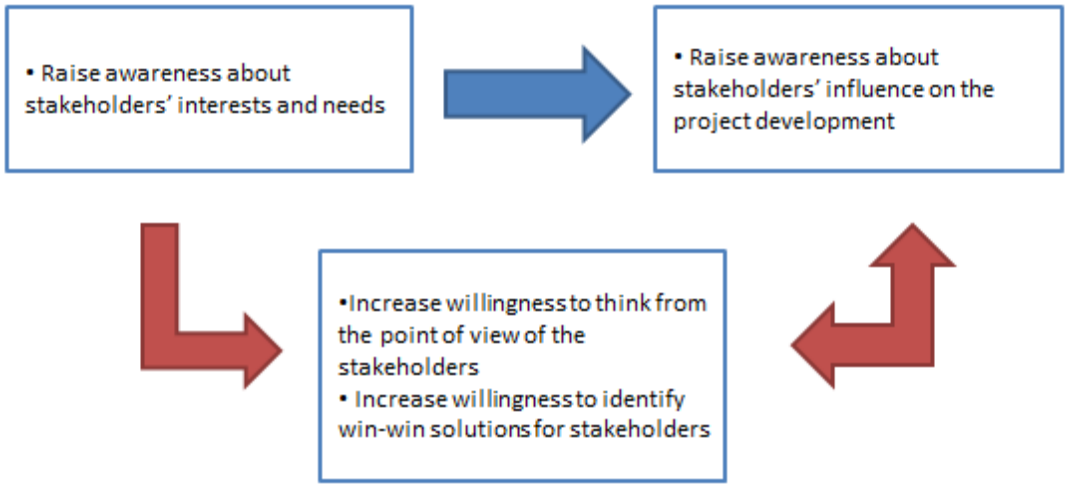

Figure 7 Relations between raising awareness about stakeholders' interests and influence, and increase willingness to think from the point of view of stakeholders and to identify win-win solutions for them

The four improvement points are all related to each other. Being aware of stakeholders' interests influences the awareness about stakeholders' influence on the project. Moreover, both of these influence the increase in willingness to think from the point of view of stakeholders and to identify win-win solutions.

RQ2: What properties make serious gaming suitable for supporting the needed improvements?
The objectives of a game designated for better understanding stakeholders' interests are based on the improvement points identified for the previous question. Therefore the game objectives are:

- OBJ1: to raise awareness about the stakeholders' interests and their influence on projects
- OBJ2: to increase willingness to identify win-win solutions for contractor and stakeholders
- OBJ3: to increase willingness to think from the point of view of stakeholders

The properties which make serious gaming suitable for supporting these objectives are the following:

- Possibility to play the roles of stakeholders: Although the tender team members will not interact directly with the real stakeholders in the game, they will have the opportunity to challenge their engineering way of thinking to react in accordance to the objectives and resources given by the stakeholder role from the game. Reflecting on their own behavior in the game, participants will realize how their and other participants' decisions taken in the game affect the outcome of the game. This reflection on the impact of players' decisions leads to awareness about the stakeholders' influence on the project (from the game), but the role playing provides support for all the three objectives.

- A game contains tasks and objectives for players, rules and constraints. These can be designed in such a way to reflect the influence and interests of the stakeholders from road infrastructure projects. The interests can be represented by the individual objectives in the game or inserted in the role descriptions. The influence of the stakeholders can be represented by giving certain powers in the game to different roles. Playing the game should generate "intersubjective" information on the system and the role of the stakeholders within it: the perceptions and opinions of the actors arising from discussions, observations or

questionnaires, etc. (Mayer et al., 2010). In this way, the players would discover by themselves what the interests of their own role and of the others' are, supporting the objective of raising awareness about stakeholders' interests.

- Games provide a safe learning environment in which the players can "test new strategies, tactics, ways of thinking and attitudes" (Geurts et al., 2000). The players will experience the trade-offs between cost/time/quality/stakeholders' interests without the fear of real consequences. In this safe environment, the players can experience the identification of win-win solutions.

- A game can have multiple outcomes which may not be revealed from the start to the players. By letting players to experience themselves which choices lead to a certain result, the players make their own conclusions (Copier, Koster, Pavloff, Uden, Vlaar, Wenzler, Zuurmond, 2012). For instance, the objective of identifying win-win solutions should not be explicitly stated to the participants. Based on the game outcomes and reflection, the players should be able to see what happens if win-win solutions were identified or not identified.

- Games can offer the opportunity for communication and negotiations between players. By this, win-win solutions can be identified. If the interests of each player are different, discussions and negotiations can arise. Furthermore, the possible solutions or outcomes of the negotiations can be already part of the game or developed by the participants during the game.

- Games are motivating activities. The motivating factors behind games are challenge, curiosity, and fantasy (Malone, 1981), structure of games, the uses of levels and an increasing difficulty (Gee, 2003) and last, but not least fun (Prensky, 2001). By being motivated, the players keep on playing and they enjoy the experience. This property offers support for all the three objectives.

- Games can provide intrinsic motivation through immersion of the player into the game. Being immersed in a game, participants invest time, effort and attention into the playing, feeling engaged to it. By being engaged in the game the players will be more captivated by the role they play and the attached objectives. The level of involvement in the game, the story, the dramatization and the exercises (tasks, objectives) contribute to a meaningful and a higher retention of the experience (Garcia-Barrios, Speelman, Pimm, 2010). This means, that an engineer playing the role of a stakeholder who feels engaged into the game, will be more connected to the role, will try to understand what he's going through and "fight" for achieving his objectives. Being part of a meaningful experience, he will remember it back in the real world situations. Remembering the game experience will give the opportunity to the engineer to think back and remember what the stakeholder "was thinking", what were his interests, how did he "feel" when his interests were not fulfilled. By doing this, the engineer will be able to think from the point of view of stakeholders when working on tenders.

7.1.2. Empirical exploration

The theoretical findings from the serious gaming field were measured by running an experiment of learning from playing a serious game. This part of the report answers the questions "What do players improve regarding their understanding of stakeholders' interests after playing a serious game ?". A statistical analysis was conducted based on the questionnaires' results from the game session held with students from TU Delft. Moreover, qualitative data obtained from participants' and facilitators' observations were used. As mentioned and explained in chapter 2, the results are based only on the

outcomes of the game session with the students. However, this is considered to be enough for the objective of developing a prototype and for the short duration of this thesis.

RQ3: What do students improve regarding their understanding of stakeholders' interests through serious gaming?

The general impression of the game session with the students is that players had fun, were enthusiastic to play and learn, and that *Someone else's shoes* was a successful learning tool.

After playing *Someone else's shoes:*

- OBJ1: The players' awareness about stakeholders' interests and their influence in projects was increased. The awareness about stakeholders' interests and their influence was based on three indicators. The results show that the participants agreed with all the statements in table 7-1. That means that after playing the game, the participants were more aware about stakeholders interests (n=76; μ =4.0; σ=0.34)[1] and their influence (n=76; μ =4.0; σ=0.34), about contractors interests (n=76; μ =3.9; σ=0.30).

Table 18 Descriptive statistics for post-game awareness about stakeholders' interests and influence in road infrastructure

After playing the game…	N	Mean	Std. Deviation
1. I am more aware of what kind of interests stakeholders could have.	76	4,0	,34
2. I am more aware of the influence of stakeholders could have.	76	4,0	,34
3. I am more aware of what kind of interests contractors could have.	76	3,9	,30

- OBJ2: The players were more willing to identify win-win solutions between contractor and stakeholders. With a score of μ=3.9 (n=76; σ=0.35), it can be said that the participants agreed that they increased their willingness to identify win-win solutions after playing the game.

Table 19 Descriptive statistics for post-game willingness to identify win-win solutions

After playing the game…	N	Mean	Std. Deviation
2. I will try more to find win-win solutions between contractors and stakeholders.	76	3,9	,35

[1] n = the number of participants who filled in the post questionnaire

μ = the mean of the answers given which can vary from 1 to 5 (1 - strongly disagree and 5 - strongly agree)

σ = standard deviation is a measure of how spread out a set of data values is. A standard deviation close to 0 indicates that the data points tend to be very close to the mean.

- OBJ3: The players were more willing to think from the point of view of stakeholders in future projects. Participants agreed that they are more aware now about the importance of changing their perspective (n=76; μ =4.0; σ=0.36) and in future they will better think from the point of view of stakeholders (n=76; μ=3.84; σ=0.51) and they will pay more attention to stakeholders interests (n=76; μ=3.81; σ=0.55).

Table 20 Descriptive statistics for post-game willingness to think from the point of view of stakeholders

After playing the game…	N	Mean	Std. Deviation
1. I will better think from the point of view of the stakeholders.	76	3,8	,51
2. I will pay more attention to stakeholders' interests.	76	3,8	,55
3. I am more aware of the importance of adopting a stakeholder perspective on projects.	76	4,0	,36

Therefore, the game reached its objectives.

To see if the learning outcome were applied in reality, an evaluation of the learning outcome was conducted one week after the game session. The conclusion is that not all the players managed to successfully apply the knowledge gained from playing the game, since the responses were spread out over a large range of value.

7.1.3. Answering main research question

The main research question was:

- In which way can serious gaming improve the contractors' understanding of the stakeholders' interests during the tender phase of road infrastructure projects?

The main research question refers to the improvement of contractors' understanding of the stakeholders' interests and not to the one of students'. Therefore, the answer to this question will be given reflecting on the answers provided for the previous sub research questions.

First of all, based on interviews with the experts in tendering, three improvement points which contractor needs to undergo in order to improve its understanding of the stakeholders' interests were extracted. These improvement points refer to:

- raise awareness about the stakeholders' interests and their influence on project
- increase willingness to identify win-win solutions for contractor and stakeholders
- increase willingness to think from the point of view of stakeholders

Secondly, serious gaming has the necessary properties to support achieving these improvement points. The properties are explained in the answer provided for the second sub research question (section 7.1.1). Games can create a desirable ideal situation from reality, by simulating it in a safe environment. Players are brought in contact with the stakeholders, by playing the roles of stakeholders. The variety of roles, their interests, perceptions, level of power, quantity of resources, dilemmas, objectives in the game, and rules generate a safe learning environment for players to gain

insights into how discussions, decisions and solutions would look like if the stakeholders would be consulted.

As mentioned in chapter 2, the chosen students for the test session are a good representative of the tender team members. Therefore, the positive results obtained from the game session with the engineer students reinforce the assumption that serious gaming is an appropriate method for supporting the needed improvement points (section 7.1.2).

The theoretical findings and the positive preliminary results obtained from the experiment with the students show that the research should be continued and further development and testing of *Someone else's shoes* game with tender team members will increase the benefits of serious gaming in the tender process of road infrastructure projects. After this step is accomplished, a more sounded conclusion can be drawn regarding the way in which serious gaming can improve contractor's understanding of stakeholders' interests during the tender process.

7.2. Recommendations

This section provides two directions of recommendations: first recommendations for contractors, which and secondly for further research.

7.2.1. Recommendations for contractors

Based on the outcomes of the interviews and the final conclusions of this research some food for thought can be given to tender teams of contractors of both new and ongoing tender projects.

