

***Understanding the influence of individual and group risk attitude on risk decisions in marine construction projects***



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## Colophon

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## Preface

Firstly, I would like to express my heartfelt gratitude to my company supervisor Cheung Yao Ting and to Charlotte Garcia and Johan Barbaix for their invaluable participation and involvement in this research. The hours they dedicated to make sure the interviews and the workshops were organized properly as well as for the adaptation and testing of the serious game made this project possible. Moreover, their friendly attitude as well as their professionalism created a pleasant and efficient environment for me to develop this research.

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Alexandru Ion Rizea



## Abstract

The construction industry is one of the biggest, most complex industries in the world, employing millions of people worldwide. This industry, like many others, is subject to uncertainty and more often than not, this results in projects failing to meet the initial goals. Some publications mention concerning numbers, stating that nine out of ten projects are faced with cost overruns. The marine construction industry is no exception, especially given its accelerated growth in the last years. Here, practitioners are faced with a multitude of risks because of factors such as the uniqueness of the projects, lack of data or the novelty of the used technology. Risks are uncertain events, which, if they occur, have a positive or negative influence on the project goals. To deal with these risks, the process of 'Risk management' was developed, which is used to identify, analyse, and mitigate the said risks. However, despite the best efforts, many projects still fail to achieve their initial objectives.

One of the causes associated with these failures is an inappropriate 'risk appetite' which is an internal tendency to take risk in a given situation. However, risk appetite is unmeasurable, a proxy being needed to express it, namely 'risk thresholds. These thresholds represent the boundaries of tolerance around project objectives and are directly influenced by 'risk attitude', which is the chosen response when faced with risk. Risk attitude is the only factor which can be adjusted in order to ensure appropriate risk thresholds are set. However, the literature on risk attitude is limited, particularly regarding its relation to the risk management process and it is therefore essential to improve the understanding on the subject.

To do this, three methods have been used throughout this research, namely a literature review was performed, followed by a series of semi-structured interviews and finally by two workshops in which serious gaming was used. The main findings from literature were regarding the two dimensions of risk attitude, namely individual risk attitude and group risk attitude. In both settings there are several factors influencing the choice of attitude. In the case of the first setting, the literature mentions the triple strand containing conscious, subconscious, and affective factors. Apart from these, several others are mentioned such as situation and age, gender, or culture of subjects. On the other hand, in the case of group risk attitude, factors such as group dynamics, organisational culture and hierarchy are stated. To understand the latter, the literature argues that it is essential to first understand the risk attitude of the individuals.

In the second stage, the seven semi-structured interviews were organized in an online setting and interviewees were asked questions concerning the risk management process as well as the way they make risk decisions. This resulted in several conclusions such as the fact that the complexity and strategic importance of projects lead to a more, or less intense risk management process as well as a shifting of decisions higher or lower on the hierarchical ladder. Additionally, it was determined that the main factors taken into consideration when risk decisions are made are the available information, the previous experiences and expertise of the practitioners and the financial strategy surrounding the project at hand. It was also observed that practitioners with lower hierarchical functions have a slight aversion to making decisions, and that higher management employees are more risk seeking. Moreover, in group settings, the hierarchy and proximity of participants were determined to have very strong influences on the risk attitude of the group, and influences are searched for when information is to be acquired.

The last stage involved the use of serious gaming in two workshops. The used game was called 'Maritude' and it was developed as a simulation of reality, in which players were required to collaborate and complete several projects of various difficulties in order to make profit. Each player had several tools at their disposal which they could use to mitigate risks, however subjective factors were present which provided them with advantages or disadvantages. A total of three methods were used to gather information, namely the games were logged, and observations were made during gameplay, a questionnaire was provided to the participants and a discussion took place at the end of the workshops during debriefing. From these some conclusions were drawn regarding the individual attitude of the participants as well as the interaction between them. Among the main findings was the fact that the risk aversity of the players was inverse proportional to their understanding of the game, therefore the presence of information. However, as the difficulty of the game increased alongside the pressure and the fear of loss, participants became risk averse once again and started making mistakes. Moreover, in terms of group risk attitude, every game had one player who was more vocal and tried to influence others, and although in some cases this was associated with a faster understanding of the game, in others this was a result of character traits alone. In both cases strong influences were exercised on group decisions, and these were not always positive, with players being distracted and opportunities being missed.

All the results from the three methods were put together and a decision tree was devised which can be used to trace the modification of risk attitude depending on the setting of the decision. Both individual and group factors were included as well as external factors such as project choice and strategy. It was concluded that the presence or lack of information and expertise is one of the most influencing factors when it comes to risk attitude, practitioners being highly averse when they do not possess enough knowledge regarding the risk at hand. The importance of the project also causes changes in attitude, with more strategic or essential projects being approached with a risk seeking behaviour and vice versa. Another vital influence is caused by the setting of the decision, as people become more risk seeking when this is done as part of a group. This is caused by an improved search for solutions, but the group setting also allows for some to avoid responsibility and "hide in the crowd". Moreover, the communication within the group played a critical role in the forming of attitudes during the four games, as players became more risk seeking when the communication improved. Additionally, it was concluded that risk attitude has an influence on every stage of the risk management process, from identification to implementation of mitigation strategies and feedback. Understanding risk attitude and its influences on decision-making is essential to limiting the negative impact of the human factor on the risk management process.

The awareness towards risk attitude needs to be increased and the concept requires consideration throughout the risk management process if appropriate and educated decisions are to be made. Although this research was focused on the marine construction industry, the findings are of a more general applicability and can be used by practitioners to understand their decisions and ensure that the human factor is taken into consideration.

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## 1. Introduction

Society at large is faced with unprecedented levels of uncertainty and the construction industry is no exception. As Hillson states (Hillson & Murray-Webster, 2012), "Leaders and managers of organisations, from the biggest government to the smallest family unit, have no choice but to make decisions about how to respond to uncertainty all around them". This uncertainty brings with itself a wide range of risks that need to be taken into consideration when making those decisions.

One of the largest industries in the world is the construction industry. An article from Market Prospects (Market Prospects, 2021) claims that more than 100 million people worldwide are employed in the construction business, which also contributes 6% to the world's gross domestic product. Regarding the European Union, this sector supports 15 million jobs and adds roughly 4.8 percent to the Union's GDP. Additionally, in 2018 it increased by almost 6.4 percent annually. This massive and growing industry is not without uncertainty and risk, which makes it challenging to finish projects in accordance with the original objectives. Cost and schedule overruns affect most projects, either significantly or to a smaller degree. In fact, nine out of ten projects have cost overruns, according to research by Aljohani (2017), while just one out of three contractors complete the project on schedule, per a separate study (Wolfe, 2021). According to Ullah et al. (2021), 65 % of megaprojects fail due to technological, financial, socio-economic, and environmental reasons.

A part of this big, complex and risk prone industry is marine construction. This is also part of the so-called Blue Economy, a concept that covers all industries that take place at sea. A book by Johnson et al. (2018) goes further and distinguishes between blue economy and blue growth, the first referring to fisheries, offshore oil and gas, shipping and shipbuilding, tourism and recreation and the latter to aquaculture, blue biotechnology, seabed mining, wave and tidal energy, offshore wind energy. According to the same publication, 40 percent of Europeans live in coastal regions, and the Blue Economy generates about 5.4 million jobs and almost 500 billion euros in GVA (Gross Value Added) annually. The Blue Economy is critical to the welfare of the society given that it supports trade and transport, food and health, energy and raw materials, labour and leisure, protection, and environmental development. Moreover, considering the limitations for growth for land-based industries, blue growth is seen as an opportunity for development. The European Commission went as far as including blue growth in the Europe 2020 strategy (EUR-Lex - 02\_2 - EN - EUR-Lex, 2015).

About two thirds of the earth's surface is covered with water, which offers great opportunities for marine development, but this does not come without challenges. The projects are subjected to a broad range of risks, and this is the result of various factors such as the uniqueness of each project, the lack of necessary data for appropriate planning or the use of new technology (El-Reedy, 2021). A different study by Karami and Olatunji (2018) identified uncertainties, safety issues, terrain constraints, complexity of design and construction methods and limited access to support infrastructure as some of the challenges such projects pose and claim that they lead to maritime projects being more challenging than conventional projects. For example, external factors such as changes in market can greatly influence the outcome of the project. The Spoilbank marina project in Western Australia saw

an increase of more than 50% in cost, from 121 million USD to 187 million USD. Officials stated that the overrun was mainly due to the increase in cost for dredging activities, and that the initial estimates from 2019 were made in a different market (Gorman, 2022). This is just one example of risk that influences the outcome of maritime projects. The success of these projects is usually dictated, but not limited to achieving the initial requirements in terms of schedule, budget, quality and safety (Karami & Olatunji, 2018). Other success factors include environmental considerations, reputation, social impact etc.

To deal with these risks, companies have processes put in place that are meant to identify, analyse, and decide on the appropriate reaction to said risks. These processes are influenced by the way companies and people perceive risk. According to Ullah et al. (2021), “a well-defined risk appetite ensures that all decisions taken throughout the course of a project are consistent with an organization’s ultimate strategic aim.” Besides appetite, there are several other principles in literature that are meant to help practitioners understand people’s approach to risk, such as risk perception, risk threshold, risk attitude. All these principles influence and are important to the decision-making process.

Risk appetite and risk attitude have been given increasing attention in the past years due to their strong influence on the risk management process. As Hillson mentions in his paper (Hillson, 2012), “Risk appetite is an internal tendency to take risk in a given situation, and it reflects organisational risk culture and the individual risk propensities of key stakeholders”. When analysing a project, there are a multitude of factors that can influence the outcome and that need to be considered in order to make decisions, a process which is influenced by the willingness to take risk or not.

Risk appetite is difficult to measure since it is an internal desire, just as the appetite for food, which is usually expressed through externally measurable terms (Hillson, 2012). Therefore, risk appetite can be expressed through a proxy called risk thresholds, which are external expressions of it. These thresholds are created in regard to the objectives of the project, and they allow for the appetite to be measured objectively and externally (Hillson, 2012). According to Hillson and Murray-Webster (2012), the concept of risk appetite is part of the control mechanisms used to develop strategies in order to deal with the uncertainty associated with construction projects. These aim to find a balance between cautiousness and acting based on one’s instinct, and understanding the trade-offs being made when deciding on a course of action. According to the same publication, the aforementioned thresholds are influenced by the chosen risk attitude of stakeholders. In their book, Hillson and Murray-Webster (2016) provide two definitions for attitude, one being a certain state of mind or mental view regarding a fact or state and the second one being the position in space of an object in relation to a reference plane. Both of these definitions refer to a chosen response to a situation, therefore this study aims to offer a better understanding of how these responses influence decisions if appropriate risk decisions are to be made.



## 2. Project definition

### 2.1. Problem description

As stated previously, marine construction projects, just as conventional projects, are subject to failure, but what is project failure? According to Pinto and Mantel (1990), there are three aspects of project performance against which success or failure can be judged. These are the implementation process itself, the perceived value of the project and the client satisfaction with the delivered project. While the last two are related to external factors, the first one relates to the internal efficiency of the implementation process, which is the focus of this research. This aspect includes criteria such as schedule, budget, technical goals etc. A different study considers success criteria as essential in construction projects, and a means to define project failure (Karami & Olatunji, 2018). They argue that a project's success or failure is determined by how well its objectives are met. Therefore, failure can be defined as an inability of the implementation process to meet the initial project goals.

Karami and Olatunji (2018) state that “marine projects require extreme management strategies to undertake complicated activities in erratic environments” and that this requirement is intensified by the high level of uncertainty and activities with a high level of risk. Moreover, it is mentioned that marine construction is a part of the industry with high risk and intense investment and that risk management strategies are crucial towards successful completion of such projects. Given these considerations, uncertainty and risk need to be taken into consideration and managed to avoid failure.

Uncertainty can be defined as a lack of assurance that involves ambiguity and/or variability (Migilinskas & Ustinovičius, 2008). This means that in uncertain events the parameters are uncertain and that probabilities are unknown. Uncertainty leads to risk, however, not every uncertain event is a risk. According to Murray-Webster and Hillson (2008), risk can be defined in a very simplistic way as “uncertainty that matters”, and it is described by its probability of occurrence and the impact provided the risk occurs. In a more elaborate way, risk is defined as “an uncertain event or condition that, if it occurs, has a positive or negative effect on at least one project objective” El-Sayegh (2008). There are a multitude of risks present in marine construction projects, such as climatic nature of the area, insufficient data for design, equipment breakdown, unfavourable economic fluctuations etc. (Mohan, 2017). Moreover, given the usual size of these projects, there are multiple stakeholders involved such as governmental agencies, design and engineering firms, contractors, environmental groups etc., all of which must be taken into consideration. The risks need to be identified, analysed and an appropriate risk response must be chosen. However, many projects still fail to deal with these risks and end up missing one or more of the initial project goals.

To deal with risk, a process has been developed called Risk Management. This is broadly described and developed in literature and consists of four main stages, namely identification of risks, assessment, response, and monitoring. There are publications that add stages to this framework such as control activities and information and communication

(Bekefi et al., 2008) or a planning step at the beginning and a split-up of the assessment stage in two, a qualitative analysis and a quantitative analysis (Hillson, 2002). Despite small differences, most papers refer to the four steps mentioned earlier. According to Alansari and Nguyen (2019) an efficient risk management system should facilitate systematic and objective decision-making regarding risk, make it possible to compare the robustness of various projects with specific uncertainties, enable project managers to rank risks and offer a better understanding of projects based on those risks and should enhance the corporate experience and effective communication. However, despite the best efforts, some of these goals are not achieved and as mentioned earlier, failures still occur.

There are cases in which risk appetite is one of the causes for such failures, as Hillson and Murray-Webster state in their paper (2012, p.2), there are “reports on failures that are judged to have been caused by decisionmakers failing to understand how much risk they should take in a particular scenario.” If the appetite is not substantiated by factual data there is a risk of it being too high or too low, which in turn can result in a very close-minded approach that might not take into consideration the best course of action. Very often, these decisions fall on the shoulders of contractors and engineering companies, which can choose to avoid, transfer, mitigate, exploit, share, enhance or accept the risks (Landage et al., 2016). In the case of an inappropriate course of action, the consequences can vary from a very small margin of profit to, in the worst-case scenario, failure to fulfil the project goals. As stated before, in order to measure risk appetite, a proxy is needed, and this is called risk threshold (Hillson, 2012). In turn, these thresholds can be moderated using risk attitude, which is defined as the chosen response to risk, influenced by perception (Hillson, 2012). This attitude does not only influence the thresholds but also the risk actions, and it is present in every step of the risk process, from identification and assessment of risks to selection and implementation of risk responses (Hillson, 2012). Moreover, risk attitude is not only present at an individual level, but also within groups, and certain individuals have a greater influence on the attitude of the group than others (Murray-Webster & Hillson, 2008). What is important about this attitude is that it is chosen, and, if properly understood, it can be modified. Unfortunately, risk appetite and risk attitude aren’t broadly understood and considered in practice, decision makers being confused by what these concepts mean and what they need to do (Hillson & Murray-Webster, 2012). Moreover, there is little to no literature regarding risk attitude and how it influences decisions in marine construction projects and the literature concerning these concepts in general is not numerous. Therefore, there is a need to develop a better understanding of risk attitude and its relation to the risk management process, that can be used by decision-makers to improve the chances of success for their projects. The argumentation above results in the following problem statement:

*“Many marine construction projects fail because of inappropriate risk management driven by a lack of understanding in terms of the influence exercised by risk attitude.”*

The above-mentioned problem leads to the following research question:

*“How does individual and group risk attitude influence the risk management process in marine construction projects?”*

## 2.2. Sub questions

The above-mentioned question will be answered by first answering the following sub-questions:

- *What are individual and group risk attitude?*
- *How does the risk management process take place in marine construction projects?*
- *What are practitioners basing their decisions on and do they take the influence of risk attitude into consideration?*
- *How does the risk attitude of practitioners change throughout the risk management process, in both individual and group settings, and how does it influence their approach?*

## 2.3. Research objective and deliverables

This research aims to create a better understanding of risk attitude and how it influences the risk management process, that can be used in future projects in order to facilitate the management of risks. By doing this, a more informed decision-making process is expected that will improve the chances of choosing the right strategies and fulfilling the initial project goals. The company can use this research to improve the understanding of risk attitude among its employees in order to aid the decision-making process. This, in turn, may lead to more appropriate risk thresholds and risk appetite, that can subsequently result in an increase in the chances of success for their projects.

At the end of this research, a description of the influences exercised by both the individual and group risk attitude on decisions in marine construction projects will be delivered, alongside with the corresponding documentation and recommendations for future improvement. This will include the following:

- A practical representation of the relation between risk attitude and risk management
- Any tools used during the research and the belonging documentation.



### 3. Methodology

The first step of this research was conducting a literature review that acted as a foundation for the study, as well as for a series of questions for several semi-structured interviews and for the adaptation of a serious game. The interviews were used to get a better understanding of the decision-making process and of the awareness towards the influence of risk attitude on this process. After all the information has been gathered using these methods, it was included in a system analysis after which a serious game was adapted and used in several workshops in order to identify how the individual and group risk attitude influence the decision-making process regarding risk in marine construction projects. The process flow-chart is highlighted in Figure 1.

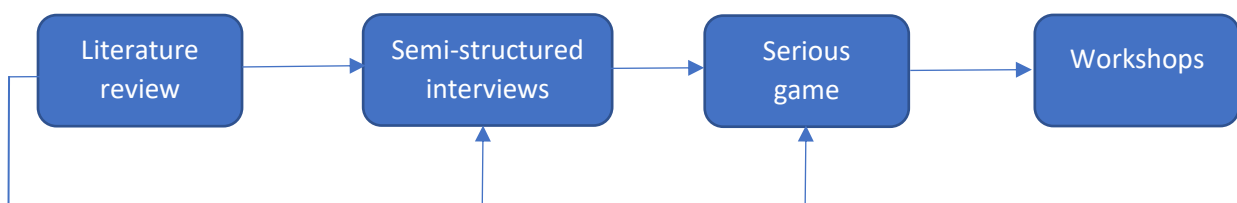


Figure 1: Research approach

In the first phase, in order to achieve a better understanding of the concept of risk attitude, a literature review was made. This allowed for an initial overview of the fundamentals of risk attitude, such as the definition and the main causes and drivers of risk attitude both individually and as a group. Besides gathering information about risk attitude, the literature also provided data about the risk management process, and particularities of the marine construction industry. These acted as a foundation for the second step, namely the acquisition of information regarding risk attitude and the decision-making process in practice and whether any influences of risk attitude on this process have been identified by practitioners. This took place through several semi-structured interviews with project managers and other relevant practitioners involved in the risk management process. Given that the problem at hand is of human nature, as Murray-Webster and Hillson (2008) claim in their work, “it is people who are most often the source of risk, and it is people who decide what level of risk is ‘acceptable’, and that the practical considerations are essential to the study, it was decided that interviewing people actively involved in making decisions regarding risk would be the most appropriate option. A total of seven interviews were taken to ensure a good amount of data is gathered. Participants were asked questions regarding the inner workings of the risk management process that is used in projects such as basis of the decisions, the involved specialists, and stakeholders, whether each step involves individual or group decisions etc. It was also asked if the participants have noticed, in their experience, influences on the decisions exercised either by their attitude or the attitude of others.

These two methods also ensured that both theoretical and practical aspects were included in the adaptation of the game in order to improve the relevance of the research and



the end results. To gather data concerning the influence of individual and group risk attitude, the decision process had to be observed. The option of joining several risk meetings in order to observe this process was analysed but due to the very high level these meetings take place at, their confidentiality and logistical difficulties concerning the organization of such meetings, this was not possible. Therefore, it was decided to simulate a decision-making scenario with the use of serious gaming, in which the participants would go through a similar process as in reality and the influences of their attitudes would be observed. This was decided after analysing several examples of serious games which have been used to simulate reality.

When the first two phases were finished, the adaptation of the game commenced. In this case the game was a physical one. The information gathered was used to develop a system analysis that contained the basic drivers of risk attitude found in literature, information regarding the decision-making process and its inner workings, a clear definition of the game's objective and any other relevant information that was related to the subject at hand. After the analysis, the initial concept of the game was developed using an already existing game, which was chosen so that it suits the purpose of the research and is fairly easy to adapt. This was tested, and refined in terms of game mechanics, score balancing, paraphernalia, etc. The use of an already existing game was chosen due to time limitations and complexity of creating and proofing a new game. In turn, this resulted into the pilot version of the game that was be played internally with the development team. The game was then further tested and refined to ensure that the gameplay is coherent, the game is easy to understand and play, the scoring or other mechanisms are balanced and the outputs are relevant to the research. This resulted in the final version of the game that was used in two workshops which allowed for an evaluation of the influences of risk attitude both individually and as a group. In order to increase the amount of information gathered even further, a questionnaire was developed and given to each participant after each workshop regarding the way decisions were made during the game and their overall experience. The answers were then analysed, and conclusions were drawn. The relation between the sub-questions and the research methods can be seen in Table 1.

Table 1: Research methods

Question	Method	Reasoning
Sub-question 1	Literature review	Review the literature on the subject of risk attitude and risk management in order to understand the basics and search for principles or concepts that can be used in the interviews and the serious game
Sub-question 2	Semi-structured interviews	This is done in order to collect information about the risk management process in-practice and risk attitude and its influence from practitioners involved in this process
Sub-question 3		
Sub-question 4	Workshops	These took place to determine how risk attitude, both individually and as a group, influences the decisions of participants and ultimately the risk management process

The three methods used in this research allowed for both theoretical and practical factors to be considered. Moreover, the use of serious gaming facilitated the immersion of the participants in the process and the acquisition of relevant and quality data.



## 4. Literature review

As mentioned earlier, the first step of this research consisted of a literature review covering the general aspects of risk management, the particularities of the marine construction industry, as well as information regarding risk appetite and attitude such as definition, influencing factors and relation between the two. This acted as a foundation for the following steps, namely the development of the interview questions and the system analysis on which the adaptation of the serious game was based.

Utilizing online resources and databases such as Google Scholar, the TU Delft repository, ScienceDirect, ProQuest, and ResearchGate the pertinent literature was gathered. Because the research was focused on risk attitude, the irrelevant papers were excluded using screening. The search was concentrated on papers containing information about the risk management process and the definitions of individual and group risk attitude and associated terms, as well as the drivers and factors influencing them. Additionally, some papers regarding serious gaming were also considered. The key words used in the screening were: "Risk Management", "Marine Construction", "Risk Appetite", "Risk Thresholds", "Risk Attitude", "Individual Risk Attitude", "Group Risk Attitude", "Influencing Factors", "Gamification", "Serious Gaming", "Game Design".

### 4.1. Risk management

The literature makes a parallel between uncertainty and risk, stating that "risk arises from randomness with knowable probabilities, whereas uncertainty reflects randomness with unknowable probabilities" (Hillson, 2009). The same publication defines risk as "uncertainty that, if it occurs, will affect achievement of objectives", and acknowledges risk as both positive and negative, emphasizing that this approach allows for a better use of opportunities and greater chances of success. A different paper defines risk as "expression of the likelihood and impact of an uncertain, sudden and extreme event that, if it occurs, may impact positively (opportunity) or negatively (threat) on the achievement of a project or program objective" (Mohan, 2017). The same paper states that offshore construction is faced with higher uncertainty than on-land construction, its projects being very complex and with a high number of participating stakeholders. This results mainly from the unfamiliarity of the environments and the scarcity, and the high cost of acquiring data. Some of the most encountered challenges are time risks, selection of faulty material, lack of formal training, improper use of management and planning tools, climatic nature of area, unqualified workforce, size of the projects, insufficient data for design, unfavourable economic fluctuations, labour shortage, inefficient training of human resources, lack of leadership quality and management, equipment breakdown and unfavourable political environment (Mohan, 2017).

When it comes to risk management, the literature provides an abundance of information and studies. This practice has become an essential part of project management and it is considered to be vital to project success. Risk management is a proactive way of addressing risks in such a way that threats are minimized, opportunities are maximized, and the achievement of project objectives is facilitated (Murray-Webster & Hillson, 2007). Until 1997, all publications regarded risk as solely negative in the risk management standards. This

changed after 2000, when most reports started considering risk management as inclusive of both threats and opportunities (Murray-Webster & Hillson, 2007). There are generally four main stages of risk management mentioned throughout literature, namely identification, analysis, response, and monitoring (Mohan, 2017), however certain papers further build upon these. Some define the steps as “1) Event Identification 2) Risk Assessment 3) Risk Response 4) Control Activities 5) Information & Communication, and 6) Monitoring” (Bekefi et al., 2008) whereas some provide more thorough processes, like Hillson (2002) who starts with a planning step and divides the analysis step into a qualitative and a quantitative analysis. The tools, techniques and process used for risk management have become very efficient, however, the process is often ineffective, and projects fail. The same publication by Murray-Webster and Hillson (2007) states that, the problem does not lie in the theory behind the process but in the way risk management is applied in practice. The risk culture and the attitude of individuals and organizations towards risk have a big influence on whether the Risk Management Process is successful or not. They further mention that risk attitude influences every step of the process.

#### 4.2. Risk attitude

To define risk attitude, it is first necessary to define risk appetite. According to Hillson (2012), it's essential to develop a way to make consistent decisions from a strategic point of view. This is done through control mechanisms and by deciding how much risk is to be taken in a certain situation. Risk appetite is “an internal tendency to take risk in a given situation, and it reflects organisational risk culture and the individual risk propensities of key stakeholders” (Hillson, 2012). This can be used to support strategy-making and effective management of risk, as well as setting boundaries for risk-taking. A well-defined risk appetite ensures that all the decisions made throughout a project are in line with the strategy of the company (Ullah et al., 2022). The same paper mentions a number of factors that influence the risk appetite of a company, such as size, strategic objectives, market competition, demographics, government and industry rules and regulations, organizational history of risk taking, pressure of its stakeholders, enterprise environmental factors and organizational process assets. However, the individual or group risk appetite “exists as a tendency independently of human choice” (Hillson & Murray-Webster, 2011) and it arises inherently. Consequently, risk appetite is intangible and cannot be measured, therefore requiring a proxy for this purpose. This role is filled by risk thresholds which are an expression of risk appetite, and which can be measured externally and objectively (Hillson & Murray-Webster, 2011). These thresholds represent higher and lower limits of tolerance around objectives, which can be, among others, of financial nature. An example of a tool used to define risk thresholds is VaR, a risk management tool used in the field of finance (Zhang et al., 2020). According to the same, above-mentioned paper, VaR is used to define a threshold value to measure the potential financial loss within a given period and at a certain confidence level. Risk thresholds are the convergence point between risk appetite and risk attitude, given that they are influenced by the chosen risk attitude (Hillson & Murray-Webster, 2011). The authors also mention three types of risk thresholds:



- Unmanaged - when they are set with no reference to appetite or attitude; in this case inherent risk exposure is not considered and there is no way of determining whether the chosen thresholds are appropriate
- Constrained - when they are consciously modified according to the risk appetite; a variety of internal factors are considered such as objectives, risk culture, risk propensity, however, the willingness of the organization or stakeholders to take risk is not considered
- Informed – when both the chosen risk attitude of stakeholders as well as other, wider organisational factors are taken into consideration when they are set; influences including subconscious cognitive biases and psychological heuristics, as well as affective emotional factors are considered, the risk attitude is managed so that the decisions are kept in line with the risk thresholds

The risk thresholds always need to be compared with the capacity of the company to bear risk (Hillson, 2012) and, if necessary, they can be modified through the altering of the risk attitude, as mentioned above.