The selected players for testing the game were students representing future engineers who might become part of real tender teams. Furthermore, the educational backgrounds of students are similar with the ones of tender team members. The game was tested in a constructed environment. The game session was integrated as part of a Technical Project, from the Project Management course. The assignment and organizational aspect of the course were very similar with a real tender process. Taking into account all of these and the findings of the test session, *Someone else's shoes* game is expected to improve contractors' understanding of stakeholders' interests by supporting the following improvement points:

1. By playing *Someone else's shoes* game it is expected that tender teams could increase their awareness about stakeholders' interests and their influence on projects. It is important to mention that this awareness refers to the general understanding of stakeholders' interests and influence, and not for a particular road project. More specifically, it means understanding that stakeholders have different interests than contractors or contracting authority and by the power they have, they can influence the project development and outcomes. In order to make this learning outcome specific for a project will require using the project information into the case from the game. This has not been part of this research.

2. By playing *Someone else's shoes* game it is expected that tender teams could increase their willingness to identify win-win solutions for stakeholders and contractor. By increasing their willingness to identify win-win solutions it is expected that tender teams will look for solutions satisfying the stakeholders, while including the time, money and technical aspects.

3. By playing *Someone else's shoes* game it is expected that tender teams could increase their willingness to think from the point of view of stakeholders. Being willing to think from the point of view of stakeholders while brainstorming, developing solutions, taking decisions will increase the possibilities to obtain solutions in accordance to what stakeholders want.

This research showed that serious gaming is beneficial for increasing willingness to identify win -win solutions for stakeholders and to think from their point of view. However, it is important to note that this willingness will not automatically lead to great changes in the way people think and work during a tender. It depends to a great extent on the individual's effort to apply this willingness in real situations. Based on the neutral results from the implementation outcomes of Someone else's shoes test session, it is recommended to further investigate if additional support (tools, methods) would be needed for reaching even better results.

Once serious gaming is introduced in the contractor's environment, it would be interesting to see if in the long run, this method will open engineers' mind to read between lines, to take another perspective on things, so that they understand what really is important for stakeholders, and not only rely on subjective translation of requirements, while working on tenders. This recommendation comes as a result from the interviews, where some experts mentioned these necessities for the tender team members.

Furthermore, four recommendations are given with respect to further development of the game and its implementation in the contractor's environment.

1. Since the objective of this research was to develop a prototype, further improvements are needed in order to reach an end product. The prototype can be improved based on the outcomes from the game session with the students. The following aspects were suggested for improvement:

   - Based on the result from questionnaires about the game design of *Someone else's shoes* and on the feedback from the students, the rules and tasks need to be clearer. In addition, the correlation analysis showed that the tasks are correlated with the desire for winning and performance in the game. The suggestions for this improvement point are:
     - to revise and structure the rules in a better way, in order to stimulate better the competition and performance in the game
     - to recheck what happens for every rule and task, what is the effect, if it is playable or not
     - to simplify the way rules and tasks are expressed in the materials

   - The students expressed that the instructions given to them need to be clearer. The instructions were presented during the presentation from the introduction. The suggestions for this improvement point are:
     - To prepare succinct instructions so that players understand what they have to do
     - To include a short preview of one round

   - Another improvement point expressed by the students refers to more information about the dilemmas and alternatives presented in the game (the star system was a bit confusing). The suggestions for this improvement point are:
     - to present the dilemmas and alternatives on additional cards, so the players get a better understanding about what they have to decide upon.
     - to include a short description of the alternative and what it implies on each card.
     - to replace the star system for the evaluation of each alternative by letting the players to evaluate for themselves the alternatives. In this case, more knowledge about the alternatives is needed. This could work with professionals.
     - to ensure a clear connection between the alternatives and the different interests coming from the stakeholders and contractor

- Students complained about the duration of the rounds. In their opinion the rounds were too long. The suggestions for this improvement point are:
    - to reduce the duration of each round to 15 minutes;
    - to evaluate what happens if the alternatives contained more information and if the players have the possibility to develop their own alternatives. In this case it is expected that the current duration of playing per round (22 minutes) shouldn't be too much.

2. For this research, the *Someone else's shoes* game was tested with students, but the final target are the tender teams. In order to be able to implement the game in the contractor's environment, the following steps should be followed:

    - after improving the prototype, the game should be tested with professionals from tender teams
    - based on the results obtained, the game should be improved once again
    - after reaching an end product, the game can be incorporated in real tenders
    - each game session should be followed up, so that improvements to the game or to the game session can be added

3. For an effective and organized process, one person should be designated as responsible for ensuring the progress of the game and implementation.

4. Since contractors are usually organizations without any experience in developing serious games, professional help from the field of gaming will also be useful. The lack of experience in developing serious games and the lack of people with relevant experience in this field was felt by the author of this research. Therefore external experts were consulted during the development of *Someone else's shoes*.

5. The evaluation after one week from the game session showed neutral results regarding the implementation of the learning points. For improving the transfer of knowledge gained from the game into practice, a list of possible ways was defined:

    - high consideration should be given to the debriefing session for a good link between the game outcomes and reality – meaning, the debriefing should not ignored and sufficient should be allocated
    - debriefing could include possible methods and actions needed to be taken by the tender teams in their real projects
    - the game could provide more freedom to players by letting them create their own possible alternatives for the dilemmas in the game
    - using an on-going project for the story of the game could improve the connection between the game experience and practice
    - or use an on-going project in the debriefing session (this means that the participants should be all from the same tender team, or at least have knowledge about the project)

6. Based on the experience with the high number of students, it is recommended to keep the game sessions at ten persons (two teams of five players). Otherwise, the session becomes noisy, difficult to facilitate and supervise. It is recommended to have an experienced facilitator, who can easily manage professional people and can successfully connect the learning points with reality.

7.2.2. Recommendations for further research

Research on the effectiveness of serious gaming is not very extensive. Usually evaluations are done only after the game was played, but the participants are not followed for a longer duration. Therefore, the knowledge about long term impacts of serious gaming is limited. For assessing the effectiveness of the game, it would be interesting to research the long term impact of using serious gaming in real tenders:

- long term evaluation of the game – when the game becomes ready to be applied for real tenders, a follow-up of the project outcomes should be conducted (if the contract was awarded, problems encountered during the execution regarding the stakeholders satisfaction)
- cross analysis of the different projects for which serious gaming was used could reveal the effectiveness of serious gaming

Another direction for further investigation concerns the improvement points needed for a better understanding of stakeholders' interests during the tender phase of projects. Since the results of this research are based only on the experiences of one organization, it would be interesting to conduct an extensive research on this matter, within other construction companies. This further research would be much welcome since the literature on this topic is very limited or almost inexistent. The outcomes to be obtained could represent further possibilities for serious gaming to support the improvement of understanding stakeholders' interests during tender phase of projects. By using more than one game will also increase the generalization of the results.

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Appendices

Appendix A: Meetings and documents

Meetings with experts

Tender process –VolkerInfra

One of the objectives of this research was to investigate why stakeholders' interests are not taken into account by the tender team members. For this, insights from the people involved in a tender were gathered. Seven stakeholder manager, three tender managers, and five project leaders/coordinator were interviewed. In total 32 people were contacted, but only these 15 people were available for providing input.

Furthermore, three more people provided their perspectives on the tender process and helped with advices and input throughout this research: one person from Value Engineering, one Lean Coach and one Senior Project Engineer.

Before each interview the relevant questions were defined. The interviews were semi-structured with a set of open questions, which allowed flexibility to address eventual new questions that were not anticipated when planning the original set of open questions.

The name of the experts can be seen below:

Table 21 Experts from Volker Infra organization

Name	Profession
1. Martin vd Berg	Stakeholder Manager
2. Frank van Ginderen	Stakeholder Manager
3. Ruben Nijlant	Stakeholder Manager
4. Herman Sjoerd	Stakeholder Manager
5. Irma Visseren Veltman	Stakeholder Manager
6. Suzan Keddeman	Stakeholder Manager
7. Petra Blok	Stakeholder Manager
8. Sallo van der Woude	Tender Manager
9. Sjoan Wierikx	Tender Manager
10. Andre Hoogcarspel	Tender Manager
11. Olav Noest	Project Leader
12. Rob van der Plas	Project Leader
13. Joris Schillemans	Project Leader
14. Dafra van Engelen	Project Coordinator
15. Leonard van der Vorm	Project Leader
16. Thera de Kramer	Value Engineering and Value Management
17. Johan Hoffman	Lean Coach
18. Bas van Loenen	Senior Project Engineer BIM

Interview questions

1. How is the tender process organized internally?
2. How much time do you have between the last opportunity to ask for clarifications from the client until submission deadline of the proposal?
1. Who are the typical external stakeholders involved in a road infrastructure project?
2. How many contractual arrangements are and between whom?
3. What type of documents is needed for the tender?
    a. From the client side
    b. From the contractor side – internal documents used
4. What is the outcome of a tender? (what documents do the tender proposal contain)
5. How is the tender team organized internally?
6. How do you prepare for the meetings with the contracting authority?
7. What kind of working methods/tools do you use in a tender process ?
8. Are the requirements received from the client systemized? (by the client or by the contractor)
9. If not, do you have a standard way of systemizing the information received (about requirements)?
10. What is the usual working method with the requirements?
11. Do you pay special attention to certain requirements from certain stakeholders?
12. Is the information about the requirements enough? If not, how do you get it?
13. What challenges do you face in working with the requirements?
14. What is the general feeling/impression of the engineers/tender team members about the requirements?
15. Do they feel there is a difference between the requirements described in the tender documents and the actual needs of the stakeholders?
1. Do the tender team members (engineers) use different perspectives when thinking about the solutions? Is it difficult to do that?
2. How do you check the drawings before submission?
3. Do you have any criteria to see if the tender documents were successful enough to avoid any conflicts with the external stakeholders?
4. What would you improve regarding the contractor relationship with the external stakeholders?
16. Are you/tender team members willing to change their working methods?
17. Which are the top 3 dilemmas encountered in the projects you've been involved between client-stakeholders-contractor?
18. Do you think that engineers (for instance tender team members) from VolkerInfra:
    a) Understand and pay attention to stakeholder interests
    b) Are aware about the importance of adopting a stakeholder perspective when working on tenders
    c) Try to find win-win solutions between stakeholders and contractor?
    d) Are willing to use "stakeholder glasses" when working on tenders

Game design

The researcher's knowledge on game design was limited. Besides reading about game design, game experts were contacted. Four people were contacted, from two organizations. Their names can be seen below:

Table 22 Experts from game design field

Name	Profession
1. Rafael Hrynkiewicz	Game designer, T-Xchange
2. Thomas de Groot	Game designer, T-Xchange
3. Herman vd Meyden	Creator Perspectivity game and Nexus game (Shell)
4. Erik Bronsvoort	Game leader Perspectivity game

Interview questions

1. What is your experience in game design?
2. How many phases are needed to reach a final version of a game?
3. Are there any similar games which may be used as reference for my topic?
4. How much time would be needed for designing a game?
5. What kind of resources is needed?
6. How do you conduct the debriefing?
7. How much time do you recommend for the game/debriefing?
8. Do you measure the effectiveness of the game? (questionnaires examples, quantitative/qualitative measures, after how much time)
9. How to choose what elements from reality are relevant for the game?
10. How do I make the transition from the system analysis to the game design?
11. Do you have any advices?

Documents analyzed

Tender documents were analyzed to gain a better understanding about what tender documents contain, what is asked in tender documents, how project requirements and award criteria are formulated. Also two trade off matrixes were consulted in order to see what are the criteria used by the tender teams. One stakeholder analysis was consulted to see what aspects are addressed in it (power, impact, interests etc.).

Table 23 Documents analyzed

Project name	Document type	Date/version
Rotterdamsebaan	Dialogue Phase Procurement Guideline	0 8 September 2014/0002 version 1.
N33 Assen – Zuidbroek	DBFM Agreement	10 May 2012/ Version C
N33 Assen - Zuidbroek	Dialogue and Tender Version of the Tendering Instructions	10 May 2012
Verhoging Hoornbrug, Reconstructie Haagweg En Aanpassing Tramlijn 15	Requirements part Eisendeel Haagweg	28 October 2013
Verhoging Hoornbrug	Requirements part Eisendeel Hoornbrug	24 October 2013
OV – SAAL - Zuidtak west	Trade Off Matrix	
Ruimte voor de Rivier – IJsseldelta	Trade Off Matrix	
-	Stakeholder analysis	10 eptember 2013

Appendix B: Research approach scheme

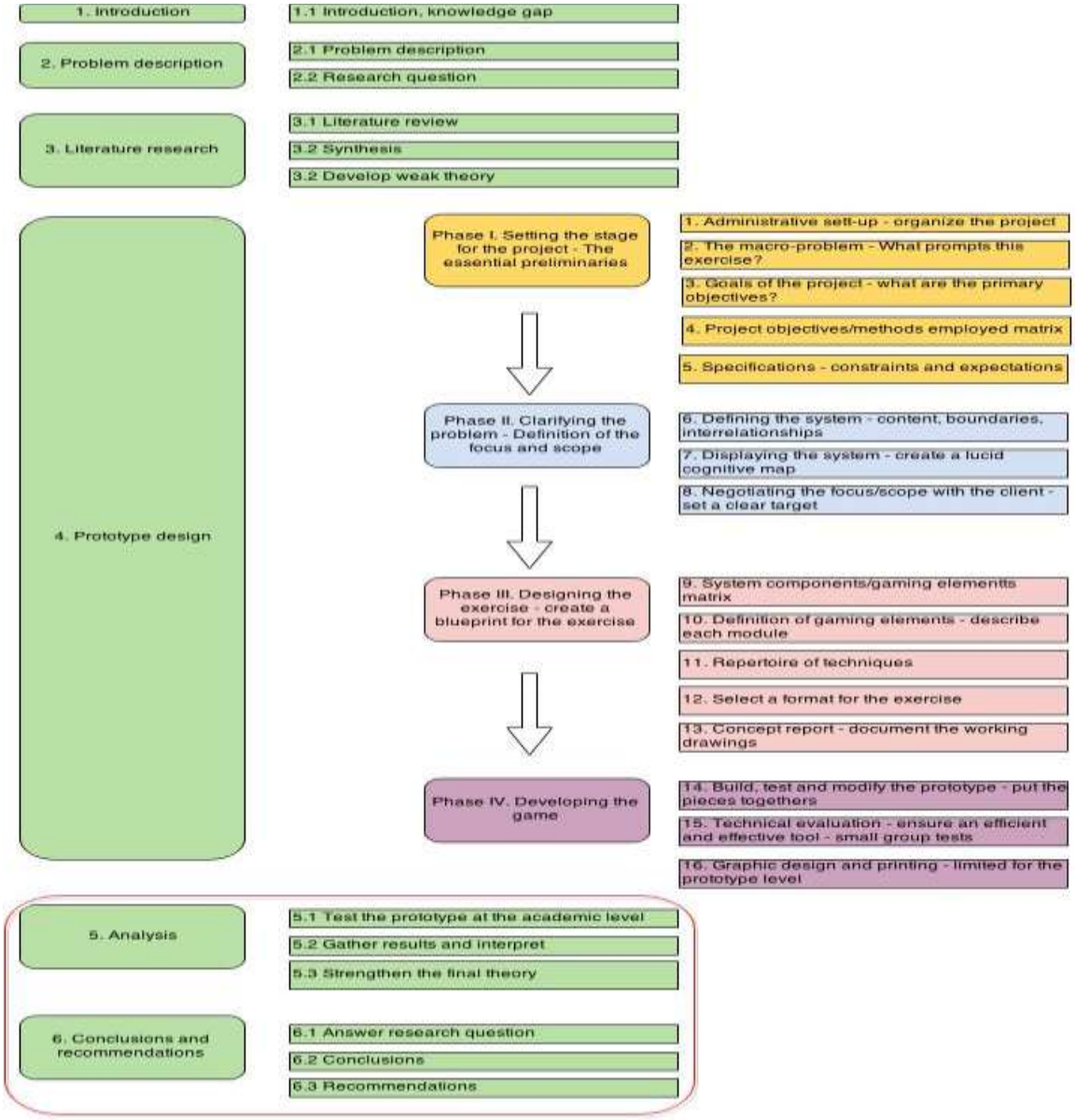


Figure 8 Research design

Appendix C: Actor analysis

Inventory of actors

An inventory of the relevant and the most common actors in a road infrastructure project (in the Netherlands) was done. The names, functions and subordinates were identified with the help from stakeholder managers. This inventory helped the researcher to get overview on who are the external stakeholders in road projects. Based on this, the roles from the game were created.

Table 24 Actors in infrastructure projects

	Actor	**Functions (what do they do, their responsibilities in a road project)**	**Subordinates (entities which go under this authority)**
1	Minister of Infrastructure and Environment	Responsible for water and road infrastructure	Minister Departments Advisors
2	Rijkswaterstaat	Executive organization of the minister Responsible for safety on highway (and main water) and traffic flow Project organization Administrative function	General Director Regional organizations Main project organization Program project organization District Legal/procurement department
3	Regional Government	Responsible for secondary roads Can be participant in (future) project Plan and design acceptance of projects Control project execution Permit release Participate in the project organisation and co-fund the project	Representative Other projects
4	Local Government	Responsible for safety and good environment for their citizens Permit release	Mayor Aldermen City council
5	Water boards	Control and manage of the water as well as treatment of waste water, but not with water supply Permit releases	Chairman Head of department
6	Environmental parties	Opposition of a new or bigger highway Check the plans Protect the environment	Nature monuments organization Local communities
7	Cables and Pipelines (independent owners, not from government)	Install new pipelines Replace existing pipelines Protect their utilities	Electricity/water/gas/telecom/ chemical/oil companies
8	Owners around the project area (gas stations,	Protect their business (since the project may interfere with their	Diverse

	shops)	business)	
9	Landowners (farmers, forests)	Protect their business (since the project may interfere with their business)	
10	Nearby residents	Live around the site construction or on the place where the road needs to be constructed	Chairman Participants
11	Main contractor	Bidding for the project Fulfill the tender guidelines and in case of winning the project respect and execute the proposed solution Make profit and construct the project smoothly	Joint venture partners Designers Different disciplines
12	Archeologists	Protect archaeological finds	

Interests, powers and resources

After having the inventory of the actors, their interests, powers and resources were identified. It is important to mention that the interests are general, don't reflect their interests in a specific road project. This information also helped the researcher to understand the external stakeholders and served as inspiration document for the game design.

As seen in the Table 24the interests in a road infrastructure project differ from actor to actor. The contracting authority (Ministry of Infrastructure and Environment together with Rijkswaterstaat), regional and local authorities, are usually the most interested in realization of the project, but for different reasons. However, the regional and local authorities may change their interests, depending on the project. They represent the actors with the highest power in decision making with legal authority (except the contractor) and financial means. The other parties, they are all more interested in the way the project will affect their own business/organization/life because they do not directly benefit from the project. These parties can be the Water Boards, Environmental Parties, Cables and Pipelines companies, nearby residents, owners –land/business, archeologists. Their power is from middle to low, and their main resources vary from permit releases (Water Boards), business/land ownership, to knowledge and expertise. The main contractor is always positively interested in the project, but also on gaining profit out of it. Its main power represents the contract with the client and its expertise represents the most important resource.

Table 25 Power interest resources table

	Actor	Interests	Power	Resources
1	Minister of Infrastructure and Environment	Policy Decision about future project Well spent budgets (taxpayer's money) Project execution according to plan	High	Decision making Legal authority Financial means
2	Rijkswaterstaat	Safety, quality and good flow Projects without financial, technical, time, safety problems or problems with the surrounding	High	Decision making Legal authority Expertise Financial means Make use of award criteria Functional specification
3	Regional Government	Positive interests - An infrastructure project can be of great economic importance for region Often they want to add requirements (on which they benefit) which makes a project more expensive Negative interests - It can happen that a region is against the chosen concept	High	Guidelines Permits release Expertise Financial means Make use of project requirements
4	Local Government	High interest in case of a highway nearby, under construction, or a new future highway Depending on the impact for the local municipality can be pro or con Often they want to add requirements (on which they benefit) which makes a project more expensive	High	Permit releases Expertise Financial means Make use of project requirements
5	Water boards	Various interests (for example enough compensation of water must be secured by new or on-going project)	Middle	Permit releases Expertise

		Often they want to add requirements (on which they benefit) which makes a project more expensive		
6	Environmental parties	Environmental issues (pollution, nuisance, protect wildlife and flora) Negative interests - they want to reduce the impact of the road project on the environment as much as possible	Middle	Knowledge Lobby
7	Cables and Pipelines (independent owners, not from government)	Not much interest, only when work from their side is involved or when their pipelines need to be replaced Generally they want to preserve their own cables and pipes	Middle	Approval
8	Owners around the project area (gas stations, shops)	Accessibility, visibility to their business during a work under construction	Low	Business ownership Lobby
9	Landowners (farmers, forests)	Accessibility to their lands	High	Land ownership Lobby
10	Nearby residents	Interested in the specific negative impacts of a highway or project in their backyard Low level of nuisance, hindrance, accessibility during construction	Low	Property rights Opinion Lobby
11	Main contractor	Win the tender and execute the project at the lowest cost, in order to get the most profit out of it Joint venture partners often have different interests originating from the specific fields of strength of the different companies Disciplines often have different preferences for different design solutions	Middle	Expertise
12	Archeologists	Preserve what is buried underground	Middle	Expertise Lobby

Appendix D: Game methodology

Game methodology Duke& Geurts

Duke and Geurts (2004) developed a design sequence composed of five phases for the development and implementation of (policy) games, within the field of strategic management. The design process "combines logic and serendipity; creating the stimulated environment is an artistic challenge" (Duke & Geurts, 2004). Although the steps are formulated as sequential, in practice the designer may adopt a simultaneous solution, adapting the order of progression (Duke & Geurts, 2004). In the case of this thesis, some of the steps, especially from the first two phase were done simultaneously while conducting the literature study of the research.