A company's risk profile is an indicator of the management's perception of the risk-reward trade-off necessary to make the risk-taking viable (Cattell & Love, 2013). However, contractors typically are not aware of their risk profiles and have not quantified their risk attitudes.

There are several definitions for risk attitude in the literature. Hillson (2012) defines risk attitude as “a chosen response to risk, driven by perception, that can act as a control point to ensure that the right amount of risk is taken”. A similar definition is provided by Rohrmann (2005), who defines risk attitude as “a generic orientation towards taking or avoiding a risk when deciding how to proceed in situations with uncertain outcomes”. Weber et. al. (2002) provides a different definition for risk attitude, describing it as “nothing more than a descriptive label for the shape of the utility function presumed to underlie a person's choices”.

The relation between risk appetite, risk thresholds and risk attitude and influencing factors can be clearly observed in Figure 2 which represent the Risk Appetite-Risk Attitude model developed by Hillson and Murray Webster (2011).

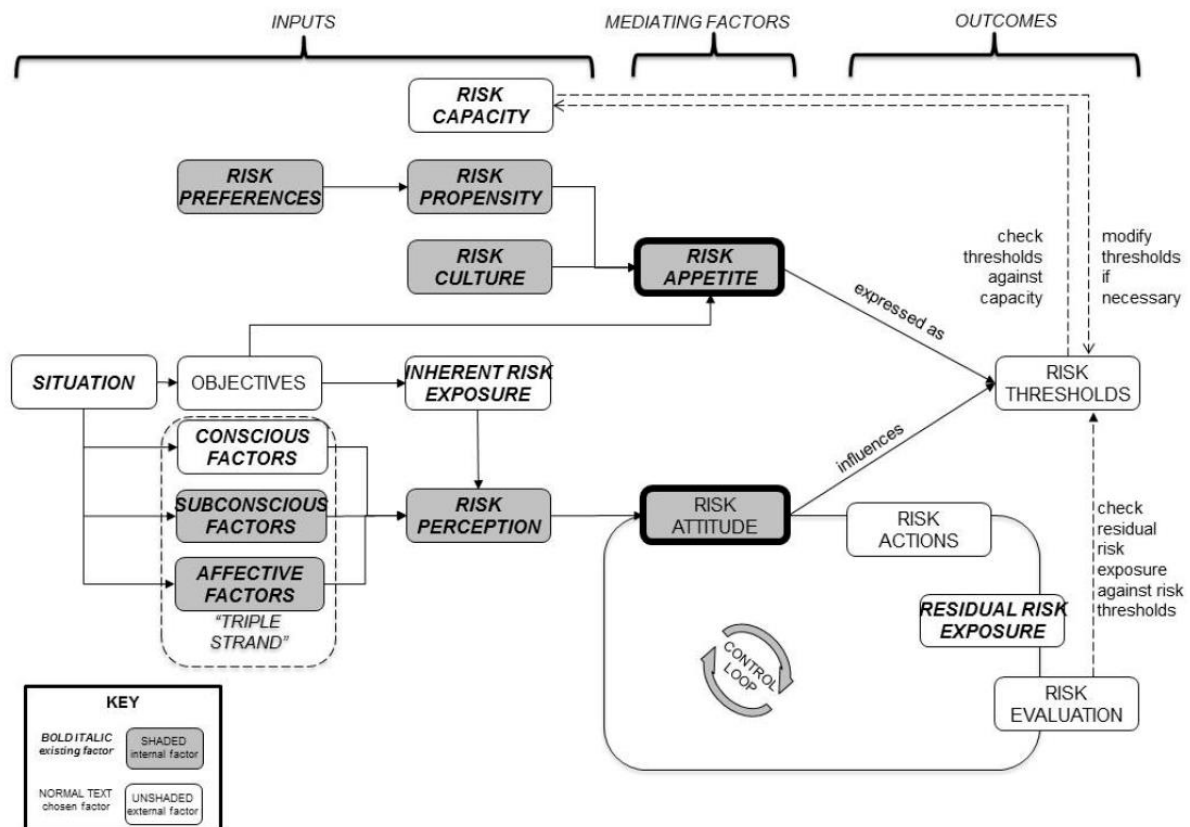


Figure 2: The Risk Appetite Risk Attitude model by David Hillson and Ruth Murray-Webster

As seen in the model above, risk preferences, which are risk-related personality traits of individuals, lead to risk propensity which is the inclination of an individual to act in a certain way when being faced with risk. This, in combination with the risk culture of the group or the company, which consists of “the common values and beliefs of a firm in risk and its significance in the decision-making process” (Ullah et al., 2022), lead to the risk appetite of the said group (Hillson & Murray-Webster, 2011). A third factor that influences the appetite are the project objectives. In a similar way, risk attitude is influenced by several factors. First, the situation leads to certain project objectives and influences the three types of factors which influence the risk perception, which Hillson calls the “triple strand”. These factors can be conscious, subconscious and affective/emotions. Second, the project objectives lead to the inherent risk exposure which also exists independently of people much like the risk appetite does (Hillson & Murray-Webster, 2011), and affects the risk perception which in turn leads to the risk attitude of the individual or group. The two lead to the risk thresholds which in turn are checked against the risk capacity of the company or group, which is the “organization’s maximum risk-bearing capacity in the pursuit of its goal” (Ullah et al., 2022). As seen in the figure, risk attitude is followed by risk actions which lead to a residual risk exposure, which refers to the remaining level of risk after mitigation measures have been implemented, that loops back and influences the risk perception. This mechanism allows for the risk attitude to be changed so that consequently the thresholds fit the risk capacity (Hillson & Murray-Webster, 2011). Given this control mechanism, it becomes vital to understand how the attitude influences the risk actions, which is the focus of this research.

As mentioned earlier, the triple strand contains three types of factors influencing perception and consequently attitude (Murray-Webster & Hillson, 2008). The conscious factors refer to situational and rational considerations such as familiarity which considers whether the person or group went through a similar experience in the past, or propinquity which expresses if the materialisation of the event matters to the individual on a personal level or not. The subconscious factors refer to heuristics and cognitive biases such as intuition, which shows if a certain action feels right or not to the person, or the illusion of control which exaggerates the personal influence and discounts luck. The third type of factors, affective ones, refer to emotions and feelings such as fear of the consequences or love, wanting more of something (Murray-Webster & Hillson, 2008). A more complete list of factors can be found in APPENDIX 1: Factors influencing risk perception and risk attitude.

Besides these factors, the literature mentions several others. One publication states that risk taking is domain specific and makes a clear distinction between risk perception and risk attitude (Weber et al., 2002). In their view, 'pure' risk attitude is always negative, whereas perceived-risk attitude has a more neutral standing. They argue that individual attitude can be found on the spectrum between risk seeking and risk averse and that the biggest influence is perception (Weber et al., 2002). This can be influenced by a number of factors such as the age and gender of the individuals as well as the risk-return framework which implies that "people's preference for risky options is assumed to reflect a trade-off between an option's expected benefit and its riskiness". Therefore, decision makers might perceive the magnitude of risk and returns to be similar in two domains but might prefer risk in one of the domains and dislike it in the other. Similarly, the perceived-attitude towards the risk in the two domains could be similar, while the perceived risks and benefits would differ. Here, the reflection effect is mentioned as the result of differences in perception regarding the riskiness of different alternatives (Weber et al., 2002). Furthermore, they argue that managers prefer options which are moderately risky and make a strong distinction between risk taking and gambling. Their list of factors influencing risk perception contains, besides age and expected return, controllability and manageability of the situation, cultural differences, personality variables, and after accounting for all these differences, perceived-risk attitude appears to be consistent across groups and domains (Weber et al., 2002). In their study, the authors mention that perceived-risk seeking is very rare, arguing that even the participants who reported that they have a tendency to be risk seeking did so believing that their behaviour was not risky or that it led to high benefits. The study was carried out across five domains and most of the participants were perceived-risk averse for all or most of the domains.

The same author mentions in a different paper that "people routinely compare the outcome of their chosen option with the outcome they could have gotten under the realized state of the world, had they selected a different option" and that they rejoice when the outcome of their choice is better than the alternative and regret when the opposite happens (Weber, 2010). However, the feeling of regret is usually stronger than the feeling of rejoicing, with decision-makers trying to predict these emotions and minimize regret after their decisions. Weber mentions in his paper that loss aversion has been shown to be a good indicator of risk preference. Moreover, he states that a greater sensation-seeking is linked to

a more positive perceived-risk attitude and that the way the information regarding the outcomes has been gathered also influences risk taking.

In his paper, Rohrmann states that risk attitudes are multi-dimensional and that the motivations for accepting risk vary depending on the type of hazard. The author makes a distinction between risk propensity instead of risk seeking and risk aversion, the two influencing not only the perception but also how the risk is appraised. Another term used in his research is perceived-risk magnitude, which refers to a person's judgement of how big the risk associated with the hazard is (Rohrmann, 2005), here magnitude referring to the impact of the risk. This builds upon the idea that perception is the most important consideration when it comes to risk attitude. Through the previous statement and others made by Rohrmann in his paper, such as "Risk orientations can be measured separately for hazard domains," it becomes clear that the author considers risk to be only negative, unlike Hillson who considers risk to have a dual character.

People are risk averse in the domain of gains and risk seeking in the domain of losses, and although they're perceived-risk averse in both cases, their risk perception differs in the two domains (Schwartz & Hasnain, 2002). The same paper mentions two accounts, a standard account, where higher variance options are riskier and preferred denoting variance seeking and risk seeking and the perceived-risk account, where lower variance options are considered riskier and avoided, showing variance seeking but risk aversity.

A very different opinion is given by Chater in his paper titled "The non-existence of risk attitude" (Chater et al., 2011). Here the authors argue that people's risky choices can differ widely depending on the range of the choices they are presented with and that their preferences can be changed by altering the range of options. Moreover, they state that imitative behaviour is widespread in the biological and social worlds and people also seek to copy their own past behaviour. One of the principles presented in the research is choice blindness. In the experiment, people are presented with two options and are asked to choose between them. Afterwards, the participants are shown their preferred option and are asked to explain their choice. However, when presented with the less preferred option, they typically fail to notice they have been given the wrong one and even come up with elaborate explanations for the choice they now think they made. This effect has been observed for taste and smell but also for moral judgements regarding hot political topics (Chater et al., 2011). Another principle mentioned by the authors is 'self-herding', which implies that people analyse their past behaviours, deduce some utility for it and act according to the concluded utility. Their conclusion is that the decision-making process should not be explained by referring to risk perception, but rather by understanding that people's risky choices are based on their past experiences or the explanations of those experiences made by themselves or others.

In order to analyse and modify risk attitude, the literature proposes the Six As Model (Hillson & Murray-Webster, 2011). The first two steps are *Awareness* of the current risk attitude and *Appreciation* of the factors that influenced the choice. This is followed by an *Assessment* step to determine whether the unmanaged attitude will lead to an acceptable outcome or not. In the case in which the attitude is deemed appropriate, it can be *Accepted*,

whereas, if intervention is needed, one must first *Assert* the need for change and then take *Action* to change the attitude.

#### 4.3. Group risk attitude

Besides the individual risk attitude, another principle that needs consideration is group risk attitude. According to Hillson and Murray-Webster (2015), “different things matter to different people to a different extent in different circumstances”. According to their paper, people belong to multiple groups such as family or religious congregations and each of these membership levels influence the individuals to a certain extent. This can be observed below in Figure 3 (Murray-Webster & Hillson, 2015).

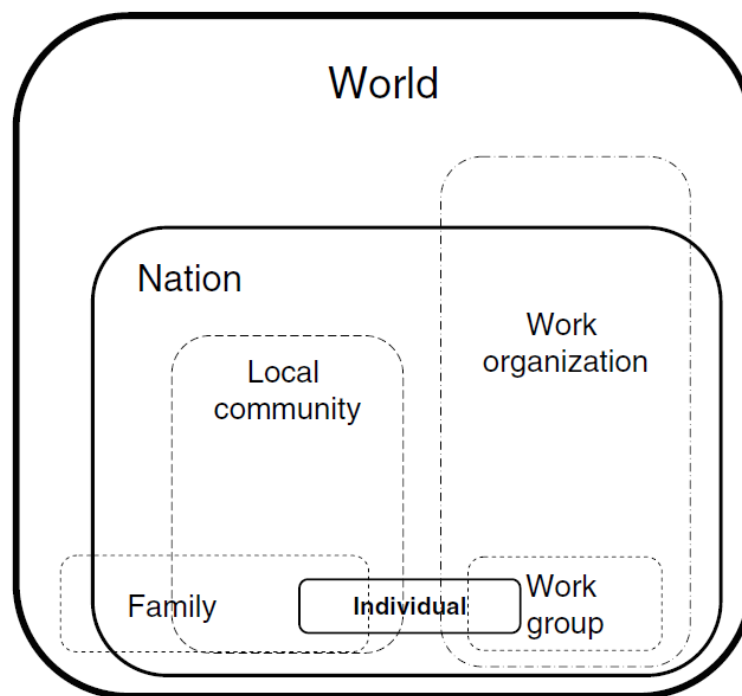


Figure 3: Membership hierarchy by David Hillson and Ruth Murray-Webster

Another influencing factor is the power or influence of individuals within a group as perceived by the group members. According to the authors, there are five types of power within a group:

- Referent power- where an individual is regarded as a role model by others.
- Expert power- based on relevant knowledge and expertise.
- Reward power- some individuals can deliver rewards to others.
- Coercive power- fear-based source of power that recognizes that some people can impose sanctions.
- Legitimate power- derives from a formal position in the group or organization.