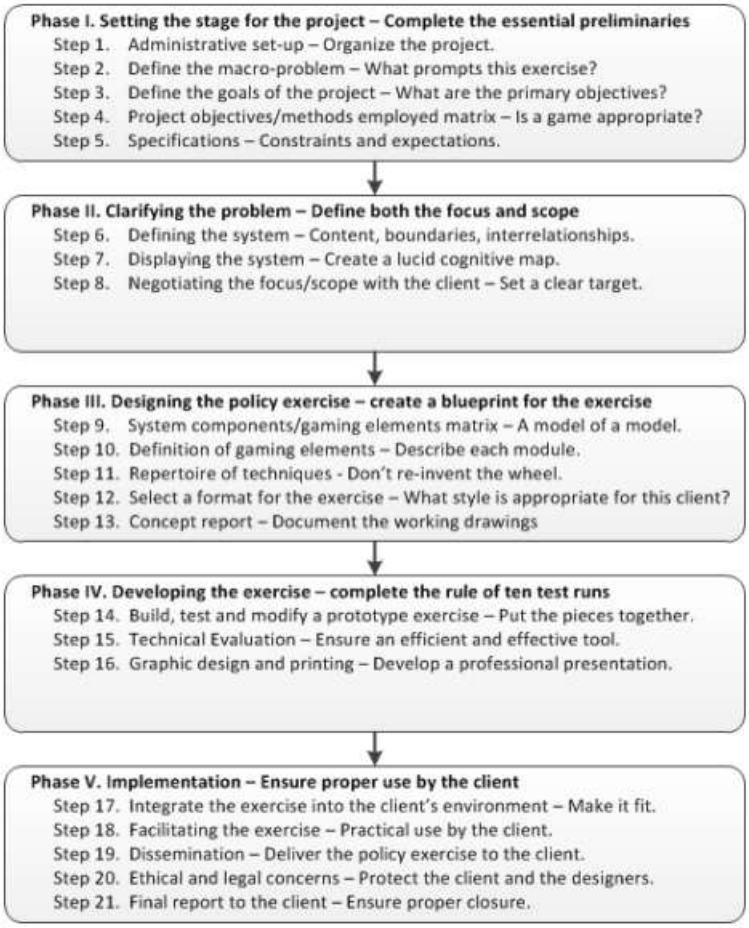


Figure 9 A design framework for gaming (Duke & Geurts, 2004)

Phase I. Setting the stage for the project The objectives of the first phase are to identify the problem which prompts the need of a game, to decide whether a game is a suitable tool or not, to define the purpose of the game (including the constraints) and the expected end-result. Furthermore, other practical specifications are meant to be established in this stage (the timeline of the project, the budget, and other resources).

Phase II. Clarifying the problem In the second phase of the game design process, an analysis of the problem is conducted. Defining the system requires a good understanding of its actors and elements, the relations between them and establishing the boundaries of the system. It is important to have a complete description of the reference system, because based on the outcomes of this phase, design

choices are later on made. As a follow-up of this step is the creation of a graphic representation of the system.

Phase III. Designing of the policy exercise The goal of the third phase is to create a blueprint or concept report for the game. That means translating the outcomes from the previous phase into a game. This objective is obtained through several steps. First of all it is important to reduce the number of elements identified in the reference system in order to be able to create a manageable, but still realistic game. The key characteristics of the reference system must be integrated into the game so that the validity is ensured. Once the gaming elements are chosen, their format and the game as a whole have to be defined. In gaming "language", elements refer to scenario, events, roles, decisions, format, rules, scoring, steps of play, indicators, visuals and paraphernalia. During this step, it is important to think what is possible to do and what is appropriate for the given purpose. The choice for the format of the game is influence by several variables such as group size, goals and objectives, organizational context, time available to play, character of the participants and substantive content. All the decisions taken at this stage are incorporated in the concept report which will serve as documentation for the development of the game.

Phase IV. Developing the exercise During this phase, the prototype of the game is build, tested several times and then modified accordingly until the game is completely calibrated. However, depending on the primary purpose of the game and system characteristics, a game may be continuously subjected to modifications and never be entirely finished.

Phase V. Implementation The goal of this phase is to ensure a proper use of it by the client. After reaching the final shape, the game is calibrated to the specific wishes and goals of the client. Then it is transferred to the client. Also, a number of concerns should be addressed, including the ethical and legal issues.

Adapted methodology

The first four phases were conducted following the same methods from Duke & Geurts methodology. The last one, the implementation was out of scope for this research. The objective was to develop a prototype and evaluate if it reaches its objectives. Therefore, the methodology followed stopped after the fourth phase.

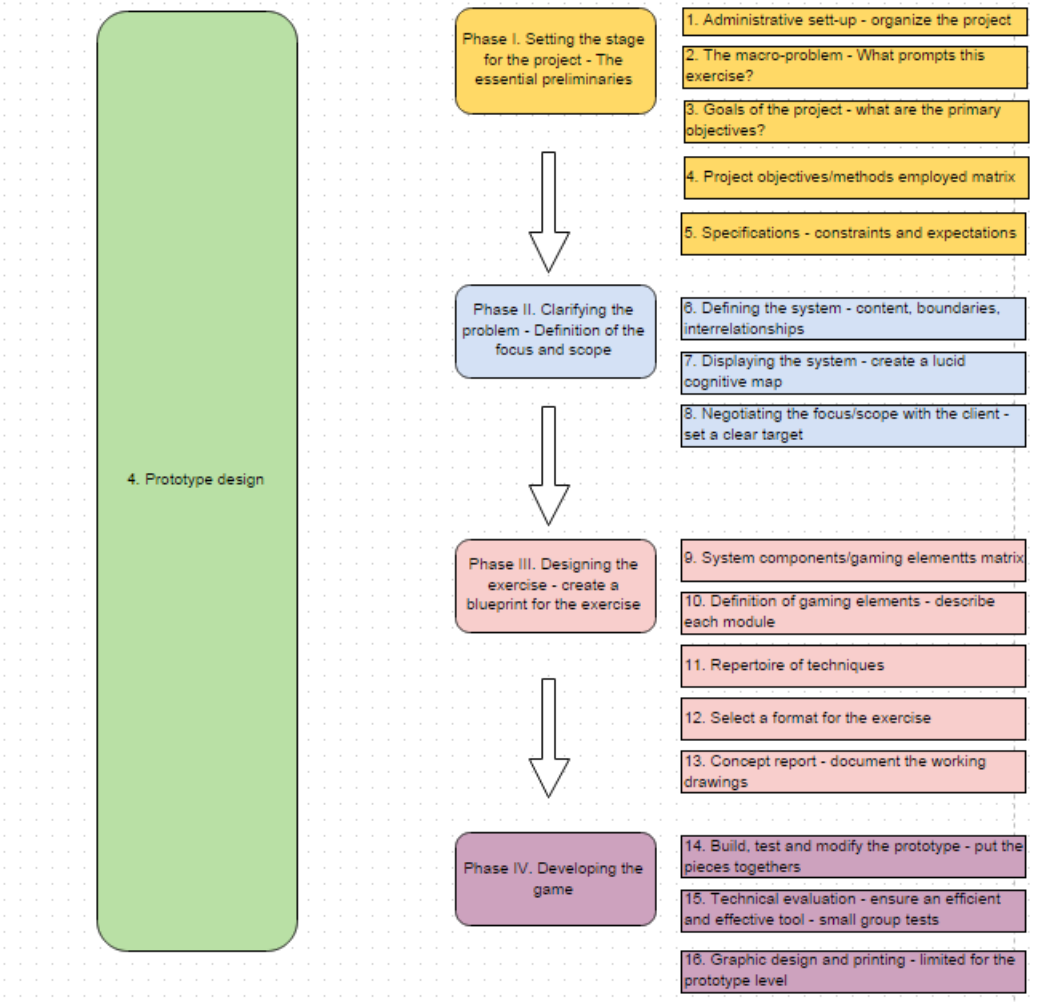


Figure 10 Game design methodology for Someone else's shoes

Appendix E: Someone else's shoes game materials

In this appendix, all the game materials are presented together with a brief explanation of their purpose.

Board

The board of the game is A3 paper, with four rectangles which are meant for placing the alternatives chosen in each round. In the picture, all three alternatives are placed on their round rectangle.

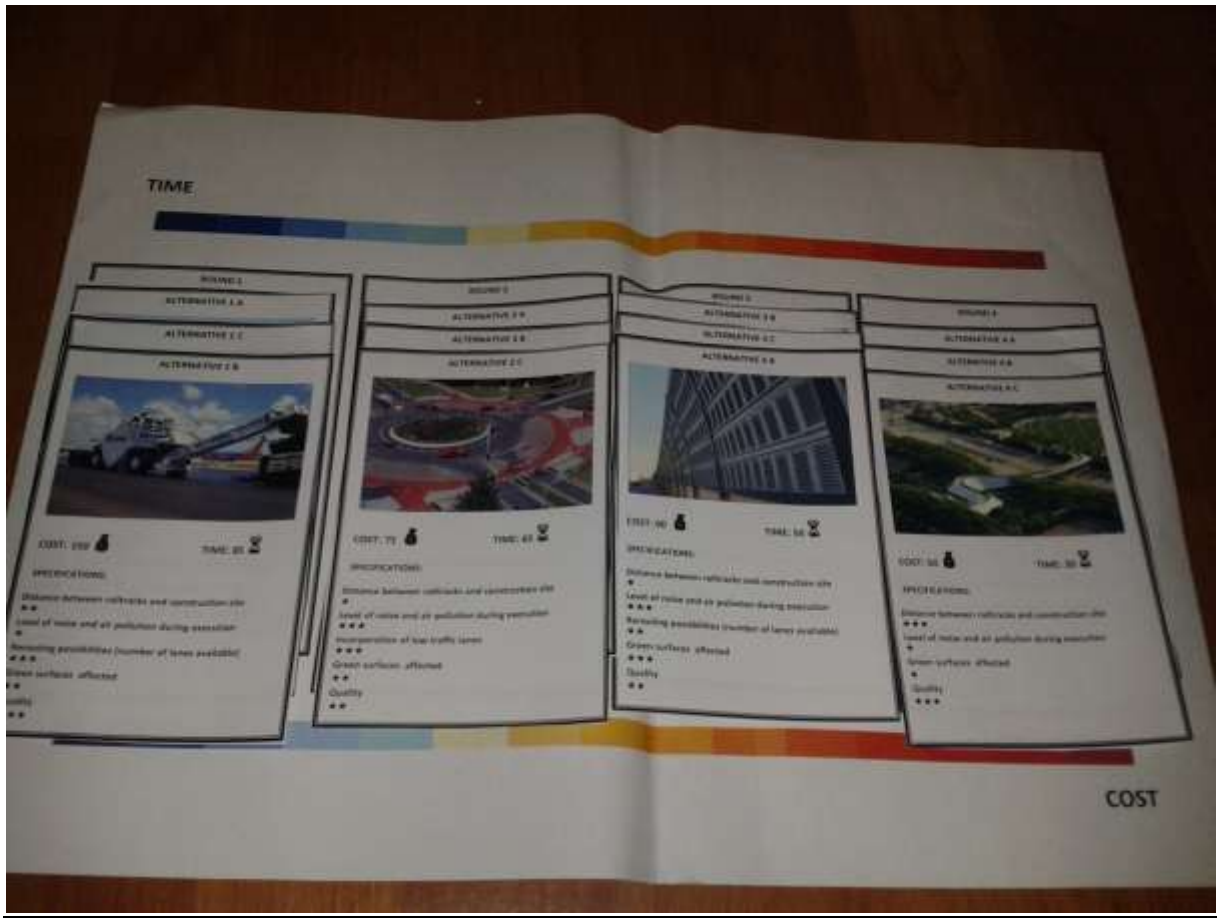


Figure 11 The board of the game

Alternative cards

For each round, three alternatives were available. The participants had to choose one of them.

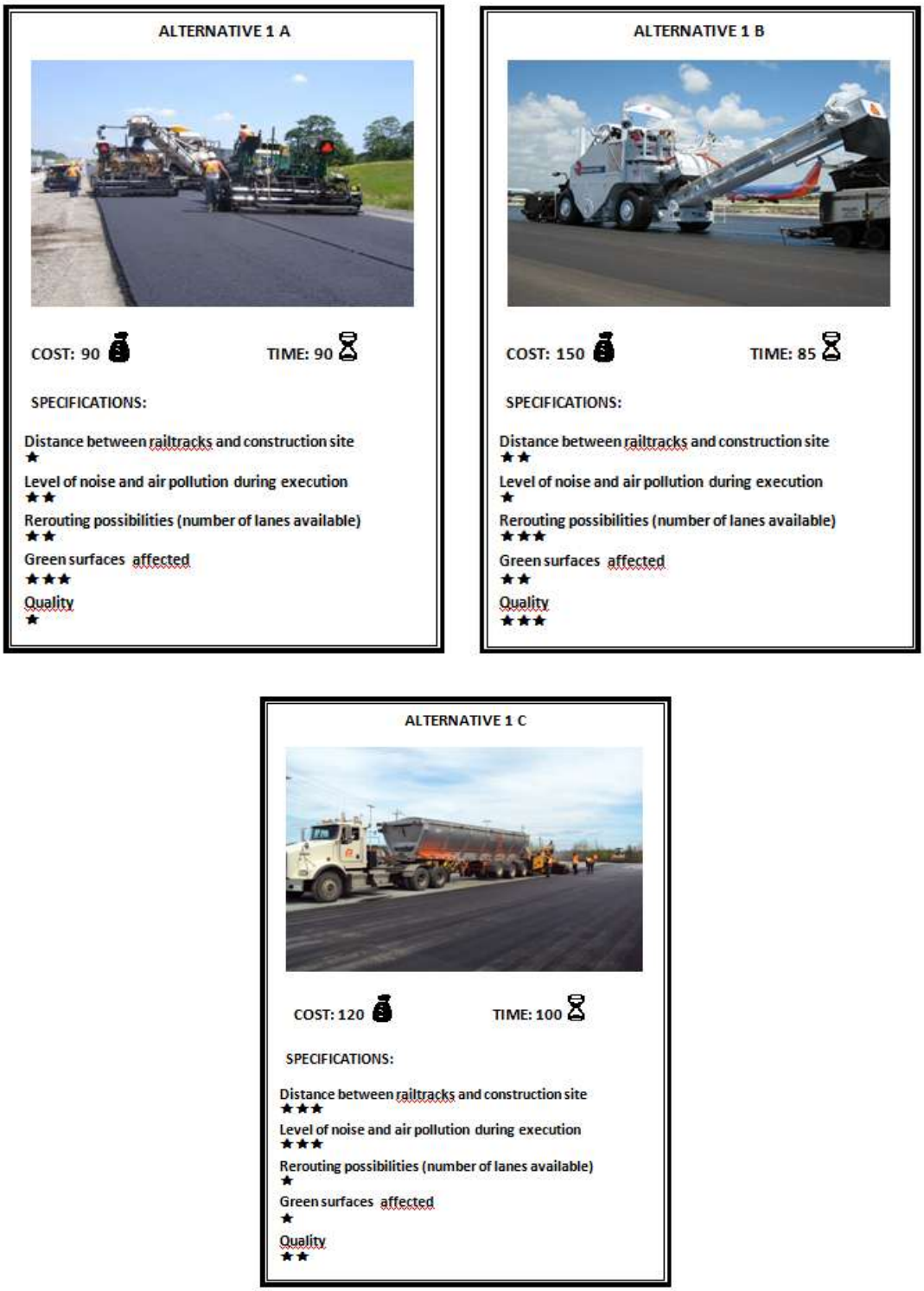


Figure 12 Alternative cards round 1

ALTERNATIVE 2 A



COST: 50 TIME: 60

SPECIFICATIONS:

Distance between railtracks and construction site
★★★
Level of noise and air pollution during execution
★★
Incorporation of low traffic lanes
★
Green surfaces affected
★★★
Quality
★★

ALTERNATIVE 2 B



COST: 65 TIME: 55

SPECIFICATIONS:

Distance between railtracks and construction site
★★
Level of noise and air pollution during execution
★
Incorporation of low traffic lanes
★★
Green surfaces affected
★
Quality
★★

ALTERNATIVE 2 C



COST: 75 TIME: 65

SPECIFICATIONS:

Distance between railtracks and construction site
★
Level of noise and air pollution during execution
★★★
Incorporation of low traffic lanes
★★★
Green surfaces affected
★★
Quality
★★

Figure 13 Alternative cards round 2

ALTERNATIVE 3 A



COST: 60 TIME: 50

SPECIFICATIONS:

Distance between railtracks and construction site
★

Level of noise and air pollution during execution
★★★

Rerouting possibilities (number of lanes available)
★★

Green surfaces affected
★★★

Quality
★★

ALTERNATIVE 3 B



COST: 85 TIME: 40

SPECIFICATIONS:

Distance between railtracks and construction site
★★★

Level of noise and air pollution during execution
★

Rerouting possibilities (number of lanes available)
★

Green surfaces affected
★★

Quality
★★★

ALTERNATIVE 3 C



COST: 40 TIME: 30

SPECIFICATIONS:

Distance between railtracks and construction site
★★

Level of noise and air pollution during execution
★★

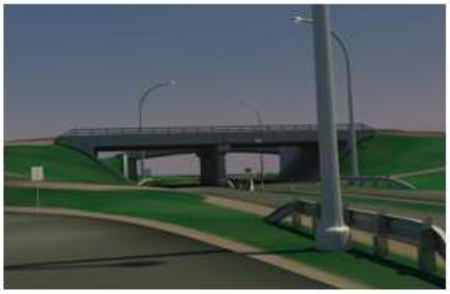
Rerouting possibilities (number of lanes available)
★★★

Green surfaces affected
★

Quality
★

Figure 14 Alternative cards round 3

ALTERNATIVE 4 A



COST: 30 TIME: 30

SPECIFICATIONS:

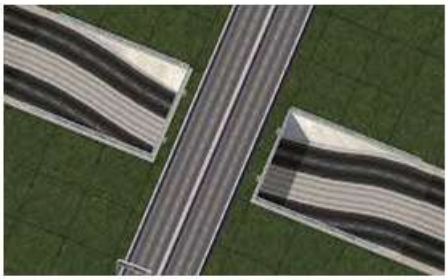
Distance between railtracks and construction site
★★

Level of noise and air pollution during execution
★★★

Green surfaces affected
★★

Quality
★★

ALTERNTIVE 4 B



COST: 40 TIME: 25

SPECIFICATIONS:

Distance between railtracks and construction site
★

Level of noise and air pollution during execution
★★

Green surfaces affected
★★★

Quality
★★

ALTERNATIVE 4 C



COST: 50 TIME: 20

SPECIFICATIONS:

Distance between railtracks and construction site
★★★

Level of noise and air pollution during execution
★

Green surfaces affected
★

Quality
★★★

Figure 15 Alternative cards round 4

Role description papers

Each participant received a role description card. This was an A4 paper, foldable, with blank space for the name of the participants. Each role had a specific color, to distinguish easily during the game play.



Figure 16 Role description paper

1. Role description contractor

You are one of the most successful construction companies in the country, with a lot of experience in road infrastructure projects, from the most complex ones to the simple and easy refurbishments projects.

Objectives:

- Finalize the project with success, while:
- You respect the cost and time constraints and
- Maintain a good relationship with the stakeholders
- Follow your objective by maximizing the exchange of your 50 red tokens in other colours

Background information:

The current national motorway M12 is a 2-lane road north- south orientated on which a traffic safety problem has arisen and traffic flow could be improved. This situation occurs on the section crossing a dense municipality. There is also a nearby railway running partly adjacent and crosses a very heavily used municipal road for combined traffic (cyclists, pedestrians and motorized traffic).

With the refurbishment of the M12 the traffic conditions will be improved, reducing thus the high rate of accidents. Moreover, the current refurbishment involves also the upgrading of the current infrastructure intersections, ensuring thus safety for all the type of traffic (cyclists, pedestrians and motorized traffic) and will provide a strong economic impetus to the region and enhance regional accessibility.

ROUND 1 Pavement Replacement The entire pavement needs to renew, including a newly applied and 2 meters lowered sub base for the whole length of the motorway without road closure or by a series of night closures consisting of a maximum of 2 lanes at a time.

Note: the area of the future park is available for rerouting the motorway during construction or general contractor needs (building site, offices, storage). No restrictions as long as the area is in pristine condition at handover

ROUND 2 Crossings refurbishment
The existing crossings at the end of the structure needs to be refurbished and made suitable for physical separation of traffic (crossing has to become 50% wider) and reconstructed into roundabouts.

ROUND 3 Noise barrier
Reduce the noise on 4 km distance on the western part of the motorway where the railway is running adjacent. Take into account the creation of space for future lane extension on the west.

ROUND 4 New crossing
Make sure slow traffic can cross the motorway safely, from the new district to the towns centre.

2. Role description local authority

You are the local authority. The local authority is appointed by political nomination (this could include the Mayor, Local Council etc.).The local authority is responsible for the respective governing area.

Objectives:

- Separated slow traffic on the roundabouts
- Pleasant neighbourhood for the new residents
- Good quality end product
- Follow your objective by maximizing the exchange of your 18 orange tokens in red tokens

Background information:

You are having a very hard time. The number of traffic casualties on the motorway crossing has risen again last year. The level is now twice above their target set. The media recently started to focus on this problem.

The new district on the east has a catastrophic lack of development. Not 5% of the houses planned have been built and even worse, last year not a single house has been added. This is creating a big budget problem for you. A lot of money has been invested in acquisition of the area and the loans cannot be repaid if this continues any longer.

The new park on the east and a safer motorway crossing with fully separated slow traffic seem to be the only way to get an increase of new houses in the district, thus avoiding a financial disaster. Of course, you are also looking at high quality end result.

Moreover, there is also scheduled the construction of an event centre in the town centre, east of the motorway. It is designed to increase the quality of life in the community and to connect both parts of the city by cultural events.

Therefore you see an escape in the refurbishment of the motorway. From previous discussions with the commissioner of the project you understood that high importance will be given to the separation of the slow traffic lanes (pedestrian and bikers) so you really expect to have good quality solutions for this.

Changes to this point of view are very much needed as the elections are planned at the end of the motorway refurbishment contract. The city council wants to be re-elected and will put all his efforts in making their wishes come true. Since you are in charge of approving the contractors design on municipal works, you expect to have enough occasions to insist on additional works.

3. Role description local community

You are the representative of The New District Community (TNDC) Organisation. The TNDC Organisation serves the interests of the residents from the new district built in the eastern part of the motorway.

Objectives:

- A safe crossing route to reach the town centre
- Low level of noise and air pollution during execution
- Pleasant neighbourhood for the new residents
- Follow your objective by maximizing the exchange of your 12 yellow tokens in red tokens

Background information:

Due to expansion of the city, a new district for young families has been started east of the M12 motorway.

A city park for this new district has also been planned along the eastern part of the road as a visual and noise buffer. Due to collapse of the housing market the municipality lacks of funds to realize this on short notice. The occupants in the new district therefore experience a lot of noise and visual hindrance. Because of this noise hindrance even fewer new houses are being built, this also influences directly the growth of new young inhabitants (and the price level of the houses already being built).

On top of this it's forecasted this situation will get worse due to the newly planned retaining wall on the western part of the motorway reflecting even more noise towards the district.