The group dynamic refers to the social and psychological processes that differentiate the group from a random collection of individuals (Murray-Webster & Hillson, 2015). The best example of influence on group dynamics is ‘groupthink’ which implies that the group is more risk seeking or more risk averse than its individual members. Here, the illusion of safety in numbers is created, reducing the personal accountability for the decisions. Another factor is



represented by the organisational culture which refers to the basic assumptions and values that operate subconsciously and are assumed as the status quo. On a higher level, the national culture also has an influence on the group risk attitude. This refers to the typical values and behaviours of a nation that shape beliefs and expectations, an example being that certain countries have more respect for the hierarchical structure than others (Murray-Webster & Hillson, 2015). An additional factor are the societal norms which describe the values and behaviours that are acceptable to most citizens within a particular culture or subculture. Another principle worth mentioning is the propinquity which describes the closeness of the individual or the group to the situation or risk.

Moreover, the group dynamics, and social, organizational, and national norms and expectations are hard to compare against the above mentioned individual conscious assessments, subconscious heuristics, and affective emotions in terms of their influence on group risk attitude (Murray-Webster & Hillson, 2015). The authors state that the individual risk attitudes of the members are the biggest influencing factor of group risk attitude, followed by power and culture and that “group risk attitude is a function of the risk attitudes held by the individuals within the group and the whole is different from the sum of the parts”.

For the purpose of facilitating appropriate risk-taking, ten principles were summarized as follows (Hillson, 2010):

1. *Risk is uncertainty that matters* - different things matter to different people to a different extent in different circumstances
2. *Risk includes both downside(threat) and upside(opportunity)* – both need to be addressed proactively so that threats are minimized, and opportunities are maximized
3. *Zero risk is unachievable and undesirable* – all aspects of life involve risk, and require appropriate risk-taking
4. *Risk has two sides* – probability of the risk event taking place and the impact of the risk if the event happens
5. *Risk management requires understanding of both probability and impact*- if the event is unlikely to take place or if the impact would be negligible, then it requires less attention
6. *Risk management is affected by perception* – How uncertain is the event and how much does it matter?
7. *Perception is affected by many factors* – including the triple strand of conscious, subconscious, and affective factors
8. *Risk attitude is a chosen response to uncertainty that matters, driven by perception* – individuals and groups adopt risk attitudes either subconsciously or consciously, ranging from risk averse to risk seeking
9. *Risk attitude can be managed consciously* – emotionally literate individuals and groups respond instead of reacting; they understand which attitude best fits the situation they are faced with
10. *Managed risk attitudes promote effective risk management with appropriate risk-taking*

The first five principles refer to the well-known risk management process, whereas the last five principles are more concerned with risk attitude.

Documents concerning the risk management process used by DEME Group were also analysed at this stage. The information acquired was then correlated with the explanations given during the interviews and taken into account for the adaptation of the serious game.

As seen in this chapter, both individual and group risk attitude are influenced by an abundance of factors such as previous experiences, culture, gender, hierarchy, and group dynamics. This is important, as risk attitude has been observed to influence the risk management process. Moreover, most practitioners don't only lack the knowledge about this principle, but are also unaware of its influences.



## 5. Semi-structured interviews

As mentioned earlier, to gather data concerning the risk management process and the awareness towards risk attitude in practice, seven semi-structured interviews were taken from practitioners involved in the risk management procedure. Initially, a screening was done internally, within DEME Group, which resulted in fifteen potential candidates. This was based on function as well as involvement in the risk management process. After further consideration, the list was narrowed to seven specialists which were considered to be best suited and had the necessary availability.

The interviews took place online, using Microsoft Teams and were based on nine questions upon which discussion was carried further and which were as follows:

1. What is your function within DEME?
2. What is your involvement in the risk management process?
3. What are some particularities of risk management in your business?
4. What are the factors you take into consideration when making a decision in every stage of the process?
  - 5.1 Identification and evaluation of risk (major/minor; factual risk exposure via scenarios)
  - 5.2 Decision on mitigation strategy (preventive/corrective treatments, contingency budget build up/build down)
  - 5.3 Feedback and lessons learned
5. What are the differences between stages in the way decisions are made?
6. Could you give an example of influence on your decisions created by your attitude towards/perception of the certain risk/situation?
7. Are there cases in which decisions are also made in groups and if so, how do these meetings take place?
8. Do stakeholders who contribute to the risk management influence each other when making decisions and if so, how?
9. Could you give some examples of differences in the way decisions are made depending on the situation or project? Are decisions different in riskier projects for example?

### 5.1 Risk management in marine construction

The first two questions were aimed to further elaborate on the involvement of the participants in risk management. The interviews included employees from several departments such as project controls engineers and managers, process owners and tender engineers, coordinators, and managers. Their roles and tasks varied based on their function. Specialists from the tender department such as tender engineers were responsible for preliminary identification and analysis of risks, followed by preliminary mitigation strategies. Moreover, they were in charge of organizing meetings with higher management and presenting the preliminary assessments. Tender coordinators were required to identify and quantify all risks associated with the project at hand, from technical risks to contractual risks, whereas tender managers had to oversee the tender process and approve the risk profile, particularly in complex projects. On the other hand, project controls engineers were reporting, planning, and guiding the opportunity and risk management. The implementation of risk management across all projects and the consistency of the process across the company

was overseen by project controls managers. Their tasks included cooperation with the management team, such as project managers and planning engineers, response management towards clients and keeping track of the actions taken to mitigate risks and opportunities.

It was observed that in this particular case, unlike in the literature, the word 'risk' was used to describe the downside of uncertainty and 'opportunity' to describe the upside. From this, a process was developed to manage both called Opportunity and Risk Management (ORM).

Given the fact that risk attitude is domain specific, as mentioned in the literature, it was important to develop an understanding of particularities associated with marine construction. The participants had a similar opinion as the literature, which mentions that marine construction is faced with more uncertainty than on-land construction. The main challenges mentioned in the interviews were the weather, the soil conditions, the availability of assets and machinery and the overall scarcity or cost of gathering information. The interviewees agreed that the most difficult stage of the risk management process was the analysis and quantification of risks. Besides the difficulty of acquiring information to perform the analysis, it was mentioned that there exists a variance between the way different people analyse the same risks, leading to different results. Another problem raised during the interviews was that, given the high uncertainty, more practical risks arise during the execution stage and the parameters can change drastically. In comparison with onshore construction where projects are more stakeholder driven, marine construction tends to be more asset driven. Because of these factors, the industry tends to be threat oriented, however it is more risk accepting than the onshore construction industry. Another point raised during the interviews was that in the case of standard or simple projects, the approach is more risk averse whereas, if a project is considered very strategic, even given high complexity, the approach will be on the risk seeking side. Additionally, in the tender phase, due to the high uncertainty, it is necessary to be more risk averse to ensure that during execution there is more leeway and room for unexpected.

The fourth question referred to the factors which are taken into consideration when a decision is made. All the respondents mentioned hard factors such as technical knowledge, budget, and project objectives. The one other factor which was brought up across the interviews was the experience of individuals. Interviewees stated that when analysing risks, they first compare the situation with their previous experiences, which is in line with the literature in which this factor is mentioned as a strong influencer of risk attitude. However, most of them, particularly the ones with hierarchically lower functions, were reluctant when decisions were mentioned, stating that only higher management makes decisions, whereas they only develop scenarios and options. This showed a certain risk aversion or even a slight responsibility aversion based on the misconception that only the final decisions concerning the mitigation strategies are actual 'decisions'. In reality, the identification and analysis of the risks are accompanied by a multitude of decisions, such as whether an uncertain event is a risk or if a certain risk has a higher impact than another. Some practitioners did mention factors related to attitude such as culture and, particularly the perception of the risks when it comes to analysing them, as well as a tendency of becoming more risk averse throughout the project due to the increase in awareness towards risks. Another factor mentioned was the

trust in other colleagues both from the same department and other departments and the feedback received from them, stating that even if they do not possess the expertise regarding a subject, they will assume others do and will deal with the issue.

In the following question, attendees were asked about differences between the stages of risk management regarding decision-making. The identification of risks, particularly the preliminary identification, is done mostly by the tender department internally, most of the time individually. During this stage, everything related to the project at hand is considered. This is further expanded upon with help from experts who have the required expertise, both internal and, when necessary, external. At this stage, the description of the risks contains more detail and only the relevant ones are considered for analysis. All the decisions made up until this point and the ones after need to be in line with the strategy decided upon up-front in the preparational stage. The identified and described risks are centralized in a register which needs to be approved by the tender manager before moving on to the next step, the analysis of risks. Here, more experts are being involved and meetings are organized, the decisions being made mostly in a group setting. The communication within the tender team and an open culture are promoted to facilitate the proper identification and analysis. Different specialists from different disciplines are involved and feedback is provided leading to a financial evaluation of the risks in order to construct a budget. However, it was mentioned during the interviews that most of the analysis is done by the tender team, which ideally should include more experts. After the risks have been considered and analysed, mitigation strategies are being drawn up and proposed to higher management in a validation meeting, where final decisions are being made. This is the point in the process that was considered by all interviewees as the decision-making point. Therefore, as the project team undergoes the risk management process, the involvement of multiple parties increases and the decision-making is shifted towards group decisions.

## 5.2 Individual risk attitude

The sixth question addressed the personal attitude of the participants and how it influences their decisions. Here it was also aimed to determine whether the interviewees are aware of their own attitudes. Most of them stated that their attitude or perception is influenced by their knowledge and previous experiences. In time, people build up a baggage of knowledge by taking part in projects and they approach future ones based on those experiences, once again similar to the findings in literature. Provided that a project is similar with one or more of the projects that the person worked on previously, they tend to be more risk seeking, believing that they know how to mitigate any arising risks. Here, the complexity of the projects is also relevant, simple ones being given less attention than more complex ones all together. Practitioners admitted that there is a downside to repetitive projects, stating that there is a tendency to become too comfortable with them and the associated risks, leading to some risks being missed or improperly quantified. On the other hand, some mentioned that if there are no or very few risks identified in a project, they will investigate into more detail and they will approach the project with extra care. Furthermore, if not all the details of the projects are understood, they will inquire until they have a good grasp of everything. Once again, as seen in question four, most participants mentioned only conscious and subconscious factors and considered themselves to be risk seeking, especially when



having all the necessary information at hand. Most mentions were about experience and environment, but culture was also brought up. A few interviewees did however bring up affective factors such as the 'gut feeling' or emotions, but their influence was deemed to be minor or insignificant on the decision-making. The vast majority of participants stated that they strive to achieve the lowest level of risk possible and that the lack of information or knowledge about a certain risk usually leads to a higher price tag for the said risk. From this it can be concluded that practitioners have a limited understanding of their risk attitude and its impact, much like the literature states.

### 5.3 Group risk attitude

The following two questions acted as an inquiry into group risk attitude. The main concern here were the setting of meetings and group decisions and the influences exerted by stakeholders on each other. Throughout the project, from the tender phase and the execution to feedback, there are several meetings in which various stakeholders with various types of expertise participate. Initially, at the beginning of the tender phase, a kick-off meeting is held where everyone is informed regarding the project goals and strategies by the tender manager. Several other meetings are held concerning the identification and quantification of risks and other orders of business, once again managed by the tender manager. The specialist participating in these meetings change according to the necessary input. This is followed by several other meetings as the tender phase advances. This is culminated by a risk focused meeting with higher management and with the relevant stakeholders, including external advisors (peers) if needed. In this meeting the risk register is discussed alongside the propositions for mitigation strategies, the focal point being on the major risks. All participating parties are encouraged to offer their input and share their concerns. The higher management, including financial managers, operations managers, project managers etc. then make the final decisions based on the information they were provided with by the internal and external stakeholders and their own experience. If very urgent or difficult matters need to be addressed, an even higher-level meeting can be organized to solve the issues. After the tender phase, regular meetings are held through the project execution stage, with the relevant project personnel and higher management where progress is discussed and the view on risks is re-evaluated. Once again, communication and openness are emphasized. Several other sessions are held and even sought, involving external stakeholders aiming to acquire all the relevant expertise and information. After the delivery of the project, feedback is provided and shared with the tender team, however this is not particularly descriptive regarding the challenges of the execution phase. The findings confirm two principles found in literature, namely the presence of the different types of power in a group (expert, legitimate etc.), as well as the importance of propinquity.

Most participants agreed that during the meetings mentioned above, certain stakeholders exercise influences upon others. It was mentioned that with every risk there is a leading party which is closest to the occurrence of the risk or has the most amount of expertise on the subject. This party is the one which tends to have the highest influence on the discussion. The stakeholders who stand to be affected most because of the risk tend to be the most vocal as well. When the necessary information cannot be sourced internally, external expertise is acquired, in which case influence is sought for due to the knowledge that is to be collected.