Plans for a new elementary school in the district have been postponed for at least 10 years. Children therefore are forced to continue using the very dangerous and busy crossing to the towns centre.

The idea of the new event centre in the other part of the town is very appealing for you, but if there are no safe crossings you are afraid that your community will not be able to enjoy the cultural activities planned for the future.

TNDC has taken notice of the planned refurbishment of the motorway. Of course they are very worried and feel more than neglected by the municipality and the commissioner of the project.

They are very afraid the future contractor will make a lot of noise, have night closures and will turn the future park area into a big construction site for years. You are here to represent and defend their interest and make sure community's concerns are taken into account for every solutions designed.

4. Role description environmentalists

You are the representative of the NGOs responsible for protecting the environment, fauna and flora. You are responsible to make sure that environmental laws are respected in the respective area.

Objectives:

- Low levels of noise and air pollution during execution
- No destruction of the existing green areas
- Follow your objective by maximizing the exchange of your 10 green tokens in red tokens

Background information:

Both the existing town and the new district locations are situated in areas with ecological value, providing shelter and forage to many animals. You represent the environmentalist groups in charge with the respective areas.

You understand the need to refurbish the existing motorway, but you want to do your best to protect the valuable open space in the region. In your opinion the area is missing of green spaces and having a park on the east side of the motorway would increase the quality of life in the new district and also the public spaces would be used in a better way. You are afraid that the planned refurbished project will transform the designated area for the park into a big construction site for a long time.

Another big concern of yours is the damage to the environment (fauna and flora) caused during the execution phase (air and noise pollution).

5. Role description railroad company

You are representing the RailRoad company. You own the rail tracks which pass westerly to the highway and it is your main priority to keep the available for operations

Objectives

- To have reliable solutions for the retaining wall in order to avoid unexpected quality problems later
- No train's timetable disruptions
- Follow your objective by maximizing the exchange of your 10 blue tokens in red tokens

Background information:

You don't really care what happens with the project as long as the train's timetables will not be disturbed. This means that construction site should be always 100 m away at least from your rail tracks. You will take care of thorough quality surveys on product level themselves because you neither trust the contractors system nor the process approach of the project commissioner.

You heard about the complaints from the residents regarding the high level of noise directing to them due to the motorway but also railway. However, you really don't want any absorbing types of sound barriers; they have proven to be absolutely unreliable as a lasting retaining wall. Plus, there

are high chances that your rail track system will be affected during the construction phase. The contractor should come up with a better solution for this kind of problem.

You will not be satisfied with any other than proven solutions, perfectly executed without any chance of time table disruptions. You will make absolutely sure you get what they want by staying on top of each and every detail.

6. Chairman

You are the chairman of this meeting. You are responsible for managing the discussions over the four rounds of the game. You should keep an objective opinion on what is discussing and you should not interfere in the discussion taken.

Responsibilities

1. Read carefully the rules of the game and make sure they are respected.
2. You must interfere if the players do not respect the rules.
3. Keep the time of the rounds. Each round should be approx. 22 minutes. Inform the players how much time they have left by showing the coloured papers like this:
    a. green: 10 minutes left
    b. yellow: 7 minutes left
    c. red: 2 minutes left (time to wrap up)
4. Remember players what they have to do: after the 5 minutes of the game players have to put down the tokens for their preferred alternative.
5. Keep the score of the group by filling in the score table with the time and cost of each alternative. At the end of the game you have to sum up the values and also fill in the tokens scores from the stakeholders.
6. Inform player about the status of time and cost of their project, but only if they ask.
7. Make sure the number of tokens is not seen.
8. Make sure players do not mixed up the rounds, the alternatives or look at the alternatives before the turn of the round.
9. Make sure the chosen alternative is put on the board at the end of each round.
10. Take care of the tokens in garbage. Do not waste them.
11. In case of negotiations and promises made, make sure people write them down.
12. Facilitate discussions, but remain impartial and not influence the opinions.
13. In case of silence break, challenge people to talk.
14. Involve silent people.
15. Take care of all the game materials.

Tokens - used in negotiations

Each participant received a number of tokens, according to their role. The difference in the number of tokens represented the power the role had in the game. Having a high number of tokens meant high power in negotiations.

Contractor – 50 red tokens
Local authority – 18 orange tokens
Local community – 12 yellow tokens
Environmentalists – 10 green tokens
Railroad company – 10 blue tokens



Figure 17 Tokens for each player – railroad (blue), environmentalist (green), local community (yellow), local authority (orange), contractor (red)

Game setting

A typical game setting involves the game board in the middle, and around it the five role description cards, together with their tokens.



Figure 18 Game setting – how the game looks like on table

Other materials - "garbage" symbol, table score, timing

- Garbage symbol – a paper to place the tokens lost in a negotiation
- Table score - each team had to keep their own score and fill in the table
- Timing papers – used by the facilitator in each team, during each round, so that players are informed how much time do they have (it was use especially because of the high number of teams)



Figure 19 Other materials used during the game

Appendix F: Someone else's shoes game rules

1. Contractor starts the game by presenting the round of the game (what is it about, which part of the road they are working on) and then reveals the alternatives for the round in progress. The alternatives cards are faced down, on the table, before this.
2. Contractor reads each alternative, in turn, and describes them. Stakeholders are allowed to ask questions and discuss (no rules about communication process).
3. After 5 minutes, each stakeholder has to choose his/her own preferred alternative by putting down a number of "tokens". The number of these tokens should not be visible. The number of tokens represents how much the player wants that alternative. The number of tokens is not allowed to be changed, only in case of negotiation.
4. Contractor is allowed to put down only one token, expressing his/her preference. This is because he will have to exchange his/her own "tokens" later on with the number expressed by the stakeholders. After expressing their choice, players can talk and ask questions about their decisions.
5. The minimum number of tokens put by one player is one per round.
6. In case that all of the players (stakeholders and also contractor) put the tokens on e xactly the same alternative, then contractor has to exchange their tokens with the number shown on the table.
7. If there are more alternatives preferred, then negotiation starts.
8. There are two ways to finish the negotiation:
    a. The stakeholders can change their mind and go for the most desired alternative (this is the only possibility where players can also change the number of tokens)
    b. The contractor takes the measure to abort the undesired alternative. In this case contractor will give (no of tokens put by the stakeholders+1), from which ½ (rounded down) goes to trash and the other ½ rounded down goes to the stakeholders. The stakeholder in this case will give (no of tokens-1)/2 to the contractor (rounded down).
9. If contractor has less tokens than what stakeholder want than the contractor has to decide who will get his tokens.
10. If contractor has 0 tokens left, his negotiation power is zero, and thus he cannot do anything in the game. The decision is then left to the stakeholders. However, in this case they will not get any tokens from the contractor. The alternative with the highest number of tokens will win. The ones against will lose their tokens and the others will keep their tokens for themselves.
    a. ii+ii -> roll a dice, the highest number wins, the losers loose the tokens to the garbage
    b. iii+i -> the one with three votes wins (depending on the number of tokens)
    c. ii+i+i -> the one with two votes wins (depending on the number of tokens)
    d. iiii -> clear winner, everybody happy

    *i represents a player and his chosen alternative. For instance ii+ii means two players want one alternative and two players want another alternative

Appendix G: Someone else's shoes final score sheet

This is the final score from all 13 teams, made in excel. The table contains:

- the 13 teams named from 1 to 13
- time and cost of the project: average and per team
- the difference between the time and cost score obtained by each team and the average time and cost of the project
- number of tokens obtained from each stakeholder and contractor

The final scores, in the last row are calculated based on the following method:

1. For each team was calculated:
   - the difference between their own cost and the average cost
   - the difference between their time and the average time
2. Stakeholders' satisfaction was measured adding up all the exchanged tokens.
3. Then these three indicators were ranked between them: the first place is given to the one with the highest number of tokens, and for the one with the lowest difference of time and cost
4. Than the ranks of all three indicators are added up and gave the final score of the team

TEAM	AVERAGE/MAX	1	2	3	4	5	6	7	8	9	10	11	12	13	WINNER
TIME	316	225	220	240	235	215	220	240	225	230	225	225	245	215	
COST	262	290	250	260	270	310	250	260	290	230	290	265	285	255	
DIFFERENCE TO AV. TIME		-91	-96	-76	-81	-101	-96	-76	-91	-86	-91	-91	-71	-101	-101
DIFFERENCE TO AV. COST		28	-12	-2	8	48	-12	-2	28	-32	28	3	23	-7	-32
LOCAL AUTHORITY GAINS	18	18	15	15	14	15	13	12	16	16	15	14	16	13	18
COMMUNITY GAINS	12	11	12	12	10	9	10	8	11	11	10	12	12	9	12
RAILROAD GAINS	10	10	9	9	10	6	12	10	8	8	9	9	9	8	12
ENVIRONMENTALISTS GAINS	10	9	10	10	9	9	9	8	8	9	13	9	12	8	13
SUM OF ALL STAKEHOLDERS GAINS	50	48	46	46	43	39	44	38	43	44	47	44	49	38	49
CONTRACTOR GAINS	50	45	44	41	37	35	35	33	25	42	45	41	53	50	53
		93	90	87	80	74	79	71	68	86	92	85	102	88	
	Time rank	5	3	11	9	1	3	11	5	9	5	5	13	1	
	Cost rank	10	2	5	8	13	2	5	10	1	10	7	9	4	
	SS rank	2	4	6	9	11	10	12	13	7	3	8	1	5	
		17	9	22	26	25	15	28	28	17	18	20	23	10	
			first place				third place							second place	

Figure 20 Excel table with the final score

The green score represents the team on the first place - team number 2. They had the best proposal, taking into account the time, cost and stakeholders' satisfaction.
The yellow score represents the team on the second place – team number 6.
The orange score represents the team on the third place – team number 12.

Appendix H: Questionnaires

Pre test

Please indicate the extent to which you agree/disagree with the statements below:

1 = Strongly disagree
2 = disagree
3 = not agree/ not disagree
4 = agree
5 = Strongly agree

Table 26 Pre questionnaire

Statement	Strongly disagree				Strongly agree
1. I am aware of what kind of interests stakeholders could have in a road infrastructure project.	1	2	3	4	5
2. I am aware of the influence stakeholders could have in a road infrastructure project.	1	2	3	4	5
3. I am aware of what kind of interests contractors could have in road infrastructure projects.	1	2	3	4	5
4. I try to find win-win solutions (engineers vs. stakeholders) when working on technical projects.	1	2	3	4	5
5. As an engineer, I am aware about the importance of adopting a stakeholders' perspective when working on technical problems.	1	2	3	4	5
6. I pay attention to stakeholders interests when working on technical projects.	1	2	3	4	5
7. I think from the point of view of stakeholders when dealing with dilemmas in technical projects.	1	2	3	4	5

Post test

Please indicate the extent to which you agree/disagree with the statements below about the game:

1 = Strongly disagree
2 = disagree
3 = not agree/ not disagree
4 = agree
5 = Strongly agree