Furthermore, influence is exercised upon external stakeholders in order to attempt and bring them to a neutral or supporting attitude towards the project strategy. Generally, the influences mentioned by the interviewees were related to the information or lack of it, however a few others were mentioned as well. The first other influence was the hierarchy within the company. In the scenario in which the opinion of a junior employee would contradict the opinion of a senior employee, the experience and rank of the latter would dictate the outcome of the decision in most cases. However, if the argument presented is described well and is consequently perceived and understood well, the discussion can be diverted in the favour of the argument. Nonetheless, this is usually only viable for adding to the point rather than changing the direction of the argument altogether. The second type of influence mentioned was the character of the speaker. Extroverted and out-spoken people tend to monopolize the discussions and push their view across, in comparison with introverts who might avoid voicing their opinion if seniors are attending the meeting. However, this type of influence is limited according to the participants, the leading factors in group attitude being expertise and hierarchy. These findings are to some degree similar to the ones in the literature, especially concerning the hierarchy and power, however it appears that practitioners do not take into consideration individual characteristics such as attitude.

The last question addressed the influences created by differences between projects. The participants stated, unanimously, that decision making regarding risk changes based on how strategic or wanted a certain project is. In the case in which there is a strong desire to work with a certain client or if the project is a joint venture, then the risk decisions will change to accommodate the objectives. Similarly, given that the marine construction industry uses big assets such as ships, it is undesirable to have them stationary not only because they do not produce revenue, but also because they are expensive to maintain. Thus, projects might be taken in order to keep the assets functional even though they might not deliver the highest amount of profit. Therefore, uncertainty is not the main factor when making decisions, but rather the strategy and the objectives of the projects, mainly financial considerations. Furthermore, the participants mentioned that riskier project usually come with higher benefits, resulting in a higher amount of risk being accepted. In this case, the risk management process does not change with the exception being the frequency of the meetings, which increases along with the riskiness. On the other hand, for easier and less risky projects, the decision-making becomes more low-level compared with difficult ones where the final decisions are taken by higher management. However, it was also mentioned that the riskier and more uncertain the project, the more risk averse the project team tends to become throughout the project. Therefore, the literature concept of risk attitude being highly situational dependant is once more confirmed.

## 5.4 Conclusions

Several conclusions were drawn after the interviews, regarding both the risk management process and the risk attitude of the participants and their awareness. Firstly, the risk management process is quite extensive, and it includes both risks and opportunities. This is particularly applicable for complex and uncertain projects where the frequency of meetings is higher, the risks are analysed in more detail and expertise is gathered, including external when required. The hierarchy during this process is very clear, the information traveling

upstream to higher management where the final decisions regarding mitigations are made. All of this is based on a predefined strategy also decided upon by high level management, usually concerning financial factors. Although the process is very well defined and detailed, and communication and collaboration are encouraged or even required, the feedback loop seems to be less effective than desired, with practitioners lacking the necessary insight into the activities and challenges of colleagues who participate in different project stages. This was observed mostly in the relation between the tender team and execution team, although attempts are made at shrinking this gap. This can be observed in Figure 4.

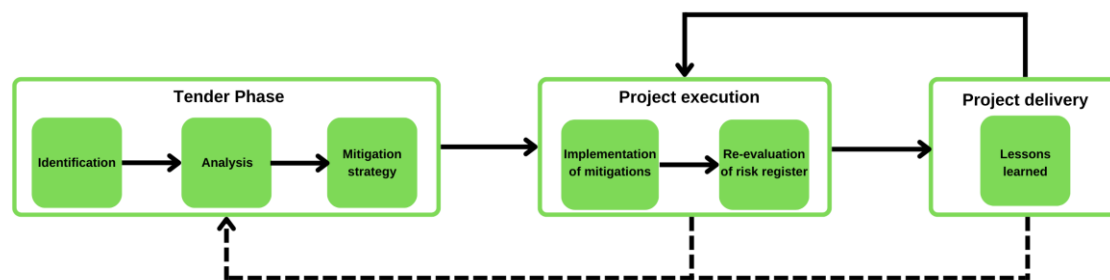


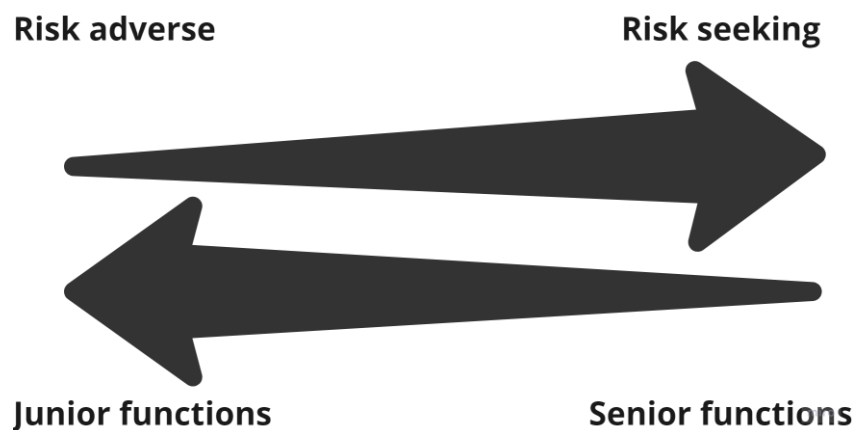
Figure 4 Risk management process

As seen in the figure above, the project execution team can get clear feedback because of them being directly involved in the implementation of mitigations. On the other hand, the tender team does receive feedback in the form of videos or documentation, according to the interviewees, but this is insufficient to offer them a clear image of how the chosen mitigation strategies were applied and what the outcomes of those strategies were.

Secondly, the strategy of the company, especially the financial one, has a very strong influence on the decision-making process regarding risks. This was mentioned to be the main factor dictating risk decisions. Moreover, when presented with a lack of information regarding a risk, or an impossibility of acquiring information due to its inexistence or due to lack of time, practitioners would settle on increasing the cost associated with the risk. The financial factors are reflected into decisions even more so considering that the industry uses very big, complex, and expensive assets to undergo their activity. This financial strategizing can lead to practitioners becoming risk averse as a result of them being afraid to give wrong or inaccurate cost estimates.

Moreover, the 'upstream' decision-making seemed to be miss-understood by practitioners, especially the ones with lower hierarchical functions. The widespread misconception was that decisions are only made at a higher level of management, during meetings, with some interviewees repeatedly stating that they do not directly make decisions. In reality, each of them is required to make low level risk decisions almost on a daily basis, whether it is choosing to note an uncertain event as a risk or to propose a mitigation strategy for a risk. Each of these decisions made by the practitioners has an influence on that final meeting in which final, higher level decisions are made. This fact denoted a type of risk aversion, increased among lower function employees, or even a slight responsibility aversion.

Another conclusion drawn from the interviews was that practitioners are only aware of a few of the factors influencing their attitude. The ones mentioned and taken into consideration are previous experiences of interviewees, the project objectives and the presence or lack of information. The risk culture was also briefly mentioned but it was not broadly considered. In comparison, the literature mentions a multitude of other factors such as age and gender which were also noticed to exert an influence during the interviews. It was noted that, generally, female participants were more risk averse than male participants. Another notable factor was the hierarchy, with higher function interviewees being more risk seeking, hinting to risk attitude being inversely proportional to the seniority as seen in Figure 5.



*Figure 5: Inverse proportionality of risk attitude*

Very few subconscious factors were brought up by the practitioners and furthermore, affective factors were entirely disregarded and considered to have no influence on the risk attitude. The vast majority of participants considered that their attitude is mostly based on factual data and the influence of other factors is fairly limited.

Furthermore, most interviewees considered themselves as being on the risk seeking side, stating that generally they trust their technical background and the information they possess in order to take on risk, whereas a few others admitted they are rather conservative. This is in line with the literature mention of 'perceived-risk attitude' for which perceived risk seeking is rare but encountered, hinting that people's perception of the risk is dictating their behaviour. However, when asked what the response is in the scenario in which information is not available, participants described risk averse behaviours, which is a confirmation of the statement found in literature that 'pure risk-attitude' is always negative. The presence of information allows practitioners to analyse the risks and compare them with previous experiences, facilitating the search for solutions, but it also decreases the difficulty of the risk. Therefore, participants were risk seeking in the domain of minor risks, but risk averse in the domain of major risks.

Lastly, the strongest influence on the group risk attitude was determined to be the hierarchy of the participants. Although other influences also appear, such as the expertise and knowledge of the participants and the individual character traits, seniority seems to dictate most of the final decisions. It was noticed that, even though communication is

incentivised, and participants are expected to provide opinions and feedback during meetings, the hierarchy has the potential to hinder proper information sharing. Nonetheless, practitioners seemed to be mostly aware of the influences others have on the decision making process and on their own approach, at times even searching to be influenced by stakeholders with more expertise in a certain domain. This does not however imply that participants were knowledgeable of all the factors influencing group risk attitude, since none of them mentioned things such as the group membership or the culture of others, particularly considering that the company participates in projects all over the world.

All these considerations offered a good insight into the in-practice state of risk management and risk attitude, both individually and as a group and were taken into consideration for the next stage of the research, namely the organization of workshops using serious gaming. It was also confirmed that, indeed, practitioners are now aware of their risk attitudes and how it influences their decisions.

## 6. Serious game

Before organizing the workshops, it was necessary to develop a means of simulating risk decisions, and this was done with the help of serious gaming. Given the short time allocated for this research it was decided to modify an already existing game based on a system analysis which included both the results from literature and interviews. The resulting game, named '*Maritude*', aimed to replicate a real-life scenario where players were required to work together and complete several projects while making risk decisions when faced with uncertainty and personal limitations.

The aim of the game was to observe how the risk attitudes of the participants form and change in a risk management setting both individually and as a group. To achieve this, it was necessary to simulate the existing risk management process in terms of steps, decision setting and other considerations which are part of the process. However, the focus of the game was not on the technical parts of risk management, such as the detailed analysis of risks or the technicalities behind mitigation strategies, but rather on the approach taken when encountering risk and the reasons behind the choices made by the participants. As mentioned before, there are a variety of factors which influence people's perception of risk and consequently their attitude towards it, such as company culture, expertise, and position. The influence of these factors, among others, was observed by presenting players with risk and allowing them to strategize and make decisions both individually and as a group.

Firstly, as seen in the interviews, practitioners are often required to make decisions on their own, although at times they are not perceived as such. Moreover, if the expertise and experience of the individual are not considered as sufficient to deal with the risk, a risk averse approach is taken. This had to be observed further, therefore the players were required, throughout the game, to make decisions on their own, being given limited information and at times high responsibility. The participants had to make decisions concerning risks and their mitigation as well as helping others and managing projects, and although sometimes communication was allowed, the final decisions were made individually. Through these settings, the influence of the individual risk attitude of the decision-maker on the decision and the outcome could be determined.

Secondly, the group attitude also needed to be observed through the game, as it became clear from the literature and especially the interviews that most of the decisions are made in a group setting. For this, several group decisions had to be made throughout the game concerning strategy and resource allocation. Moreover, the group decisions were even more essential as the game is a cooperative one that can only be won as a team. By creating this environment, factors such as group dynamics, hierarchy and individual character were observed alongside their influence on the decision-making. This allowed for observations to be made regarding the group risk attitude and how this is formed as well as how it differs from the individual one.

Therefore, by giving the players the opportunity of making decisions both individually and as part of a group, it was hoped that the understanding of risk attitude will be improved, and its influence on the risk management process could be mapped out.

### 6.1. System analysis

In order to choose a base game and modify it to fit the purpose of this research it was first necessary to develop a system analysis based on the literature review and the interviews, which resulted in the requirements for the serious game.

In this case the system is defined as a company/department applying risk management to their projects. Vital to this is the definition of risk attitude, which in literature is defined as “a chosen response to risk, influenced by perception” (Hillson, 2012). As mentioned previously there are several factors influencing risk attitude such as previous experiences, culture, age etc. This is present in every stage of the risk management process, from identification to mitigation and feedback and results in decisions that have a tendency of being either risk averse or risk seeking.

There are two dimensions of risk attitude, an individual and a group one. The first one is influenced by factors such as perception, situation, specialisation etc. and it reflects on decisions made at an individual level such as deciding whether a certain event is a risk or not or if a certain threat requires mitigation. The second one is influenced by the dynamics of the groups in which decisions are made, the individual character of the members, their hierarchy etc. and it reflects in meetings where participants can influence each other and alter the final decisions.

As seen from the interviews, each project has multiple stages and in each one, different people with different expertise participate. Depending on the difficulty of the project, the frequency of certain meetings is increased or decreased, and emphasis is put on the transfer of knowledge. The decisions regarding project selection and strategy are taken at a high management level and the main considerations are of financial nature. Regardless of the project, both threats and opportunities are taken into consideration and collaboration is of the utmost importance.



All these factors need to be taken into consideration for the adaptation of the game, to be able to simulate a risk management process as close as possible to reality while at the same time keeping the gameplay simple. This is summarized below in Figure 6, where the game requirements are also shown.

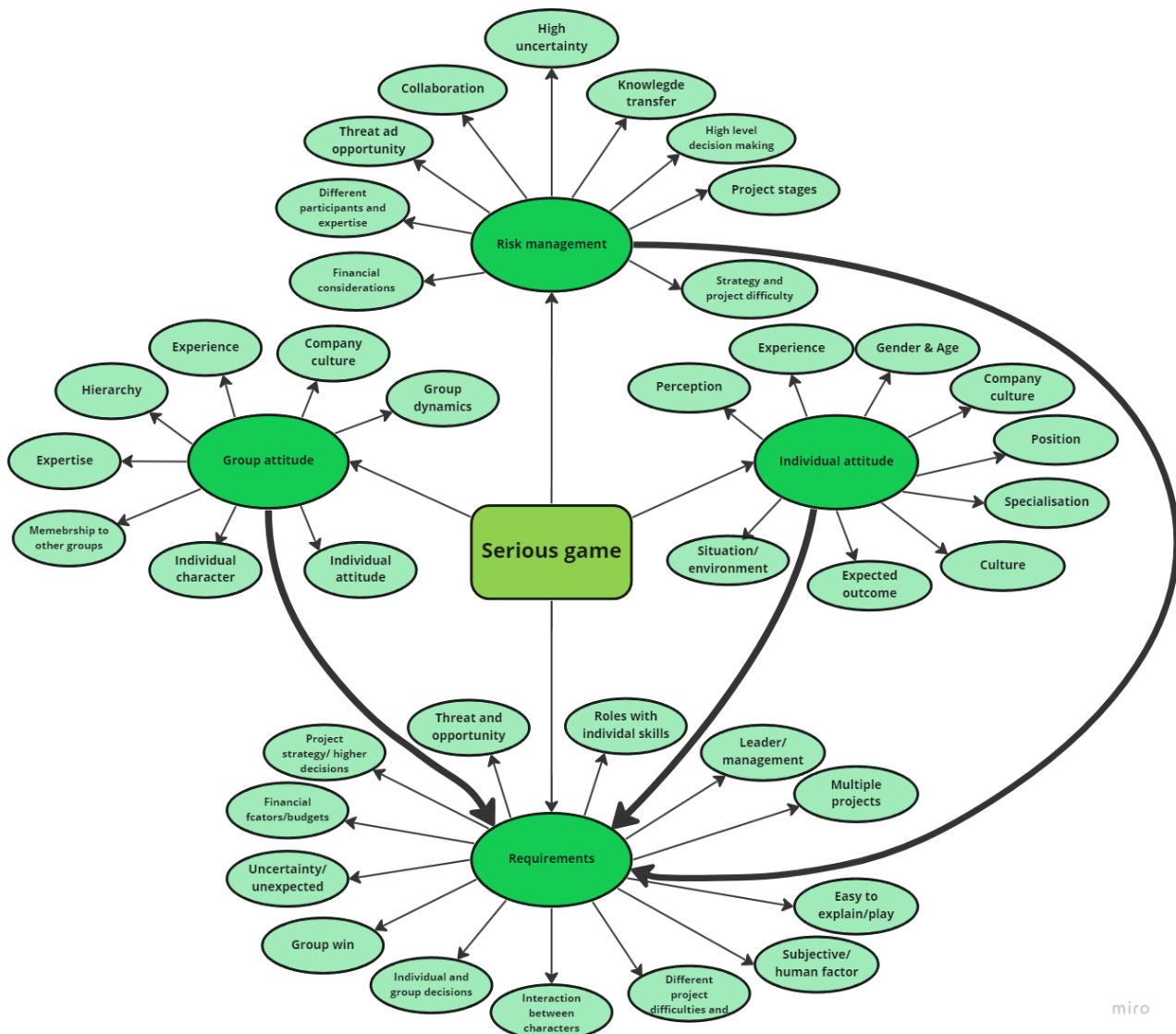


Figure 6: System analysis

miro

## 6.2. Base game

After the system analysis was made, the game based on which the serious version was developed, had to be chosen. For this, an initial screening was done using key words such as 'cooperative', 'characters', 'projects/missions', 'leader'. A total of five games were chosen which matched multiple game requirements from the system analysis. Below, in Table 2, a list of the five games and their pros and cons for each of them can be observed.

Table 2 Choice of base game

Game	Pros	Cons
<b>The Grizzled</b>	Cooperation	Only threat oriented
	Threats involved	No subjective factor
	One leader	
	Decision on difficulty	
	Some uncertainty	
	Multiple characters with skills	
	Multiple missions (projects)	
	Relatively simple gameplay	
<b>5-minute dungeon</b>	Cooperation	Lack of leader/ management
	Use of resources	No strategic project/mission choice
	Time pressure	Not a lot of group influence
	Multiple difficulties	
	Characters with skills	
	Multiple and different threats	
<b>Atlantis rising</b>	Use of resources and assets	High complexity
	Characters with skills	Lack of leader
	Strategizing present	
	Rising difficulty	
	Uncertainty present	
	Multiple projects with info and perks	
	Cooperation	
<b>Pandemic</b>	Cooperation	High complexity
	Group influence	Lack of leader
	Some uncertainty	Domino effect (could be pro)
	Characters with skills	
	Increasing difficulty	
	Possibility to strategize	
	Multitude of projects	
	Use of resources	
<b>Burgle brothers</b>	Cooperation	Lack of leader
	Strategizing	Lack of project choice
	Growing difficulty	Takes a too long with 3 levels
	Different projects	Not much interaction between characters
	Characters with skills	
	A lot of uncertainty	
	Both threats and opportunities	

Following the initial screening, a multi criteria analysis was performed based on the system analysis for the games listed above. All the game requirements stated previously were included in the MCA. This can be seen below in Table 3.

Table 3 MCA

	The Grizzled	5-minute Dungeon	Atlantis Rising	Pandemic	Burgle Brothers
Roles with individual skills	✓	✓	✓	✓	✓
Presence of a leader	✓	✗	✗	✗	✗
Multiple projects	✓	✓	✓	✓	~
Different difficulties for the projects	✓	✓	~	~	~
Easy to explain & play	~	✓	✗	✗	~
Subjective/ human factor	✓	~	✓	✓	✓
Interaction between characters	✓	✗	✓	~	✗
Individual and group decisions	✓	✗	✓	✓	✓
Group win	✓	✓	✓	✓	✓
Uncertainty/ unexpected	~	✓	✓	✓	✓
Financial factors/ budget	✓	~	✓	✓	~
Project strategy & higher decisions	✓	✗	✓	✓	✓
Threat & opportunity	✗	✗	~	✓	✓

As observed in the table above, the game “*The Grizzled*”, created by Fabien Riffaud and Juan Rodriguez, was the most appropriate choice, fulfilling most of the necessary criteria. The game is based on a war theme in which characters undergo multiple missions in order to try and win the war and return home safely. This was chosen because of the many game mechanics which resemble stages of risk management as well as the simplicity of the game in terms of both modifications and gameplay.

The first criterium in the MCA was the presence of individual roles with individual skills. There are six characters present in the game and each character has its unique lucky charm corresponding to a threat, which they can use to remove a threat during gameplay. This resembles real life where different experts with different types of expertise participate in the risk management process. This can be seen below in Figure 7.



Figure 7: Base game Characters

The game is based on a First World War theme, where the characters need to work together to complete a number of missions by playing cards and ultimately win the war. This is in line with the requirement of multiple projects being present. The cards consist of six types of threats, namely three types of weather, night, snow, and rain and three signs, bullet, mask and whistle, which is partially appropriate, opportunities not being represented. These threats also resemble the reality in construction projects where different ones are encountered. Additionally, the game also contains other cards called hard knocks which, when played, negatively or positively influence the characters, resembling the human factor present in real life. Below, in Figure 8 a visualisation of the cards can be found. As seen in the figure, some of the hard knock cards are called phobia/trauma which resembles the aversity of character towards a certain threat, much like in practice, further adding subjectivity to the game.

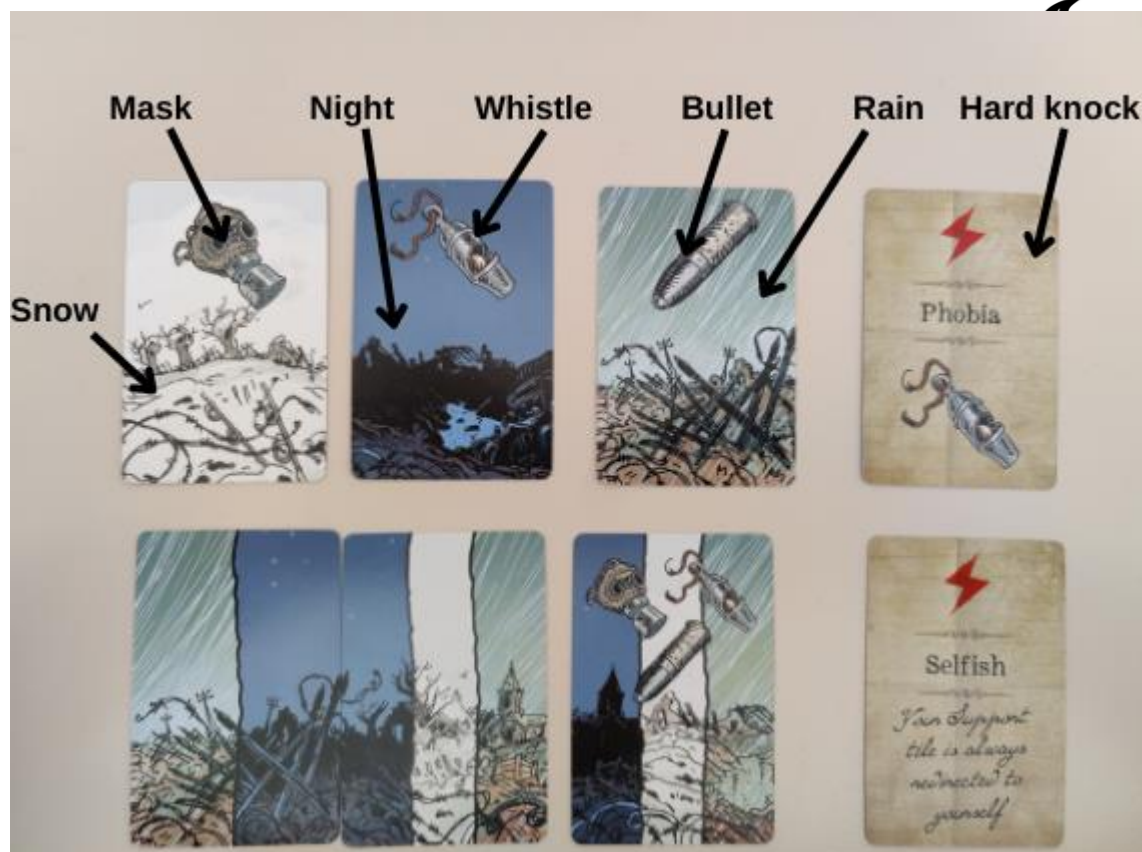


Figure 8: Base game cards

Another two criteria are satisfied through the presence of the leader who decides the difficulty of the missions (the number of cards to be dealt to each player) and which moves clockwise each turn. This resembles reality where projects differ in difficulty and have different project leaders depending on the required expertise.

The financial factors can be represented by the presence of two piles of cards named Trial and Morale piles which dictate the winning or losing of the game. This could resemble the project risks and the maximum risk threshold for a company undertaking projects. This also partially satisfies the necessity for uncertainty given that players do not know what cards they'll be dealt, however this could be represented more.

Furthermore, the players interact through multiple mechanics, mainly through the use of support tokens which allow them to help other players. The appropriate use of these tokens to remove hard knocks from players is essential given that the game will be lost if a player owns four hard knocks. Another mechanic is the presence of speech tokens which can be used to remove threats from all the players. This is similar to practice, where knowledge is shared, allowing for mitigation of risks. Additionally, players can discuss certain decisions and strategize, which leads to group decisions being made and influences being exercised. Only by working together, can the players succeed and win the game.

The aforementioned high level decisions regarding project difficulty and other matters alongside with the discussions and strategizing satisfy the second last requirement in the MCA table, resembling the findings from the interviews.

Below, in Figure 9 the game set-up can be seen with all corresponding game elements.

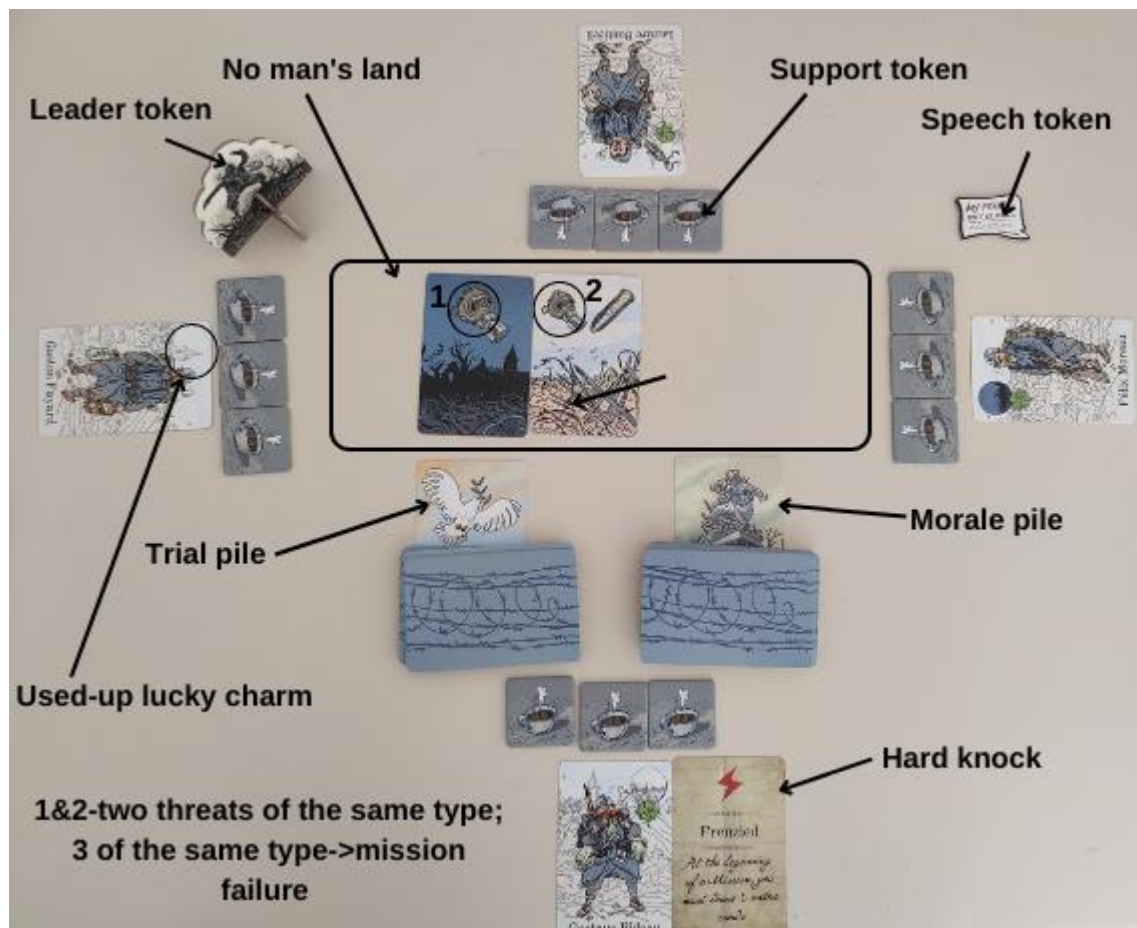


Figure 9: Base game set-up and elements

Although the game does not contain a lot of elements, the mechanics do take time to explain and understand. However, this becomes clear after a few rounds are played and participants become accustomed with the basics.