Table 27 Post questionnaire _ game experience

Statement	Strongly disagree				Strongly agree
1. The game was fun.	1	2	3	4	5
2. The game was challenging.	1	2	3	4	5
3. I liked the team objective in the game.	1	2	3	4	5
4. I liked the individual objective in the game.	1	2	3	4	5
5. The game materials – such as role descriptions – were understandable and clearly written.	1	2	3	4	5
6. The tasks in the game were understandable and clearly formulated.	1	2	3	4	5
7. The tasks in the game were too easy.	1	2	3	4	5
8. The tasks in the game were too difficult.	1	2	3	4	5
9. The game held my attention.	1	2	3	4	5
10. I put a lot of effort into playing the game.	1	2	3	4	5
11. I felt very motivated while playing the game.	1	2	3	4	5
12. I believe I performed very well in the game.	1	2	3	4	5
13. I really wanted to win the game.	1	2	3	4	5
14. I really put myself into my character.	1	2	3	4	5
15. I was able to understand the alternatives from each round in a manner similar to that in which my character might understand them.	1	2	3	4	5
16. I felt I could really get inside my character's head.	1	2	3	4	5
17. At key moments, I felt I knew exactly what the character was going through.	1	2	3	4	5
18. I wanted my character to succeed in achieving its goal.	1	2	3	4	5

Please indicate the extent to which you agree/disagree with the statements below:

1 = Strongly disagree
2 = disagree
3 = not agree/ not disagree
4 = agree
5 = Strongly agree

Table 28 Post questionnaire_learning outcomes

Statement **By playing the game…**	**Strongly disagree**				**Strongly agree**
1. I am more aware of what kind of interests stakeholders could have in a road infrastructure project.	1	2	3	4	5
2. I am more aware of the influence stakeholders could have in a road infrastructure project.	1	2	3	4	5
3. I am more aware of what kind of interests contractors could have in road infrastructure projects.	1	2	3	4	5
4. I will better try to find win-win solutions (engineers vs. stakeholders) when working on technical projects.	1	2	3	4	5
5. As an engineer, I am more aware about the importance of adopting a stakeholders' perspective when working on technical problems.	1	2	3	4	5
6. I will pay more attention to stakeholders' interests when working on technical projects.	1	2	3	4	5
7. I will better think from the point of view of stakeholders when dealing with dilemmas in technical projects.	1	2	3	4	5

Implementation

Please indicate the extent to which you agree/disagree with the statements below:

1 = Strongly disagree
2 = disagree
3 = not agree/ not disagree
4 = agree
5 = Strongly agree

Table 29 One week after questionnaire_implementation outcomes

Statement **Because of the game…**	**Strongly disagree**				**Strongly agree**
1. I was aware of what kind of interests stakeholders could have in a road infrastructure project.	1	2	3	4	5
2. I was aware of the influence stakeholders could have in a road infrastructure project.	1	2	3	4	5
3. I was aware of what kind of interests contractors could have in road infrastructure projects.	1	2	3	4	5
4. I tried to find win-win solutions (engineers vs. stakeholders) when working on technical projects.	1	2	3	4	5
5. I was aware about the importance of adopting a stakeholders' perspective when working on technical problems.	1	2	3	4	5
6. I paid attention to stakeholders interests when working on technical projects.	1	2	3	4	5
7. I thought from the point of view of stakeholders when dealing with dilemmas in technical projects.	1	2	3	4	5

Appendix I: Quantitative results – Factor Analysis

In this appendix, the outcomes of numerical analysis presented. This consists of the Factor analysis and the descriptive analysis of the indicators. To reduce the variables, the principle factor analysis was used.

Game experience factors

Descriptive analysis game objectives

Table 30 Descriptive analysis game objectives

Indicator	N	Mean	Std. Deviation
I liked the team objective in the game.	76	3.4	.89
I liked the individual objective in the game.	76	3.5	.85

Factor analysis game objectives

Table 31 actor analysis game objectives

Indicator	I F1game_obj
I liked the team objective in the game. I liked the individual objective in the game.	.78 .78
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	1.21 60.82% .50 .50

This analysis gives one Factor: F1 game_obj.

Descriptive analysis for tasks

Table 32 Descriptive analysis for tasks

Indicator	N	Mean	Std. Deviation
The tasks in the game were understandable and clearly formulated.	76	2.6	1.02
The tasks in the game were too easy.	76	3.3	.83
The tasks in the game were too difficult.	76	2.3	.73

Factor analysis tasks

Table 33 Factor analysis tasks

Indicator	I F2game_tasks
The tasks in the game were understandable and clearly formulated. The tasks in the game were too easy. The tasks in the game were too difficult.	.52 .78 .79
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	1.51 50.34% .55 .50

This analysis gives one Factor: F2 game_tasks.

Descriptive analysis for fun and challenge

Table 34 Descriptive analysis fun and challenge factor

Indicator	N	Mean	Std. Deviation
The game was fun.	76	3.5	.91
The game was challenging.	76	2.6	.93

Factor analysis fun and challenge

Table 35 Factor analysis fun and challenge

Indicator	I F3fun and challenge
The game was fun. The game was challenging.	.79 .79
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	1.27 63.82% .50 .50

This analysis gives one Factor: F3 fun and challenge

Descriptive analysis for game materials

Table 36 Descriptive analysis for game materials

Indicator	N	Mean	Std. Deviation
The game materials – such as role descriptions – were understandable and clearly written.	76	2.8	1.11

Because it is only one indicator, no factor analysis was conducted.

Descriptive analysis engagement

Table 37 Descriptive analysis engagement

Indicator	N	Mean	Std. Deviation
The game held my attention.	76	2.9	1.02
I put a lot of effort into playing the game.	76	3.1	.85
I felt very motivated while playing the game.	76	3.1	.84

Factor analysis engagement

Table 38 Factor analysis engagement

Indicator	I F4attention, effort, motivation.
The game held my attention. I put a lot of effort into playing the game. I felt very motivated while playing the game.	.77 .83 .86
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	2.05 68.37% .67 .75

This analysis gives one Factor: F4 attention, effort, motivation.

Descriptive analysis performance and motivation

Table 39 Descriptive analysis performance and motivation

Indicator	**N**	**Mean**	**Std. Deviation**
I believe I performed very well in the game.	76	3.5	.95
I really wanted to win the game.	76	3.5	1.06

Factor analysis for performance and motivation

Table 40 Factor analysis for performance and motivation

Indicator	I F5performance, motivation
I believe I performed very well in the game. I really wanted to win the game.	.79 .79
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	1.24 62.42% .50 .50

This analysis gives one Factor: F5 performance, motivation.

Descriptive analysis role taking

Table 41 Descriptive analysis role taking

Indicator	**N**	**Mean**	**Std. Deviation**
I really put myself into my character.	76	3.6	.90
I was able to understand the alternatives from each round in a manner similar to that in which my character might understand them.	76	3.1	.99
I felt I could really get inside my character's head.	76	3.2	.82
At key moments, I felt I knew exactly what the character was going through.	76	2.9	1.04
I wanted my character to succeed in achieving its goal.	76	3.6	.83

Factor analysis role taking

Table 42 Factor analysis role taking

Indicator	I F6role taking
I really put myself into my character.	.64
I was able to understand the alternatives from each round in a manner similar to that in which my character might understand them.	.63
I felt I could really get inside my character's head.	.71
At key moments, I felt I knew exactly what the character was going through.	.69
I wanted my character to succeed in achieving its goal.	.70
Eigen value	2.30
Explained variance	46.17%
KMO Measure of sampling adequacy	.73
Cronbach´s Alpha	.70

This analysis gives one Factor: F6 role taking.

Pretest factors

Descriptive analysis for pre awareness about stakeholders' interests and influence

Table 43 Descriptive analysis for awareness about stakeholders' interests and influence

Indicator	N	Mean	Std. Deviation
I am aware of what kind of interests stakeholders could have in a road infrastructure project.	79	3.7	.85
I am aware of the influence stakeholders could have in a road infrastructure project.	79	3.6	.77
I am aware of what kind of interests contractors could have in road infrastructure projects.	79	3.6	.63

Factor analysis for pre awareness about stakeholders' interest and influence

Table 44 Factor analysis for pre awareness about stakeholders' interest and influence

Indicator	I F7pre_ awareness stakeholders' interests and influence
I am aware of what kind of interests stakeholders could have in a road infrastructure project. I am aware of the influence stakeholders could have in a road infrastructure project. I am aware of what kind of interests contractors could have in road infrastructure projects.	.74 .79 .73
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	1.71 57.15% .63 .61

This analysis gives one Factor: F7 pre_ awareness stakeholders' interests and influence.

Descriptive analysis for pre identification of win-win solutions

Table 45 Descriptive analysis for pre identification of win-win solutions

I try to find win-win solutions (engineers vs. stakeholders) when working on technical projects.	79	3.9	.88

Because it is only one indicator, the factor can be noted F8 pre_identification win win solutions.

Descriptive analysis for pre thinking from the point of view of stakeholders

Table 46 Descriptive analysis for pre thinking from the point of view of stakeholders

As an engineer, I am aware about the importance of adopting a stakeholders' perspective when working on technical problems.	79	3.9	.82
I pay attention to stakeholders interests when working on technical projects.	79	3.7	.79
I think from the point of view of stakeholders when dealing with dilemmas in technical projects.	79	3.3	.92

Factor analysis for pre thinking from the point of view of stakeholders

Table 47 Factor analysis for pre thinking from the point of view of stakeholders

Indicator	I F9pre_thinking from the point of view of stakeholders
As an engineer, I am aware about the importance of adopting a stakeholders' perspective when working on technical problems.	.79
I pay attention to stakeholders interests when working on technical projects.	.77
I think from the point of view of stakeholders when dealing with dilemmas in technical projects.	.83
Eigen value	1.82
Explained variance	60.94%
KMO Measure of sampling adequacy	.64
Cronbach´s Alpha	.67

This analysis gives one Factor: F9 pre _thinking from the point of view of stakeholders.

Learning outcomes factors

Descriptive analysis for post awareness about stakeholders' interests and influence

Table 48 Descriptive analysis for post awareness about stakeholders' interests and influence

Indicator	N	Mean	Std. Deviation
I am more aware of what kind of interests stakeholders could have in a road infrastructure project.	76	4.0	.34
I am more aware of the influence stakeholders could have in a road infrastructure project.	76	4.0	.34
I am more aware of what kind of interests contractors could have in road infrastructure projects.	76	3.9	.30

Factor analysis for post awareness about stakeholders' interest and influence

Table 49 Factor analysis for post awareness about stakeholders' interest and influence

Indicator	I F10post_awareness stakeholders' interests and influence
I am more aware of what kind of interests stakeholders could have in a road infrastructure project. I am more aware of the influence stakeholders could have in a road infrastructure project. I am more aware of what kind of interests contractors could have in road infrastructure projects.	.83 .90 .79
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	2.14 71.45% .65 .79

This analysis gives one Factor: F10 post_awareness stakeholders' interests and influence

Descriptive analysis for post identification of win-win solutions

Table 50 Descriptive analysis for post identification of win-win solutions

I will better try to find win-win solutions (engineers vs. stakeholders) when working on technical projects.	76	3.9	.35

Because it is only one indicator, the factor can be noted F11 post_identification win win solutions.

Descriptive analysis for post thinking from the point of view of stakeholders

Table 51 Descriptive analysis for post thinking from the point of view of stakeholders

As an engineer, I am more aware about the importance of adopting a stakeholders' perspective when working on technical problems.	76	4.0	.36
I will pay more attention to stakeholders' interests when working on technical projects.	76	3.81	.55
I will better think from the point of view of stakeholders when dealing with dilemmas in technical projects.	76	3.84	.51

Factor analysis for post thinking from the point of view of stakeholders

Table 52 Factor analysis for post thinking from the point of view of stakeholders

Indicator	I F12post_willingness thinking from the point of view of stakeholders
As an engineer, I am more aware about the importance of adopting a stakeholders' perspective when working on technical problems.	.90
I will pay more attention to stakeholders' interests when working on technical projects.	.92
I will better think from the point of view of stakeholders when dealing with dilemmas in technical projects.	.91
Eigen value	1.74
Explained variance	58.30%
KMO Measure of sampling adequacy	.50
Cronbach´s Alpha	.50

This analysis gives one Factor: F12 post_willingness thinking from the point of view of stakeholders.