### 6.3. Adapted version

In order to fulfil the purpose of this research, the game was modified in terms of both game mechanics and game design starting from the previously mentioned system analysis, which resulted in a new game called “*Maritude*”. The main focus of these modifications was to ensure that the game resembles reality as much as possible so that the players would immerse in the gameplay, resulting in an accurate display of both individual and group risk attitude. Moreover, the new version was compared with the original one in terms of game balancing to achieve a similar level of difficulty.

#### 6.3.1. Game mechanics

The first major change brought to the original game was the renaming of the “Hard Knock” cards into “Character” cards and the addition of seven such cards, six positive ones and a negative one, bringing the total to twenty negative cards and seven positive ones, resembling the real-life ratio of positive and negative events. This was done also to keep the original ratio between project risk cards and risk threshold cards which is explained below. Most of the cards added were created as opposites of the existing ones so that a certain level of balance is kept. Just like the negative character cards can be removed by receiving support



from other players, the positive character cards are removed if no help is received at the end of a project. Additionally, the text on the cards was also changed to avoid copyright infringement. A full description of the cards can be found in Table 4.



Table 4: Character cards

Original	Action	Corresponding positive	Action
<i>Over-achieving</i>	at the start of a project, you must draw 2 extra cards	<i>Cool-headed</i>	at the start of a project, you draw one less card
<i>Burnout</i>	Counts as 2 negative character cards		
<i>Forgetful</i>	after your transfer you must draw a risk card and play it	<i>Efficient</i>	after your transfer you can remove a card from another player's hand
<i>Stubborn</i>	you cannot transfer if you have 2 or more cards in hand		
<i>Supportive</i>	discard a negative character card from yourself or another player	<i>Insecure</i>	discard a positive character card from yourself or another player
<i>PTSD(x6)</i>	one extra threat		
<i>Frightened</i>	on your turn you must transfer if 2 identical threats are active		
<i>Unnerved</i>	when the threshold drops flip one extra card (min 4)	<i>Pep talk</i>	when the threshold drops flip one less card (min 2)
<i>Greedy</i>	your assistance tile is always directed to yourself	<i>Selfless</i>	your assistance tile always counts as 2 tiles
<i>Distracted</i>	before transferring remove one of your assistance tiles from the game		
<i>Distressed</i>	during transfer draw your assistance tile randomly		
<i>Flimsy</i>	other players cannot transfer if they have any cards in hand		
<i>Tongue-tied</i>	you can no longer speak or communicate with other players in any way; you may not use a knowledge token	<i>Inspiring</i>	when you receive a knowledge token as leader give one to another player as well
<i>Dictator</i>	take the project leader role and keep it, preventing the distribution of knowledge tokens		
<i>Egotistic</i>	you may transfer only if your hand is empty or if you are the last one still in the project		
		<i>Jack of all trades</i>	remove a threat of your choosing from the table

In addition to the character cards, nine new threat cards were added to compensate for the addition of positive effects. In the original version, each threat appeared fifteen times throughout the game as seen in Table 5.

Table 5: Original threats and combinations

THREAT/COMB	BULLET	MASK	WHISTLE	NIGHT	SNOW	RAIN
<b>B+M</b>	1	1				
<b>B+W</b>	1		1			
<b>B+N</b>	4			4		
<b>B+S</b>	3				3	
<b>B+R</b>	3					3
<b>M+W</b>		1	1			
<b>M+N</b>		3		3		
<b>M+S</b>		3			3	
<b>M+R</b>		4				4
<b>W+N</b>			3	3		
<b>W+S</b>			4		4	
<b>W+R</b>			3			3
<b>N+S</b>				1	1	
<b>N+R</b>				1		1
<b>S+R</b>					1	1
<b>B+M+W</b>	1	1	1			
<b>N+S+R</b>				1	1	1
<b>ALL</b>	1	1	1	1	1	1
<b>PHOBIA</b>	1	1	1			
<b>TRAUMA</b>				1	1	1
<b>OCCURRENCE</b>	15	15	15	15	15	15

Each card containing a combination of an icon with a background repeated four times for a pair of the two and three times for the combination of icon with the other backgrounds. The combination of backgrounds only appeared once in each instance. This was modified so that each combination of icon and background would repeat four times and the background combinations would repeat twice each, resulting in every threat occurring seventeen times throughout the game as seen in Table 6. The initial *Trauma* and *Phobia* cards were combined in six negative character cards called *PTSD*, one for each threat, keeping the initial number.

Table 6: Modified combinations

THREAT/COMB	MARINE LIFE	ASSETS	SCHEDULE	WEATHER	MARINE TRAFFIC	FINANCIAL CONSTRAINT
M+A	1	1				
M+S	1		1			
M+W	4			4		
M+T	4				3	
M+F	4					3
A+S		1	1			
A+W		4		3		
A+T		4			3	
A+F		4				4
S+W			4	3		
S+T			4		4	
S+F			4			3
W+T				2	2	
W+F				2		2
T+F					2	2
M+A+S	1	1	1			
W+T+F				1	1	1
ALL	1	1	1	1	1	1
PTSD	1	1	1	1	1	1
OCCURRENCE	17	17	17	17	17	17

The numbers in the two tables above represent how many times the threats appear throughout the game and not the number of cards in the game. For example, a threat card can contain two or more threats. In the adapted version there are a total of forty-eight threat cards.

These additions resulted in a total number of seventy-five risk cards in comparison with the initial fifty-nine. All the changes were done so that the initial ratio between the trial pile and the morale pile (now risk pile and risk threshold pile) is kept ensuring a similar balance of the gameplay. This can be observed in Table 7.

Table 7: Pile balance

Version	Total nr. of cards	On trial (Project)	On morale (Threshold)	Ratio
Initial	59	25	34	0.735
Modified	75	36	49	0.735

A second major addition was the introduction of an intermediary step if the chosen difficulty of the project is four or higher. For this, the difficulty of the projects was limited at a maximum of six. This distinction was made to highlight the reality of projects with different difficulties being contracted. It was concluded from the interviews that the more difficult

projects are given more attention and meetings are being held more often, such as the project kick-off meeting where risks and their mitigation are discussed. This is shown in the game through the additional step where the project leader chooses a type of threat that each player can remove from their hand. The players can agree or disagree with the chosen threat and the leader can choose whether they will remove the initially proposed threat, or they will choose a different one. The second chosen threat will be removed without further debate. This does incentivise towards choosing a difficulty of four or more for the projects in the initial stages, but as the game goes forward and the difficulty increases, this will become less and less appealing, allowing for more strategic decisions.

Another modification brought to the game is the transfer of cards from the risk threshold pile to the project risk pile. Originally, this took place regardless of the number of players, where at the end of a project, a minimum of three cards was transferred plus the number of cards players had left in their hands. The new mechanic states that the minimum number of transferred cards is dependent on the numbers of players, hence if four people are playing, a minimum of four cards are transferred at the end of each project and so forth. This was done to both symbolise the increasing of the number of threats that can be engaged when more people work on a project, and to increase the difficulty of the game, compensating for the previous modifications which simplified it.

As mentioned earlier, the game contains mechanics which allow for the removal of both positive and negative character cards. In the original version, players could only remove negative cards by receiving help from other players. However, considering the addition of positive cards which take effect once every project much like the negative ones, it was necessary to add a mechanic which would remove these cards. This is achieved by requiring players to remove a positive character card from their character, provided they have one, if they do not receive any assistance from other players at the end of the Lessons learned stage. Reality is also shown through this modification, indicating that employees might have a drop in morale or efficiency and their attitude might change if they are isolated from the other project team members.

The last addition to the game mechanics was allowing the players to choose from two available options during the transfer phase. At the end of each project the players, whether they finished their cards and actions or they do not wish to play any further cards, are required to transfer to the next project. In this case they can choose to assist another player which could help them remove negative character cards, or prevent them from losing positive ones, or they can reset their tool kit, provided they used it previously. This allowed for more selfish decisions and more strategizing. Additionally, another change was introduced during the transfer phase, namely, when assistance is given, the assisting player places their token face up, allowing the others to strategize and ensure a majority of assistance is achieved leading to the removal of negative character cards. Once again, this resembles a real-life scenario where employees would know if help were given between colleagues.

Moreover, other changes were tried but were, eventually, disregarded for various reasons. First, in the initial phase, it was considered to add an event stack to the game, containing positive and negative cards similar to the character cards ( APPENDIX 2: Early-stage

design of event cards ), while removing the previously known ‘hard knocks’ from the risk piles and including them in the event stack. This change was not applied because it added too much complexity to the game and created confusion, while also negatively influencing the game mechanics and game flow. The second attempted change was to declare the loss of the project only at the end of the project execution phase, after all players transferred, rather than every turn. This would have meant that three threats of the same type could be present on the table without losing the project, giving the players the opportunity to remove them on their next turn. However, this change was not applied because it was simplifying the game too much and it was bringing imbalances to the game mechanics. The last attempted change was to allow a player who finished all the cards in their hand to reset their toolkit. Although this change was beneficial to the game, adding an individual goal for the players, it was preferred to apply the mechanic mentioned earlier where a player must choose between assisting others or resetting their toolkit during the transfer action. The reasoning behind this was that the second option would allow for a trade-off between helping oneself or helping others, denoting the presence or lack-of selfish behaviour, in addition to strategizing.

### 6.3.2. Game design

From a design point a view, the game underwent major changes to ensure a proper immersion of the participants and a facilitated understanding of the gameplay. The entire design of all game elements was changed, including the texts on all the cards.

As mentioned before, the game was named ‘Maritude’ (marine-risk-attitude), based on which a logo was developed, using a similar colour as the one used in the DEME Group logo. The logo is shown below in Figure 10.



Figure 10: Game logo

Firstly, the six characters were chosen to be real-life functions, namely “Project Manager”, “Lead Engineer”, “Works Manager”. “Business Manager”, “Financial Controller” and “Project Controls Manager”. These were chosen as the most important functions during projects and particularly relevant to the decision-making. This is represented in Figure 11.

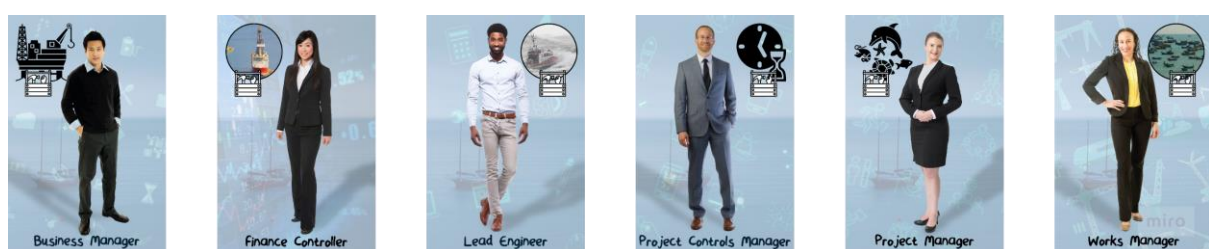


Figure 11: Characters

As mentioned earlier, each character has its own toolkit corresponding to one of the six threats present in the game.

Secondly, the initial six threats were changed with ones that can be found in the marine industry, namely for the background/environment, “Weather”, “Marine traffic” and “Financial constraints” were chosen and for the icons/technical threats, “Marine life”, “Assets/equipment” and “Schedule” were chosen. This can be seen below in Figure 12.