Implementation factors

Descriptive analysis for awareness about stakeholders' interests and influence

Table 53 Descriptive analysis for awareness about stakeholders' interests and influence during implementation

Indicator	N	Mean	Std. Deviation
I was aware of what kind of interests stakeholders could have in a road infrastructure project.	59	3.0	1.2
I was aware of the influence stakeholders could have in a road infrastructure project.	59	2.9	1.1
I was aware of what kind of interests contractors could have in road infrastructure projects.	59	3.2	1.2

Factor analysis for awareness about stakeholders' interest and influence

Table 54 Factor analysis for awareness about stakeholders' interest and influence during implementation

Indicator	I F13impl_awareness stakeholders' interests and influence
I was aware of what kind of interests stakeholders could have in a road infrastructure project. I was aware of the influence stakeholders could have in a road infrastructure project. I was aware of what kind of interests contractors could have in road infrastructure projects.	.90 .91 .76
Eigen value Explained variance KMO Measure of sampling adequacy Cronbach´s Alpha	2.25 75.11% .65 .82

This analysis gives one Factor: F13impl_awareness stakeholders' interests and influence.

Descriptive analysis for identification of win-win solutions

Table 55 Descriptive analysis for identification of win-win solutions during implementation

I tried to find win-win solutions (engineers vs. stakeholders) when working on technical projects.	59	2.7	1.1

Because it is only one indicator, the factor can be noted F14 impl_identification win win solutions.

Descriptive analysis for thinking from the point of view of stakeholders

Table 56 Descriptive analysis for thinking from the point of view of stakeholders during implementation

I was aware about the importance of adopting a stakeholders' perspective when working on technical problems.	59	3.0	1.0
I paid attention to stakeholders interests when working on technical projects.	59	3.0	1.2
I was thinking from the point of view of stakeholders when dealing with dilemmas in technical projects.	59	2.9	1.0

Factor analysis for thinking from the point of view of stakeholders

Table 57 Factor analysis for thinking from the point of view of stakeholders during implementation

Indicator	I F15impl_thinking from the point of view of stakeholders
I was aware about the importance of adopting a stakeholders' perspective when working on technical problems.	.89
I paid attention to stakeholders interests when working on technical projects.	.87
I thought from the point of view of stakeholders when dealing with dilemmas in technical projects.	.86
Eigen value	2.30
Explained variance	76.85%
KMO Measure of sampling adequacy	.72
Cronbach´s Alpha	.84

This analysis gives one Factor: F15 impl_thinking from the point of view of stakeholders.

Appendix J: Quantitative results - Correlations

Game experience – Learning outcomes

Table 58 Correlations Game experience – Learning outcomes

		F2 Tasks in the game	F3 Fun and challenging	F1 Objectives of the game	F4 Attention, effort, motivation in the game	F5 Winning desire, performance in the game	F6 Role taking	The game materials
F10 post_awareness stakeholders interests_influence	Pearson Correlation	,219	,146	,280*	,016	,182	,161	-,034
	Sig. (2-tailed)	,057	,209	,014	,894	,115	,166	,770
	N	76	76	76	76	76	76	76
F12 post_thinking from the point of view of stakeholders	Pearson Correlation	,203	,246*	,436**	,005	,136	,236*	,135
	Sig. (2-tailed)	,078	,032	,000	,962	,240	,041	,246
	N	76	76	76	76	76	76	76
F11 post_identification of win-win solutions	Pearson Correlation	,239*	-,059	,217	-,069	-,007	-,068	,146
	Sig. (2-tailed)	,038	,615	,060	,556	,953	,562	,208
	N	76	76	76	76	76	76	76

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There are five statistically significant correlations between the game experience and learning outcomes. The correlation between the objectives in the game and the willingness to think from the point of view of stakeholders is high moderate. The other four correlations are moderate.

Game experience – implementation outcomes

Table 59 Correlations Game experience – implementation outcomes

		The game materials	F3 Fun and challenging	F1 Objectives of the game	F2 Tasks in the game	F4 Attention, effort, motivation in the game	F5 Winning desire, performance in the game	F6 Role taking
F13 impl_stakeholders interests_influence	Pearson Correlation	-,297*	-,212	-,121	-,080	-,131	,167	-,147
	Sig. (2-tailed)	,023	,107	,361	,548	,324	,207	,268
	N	59	59	59	59	59	59	59
F15 impl_thinking from the point of view of stakeholders	Pearson Correlation	-,341**	-,248	-,087	-,071	-,095	,108	-,130
	Sig. (2-tailed)	,008	,058	,513	,593	,475	,416	,326
	N	59	59	59	59	59	59	59
F14 impl_ identifications win win solutions	Pearson Correlation	-,252	-,086	-,152	-,071	-,233	,075	-,019
	Sig. (2-tailed)	,054	,518	,251	,595	,075	,571	,884
	N	59	59	59	59	59	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There are only two significant correlations between the game experience and the implementation. These correlations are negative moderate and refer to the correlation between the game materials and the implementation of awareness about stakeholders' interests and influence and between the game materials and the implementation of thinking from the point of view of stakeholders.

Learning outcomes – Pre knowledge

Table 60 Correlations Learning outcomes – Pre knowledge

		F7 Pre_stakeholders interests_influence	F8 pre_identification win win solutions	F9 pre_thinking from the point of view of stakeholders
F10 post_stakeholders Interests_influence	Pearson Correlation	-,061	,091	,192
	Sig. (2-tailed)	,600	,435	,097
	N	76	76	76
F12 post _ thinking from the Point of view of stakeholders	Pearson Correlation	,016	,124	,314**
	Sig. (2-tailed)	,892	,286	,006
	N	76	76	76
F11 post_ identification of win win solutions	Pearson Correlation	-,087	,114	,042
	Sig. (2-tailed)	,456	,325	,720
	N	76	76	76

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There is only one significant correlation between the learning outcomes factors and pre knowledge factors. The correlation is moderate and refers to the correlation between the pre willingness to think from the point of view of stakeholders and the post willingness to think from their point of view.

Learning outcomes – implementation outcomes

Table 61 Correlations Learning outcomes - implementation outcomes

		F10 post_stakeholders Interests_influence	F12 post_ thnking from The point of view of stakeholders	F11post_ identification of win win solutions
F13 impl_stakeholdersInterests_influence	Pearson Correlation	-,094	-,069	-,041
	Sig. (2-tailed)	,478	,606	,760
	N	59	59	59
F15 impl_ thnking from the point of view of stakeholders	Pearson Correlation	-,110	-,133	-,042
	Sig. (2-tailed)	,408	,316	,749
	N	59	59	59
F14 impl_ identification of win-win solutions	Pearson Correlation	,010	,070	,135
	Sig. (2-tailed)	,941	,599	,309
	N	59	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There are no significant correlations between the learning outcomes and implementation outcomes.

Game experience factors

Table 62 Correlations Game experience factors

		F3 Fun and challenging	F1 Objectives of the game	F2 Tasks in the game	F4 Attention, effort, motivation in the game	F5 Winning desire, performance in the game	F5 Role taking	The game materials
F3 Fun and challenging	Pearson Correlation	1	,271*	,062	,081	-,060	,203	,129
	Sig. (2-tailed)		,018	,595	,487	,607	,079	,266
	N	76	76	76	76	76	76	76
F1 Objectives of the game	Pearson Correlation	,271*	1	-,037	,296**	,128	,118	,110
	Sig. (2-tailed)	,018		,752	,010	,270	,309	,343
	N	76	76	76	76	76	76	76
F2 Tasks in the game	Pearson Correlation	,062	-,037	1	,037	,361**	-,013	,063
	Sig. (2-tailed)	,595	,752		,752	,001	,912	,588
	N	76	76	76	76	76	76	76
F4 Attention, effort, motivation in the game	Pearson Correlation	,081	,296**	,037	1	,119	,238*	,048
	Sig. (2-tailed)	,487	,010	,752		,306	,039	,683
	N	76	76	76	76	76	76	76
F5 Winning desire, performance in the game	Pearson Correlation	-,060	,128	,361**	,119	1	-,009	,218
	Sig. (2-tailed)	,607	,270	,001	,306		,935	,059
	N	76	76	76	76	76	76	76
F6 Role taking	Pearson Correlation	,203	,118	-,013	,238*	-,009	1	,119
	Sig. (2-tailed)	,079	,309	,912	,039	,935		,306
	N	76	76	76	76	76	76	76
The game materials	Pearson Correlation	,129	,110	,063	,048	,218	,119	1
	Sig. (2-tailed)	,266	,343	,588	,683	,059	,306	
	N	76	76	76	76	76	76	76

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

There are 8 significant correlations between the game experience factors. They are all moderate correlations.

Pre knowledge factors

Table 63 Correlations Pre knowledge factors

		F7 Pre_stakeholders interests_influence	F8 Pre_identification of win win solutions	F9 pre_thinking from the point of view of stakeholders
F7 Pre_stakeholders interests_influence	Pearson Correlation	1	,054	,132
	Sig. (2-tailed)		,642	,257
	N	76	76	76
F8 Pre_identification of win win solutions	Pearson Correlation	,054	1	,245*
	Sig. (2-tailed)	,642		,033
	N	76	76	76
F9 pre_thinking from the point of view of stakeholders	Pearson Correlation	,132	,245*	1
	Sig. (2-tailed)	,257	,033	
	N	76	76	76

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

There are two significant correlations between the pre knowledge factors. The correlations are moderate.

Learning outcomes factors

Table 64 Correlations Learning outcomes factors

		F10 post_awareness stakeholders interests_influence	F12 post_thinking from the point of view of stakeholders	F11 post_identification of win-win solutions
F10 post_awareness stakeholders interests_influence	Pearson Correlation	1	,688**	,526**
	Sig. (2-tailed)		,000	,000
	N	76	76	76
F12 post_thinking from the point of view of stakeholders	Pearson Correlation	,688**	1	,468**
	Sig. (2-tailed)	,000		,000
	N	76	76	76
F11 post_identification of win-win solutions	Pearson Correlation	,526**	,468**	1
	Sig. (2-tailed)	,000	,000	
	N	76	76	76

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

All the factors from the learning outcomes are highly significantly correlated between them.

Implementation outcomes factors

Table 65 Correlations Implementation outcomes factors

		F13 impl_stakeholders Interests_influence	F15 impl_ thnking from The point of view of stakeholders	F14 impl_ identification of win win solutions
F13 impl_stakeholders Interests_influence	Pearson Correlation	1	,881**	,727**
	Sig. (2-tailed)		,000	,000
	N	59	59	59
F15 impl_ thnking from The point of view of stakeholders	Pearson Correlation	,881**	1	,680**
	Sig. (2-tailed)	,000		,000
	N	59	59	59
F14 impl_ identification of win win solutions	Pearson Correlation	,727**	,680**	1
	Sig. (2-tailed)	,000	,000	
	N	59	59	59

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

All the factors from the implementation outcomes are highly significantly correlated between them.