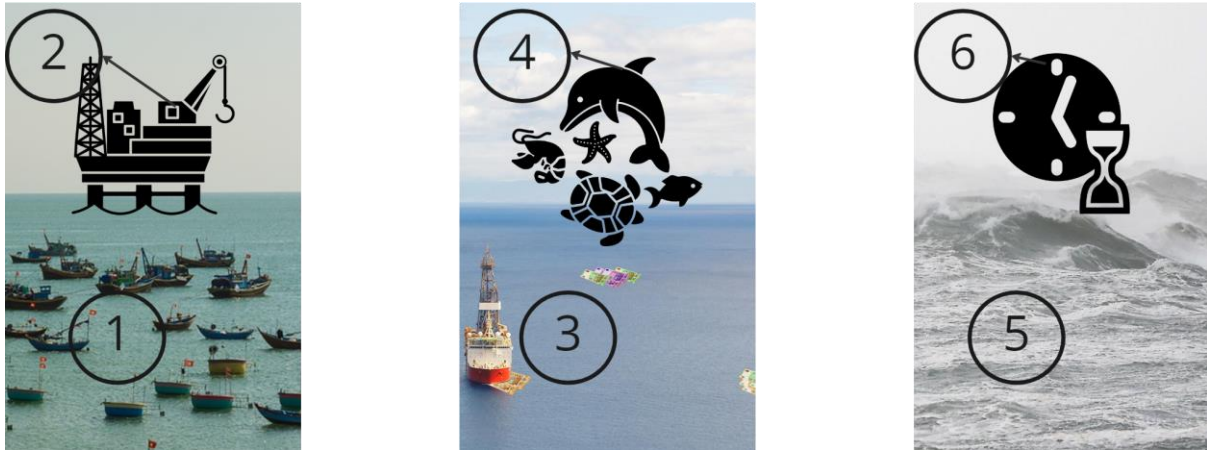


Figure 12: Threats

The threats and images are associated as follows:

- 1) Marine traffic.
- 2) Assets/ equipment.
- 3) Financial constraints.
- 4) Marine life.
- 5) Weather.
- 6) Schedule.

The photos and icons used for the design of these cards aims to increase the immersion of the participants and allow them to relate to the threats presented in order to incentivise the display of risk attitude.

It is worth mentioning that there are also nine trap cards in the game, as seen in Figure 13, one for each combination of two threats. This is represented by a rectangle containing the back of the risk cards, indicating that when such a card is played, the player is required to immediately play a card from the project risk pile onto the table. However, if the project risk pile is empty no cards need to be played, or if the played card is another trap card, the action does not take effect again. This is done to represent the secondary risks associated with threats.



Figure 13: Trap threat card

Another type of cards present in the game are the character cards mentioned previously. These, when played, give the players or the game as a whole, positive, or negative effects. As seen below in Figure 14, the red 'X' represents a negative character card, while the green '✓' represents a positive character card. Moreover, as part of the negative character cards, the six 'PTSD's each contain one of the six threats mentioned above, as seen below in the 'Weather PTSD'.



Figure 14: Character cards

The chosen background for these cards was a whiteboard, aiming to lead the minds of the players to a learning scenario, where they would acknowledge their own limitations and strengths.



The two types of cards mentioned previously, the threat cards and the character cards, together, make up the risk cards which are split up between the two stacks, the project risk pile, and the risk threshold pile during the game. This is seen on the back of these cards as shown below in Figure 15, which is covered in a blue and white blueprint, which is generally used to represent engineering activities.

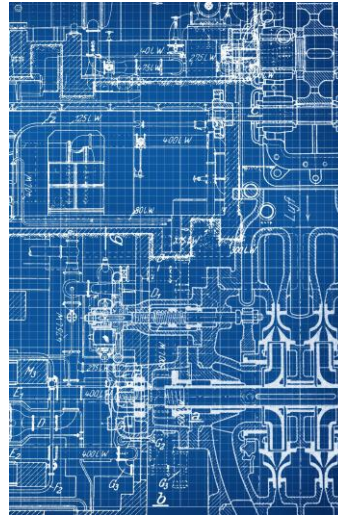


Figure 15: Back of risk cards

The two piles stated previously, project risk and threshold, are represented by strong visuals to clarify the meaning of winning or losing the game. As seen in Figure 16, the win pile is represented by a card containing money bills, denoting the achievement of profit at the end of the year, while the lose pile is represented by burning bills, denoting the exhaustion of the budget allocated for risk management and the lack of profit.



Figure 16: Project risk and Risk threshold piles

For the leader token, the strong hierarchical influence mentioned in the interviews was taken into consideration. Therefore, the leader was represented as a strong figure giving orders and the background was, once again, marine industry related, as seen in Figure 17.



Figure 17: Leader token

Another game element that underwent design changes were the assistance tokens which are used by the players to help others. On the back, these tokens contain a generic coffee picture representing the 'break' players get when transferring between projects, whereas, on the front, besides another coffee picture with the same meaning, the tokens contain arrows showing the direction in which the assistance is given. Help can be given to the left, right, double left or double right. This can be observed in more detail below in Figure 18.



Figure 18: Assistance tokens

The second last element which was redesigned were the knowledge tokens. They were devised so that they would represent the transfer of knowledge from a player to the others and act as a morale booster, thus the generic messages written on them. An example can be seen in Figure 19.

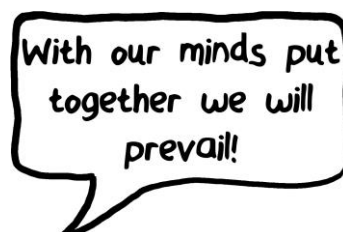


Figure 19: Knowledge token

Lastly, the game aid was also redesigned following the new additions and renaming of the elements, as seen in Figure 20. Here, the risk management process was followed, with the 'Kick-off meeting' representing the identification and analysis of risk, followed by the 'Project execution' where mitigation measures were taken, leading to the 'Lessons learned' phase, where feedback would be given and ultimately to the 'Transfer' to the next project. Each of these steps contains further elaboration on the actions which need to be taken in each of these stages. Moreover, the conditions leading to a winning or losing scenario are also mentioned. The aid card aims to help the players understand the game and give them a better view of the options they have at hand.

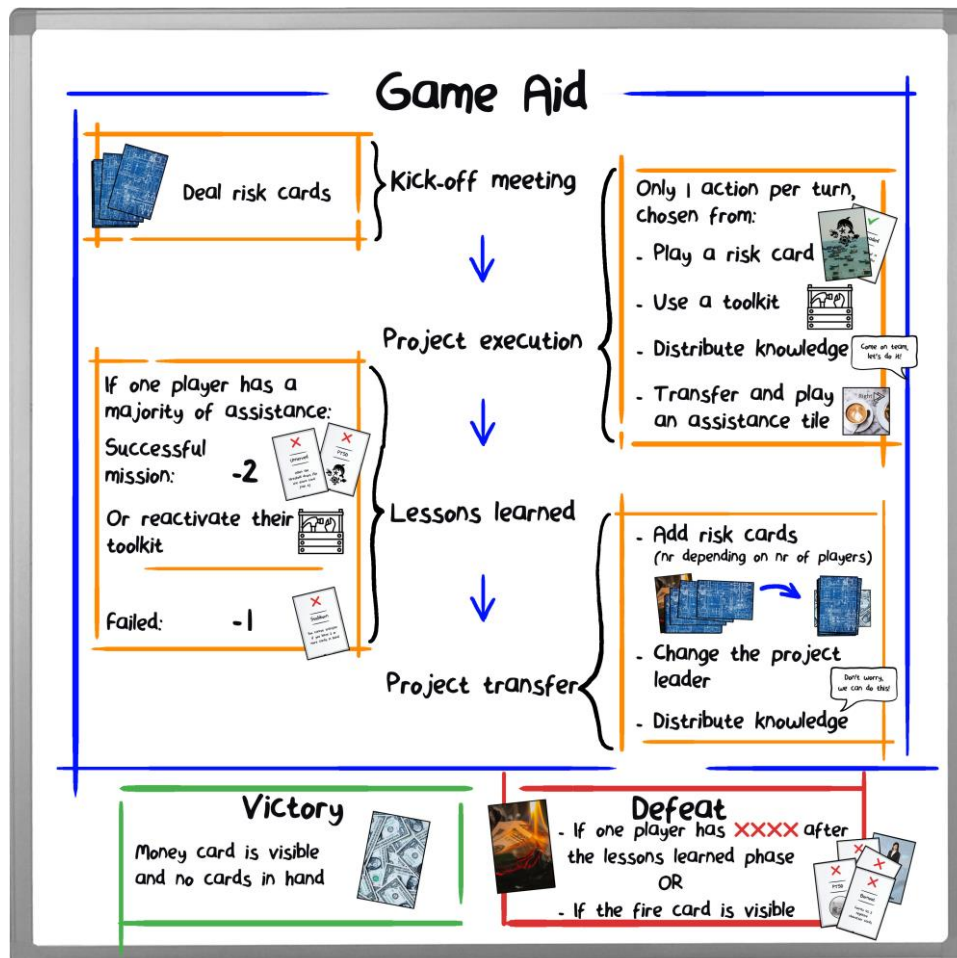


Figure 20: Game aid

All the game elements were design so that the marine construction theme could be found throughout the game and to ensure that the risk management process and elements would be represented as accurately as possible. The reasoning behind this was that the players would immerse in the gameplay and would display risk attitudes similar to the ones in real-life projects, allowing for accurate observations to be made. Below, in Table 8, a full list of game elements can be found.

Table 8: List of game elements

Character cards	27 (20 negative, 7 positive)
Threat cards	48
Knowledge tokens	5
Assistance tokens	16 (6 left, 6 right, 2 double left, 2 double right)
Characters	6
Aid card	1
Leader token	1

### 6.3.3. Gameplay

The changes stated above regarding the game mechanics and design resulted in the gameplay explained in this sub-chapter. In Figure 21 the setup of the game can be observed.

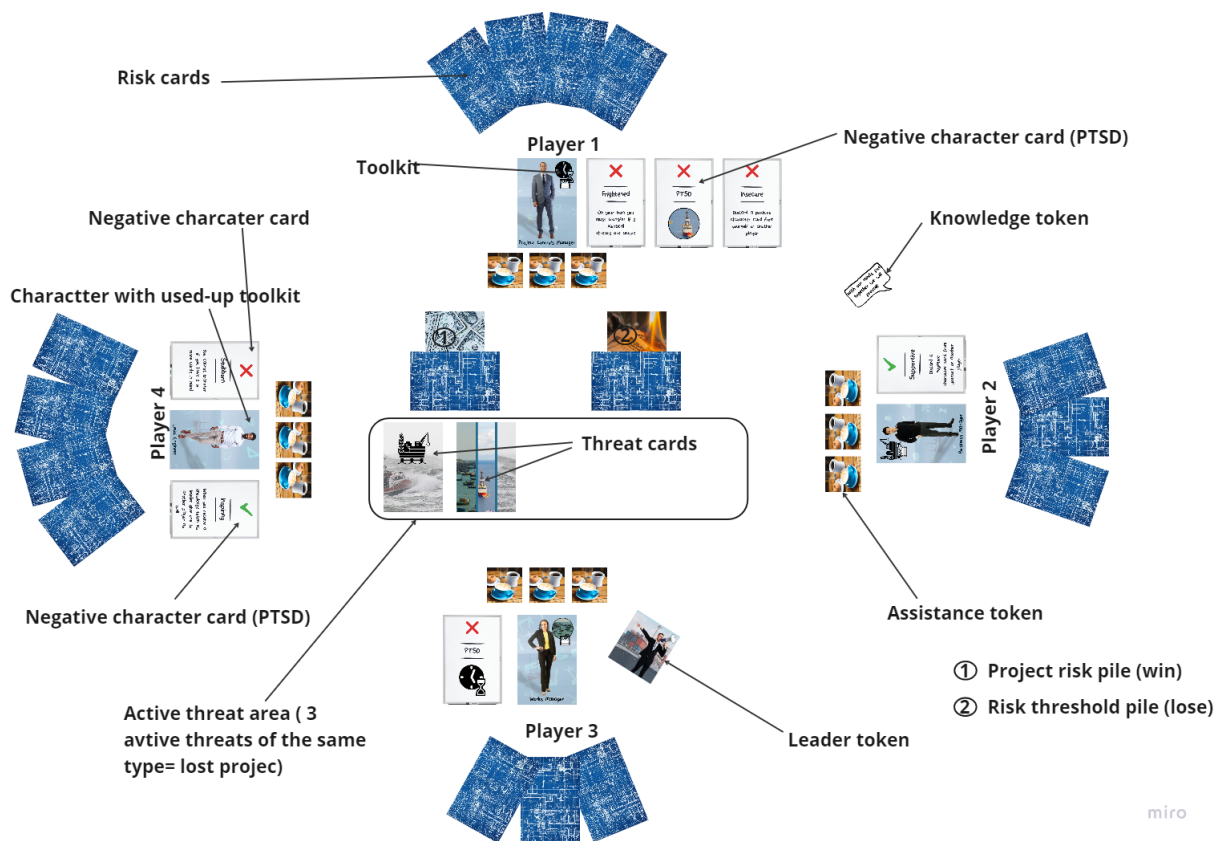


Figure 21: Game setup

As stated before, the players are required to work together in order to complete a number of projects and ultimately make a profit, symbolized by the bottom card from the project risk pile. If this card is revealed and all the players have finished the cards in their hands, then the game is won. However, if the card on the bottom of the risk threshold pile is revealed, this means that the players have used-up all the budget allocated which results in no profit and they loose of the game.

At the beginning of the game, the players are allowed to choose one of the six available characters, each with its own toolkit corresponding to a threat. The players then



place the character in front of them with the side containing the toolkit facing upwards, showing that the toolkit is active and available for use. Additionally, each player is given three assistance tokens. As seen below in Figure 22, each player is given a token with an arrow pointing left, one pointing right, and a third one chosen randomly from the remaining tokens. The rest of the tokens are then discarded. The players are not allowed to show their tokens to the other players until they choose to use one of the tokens.

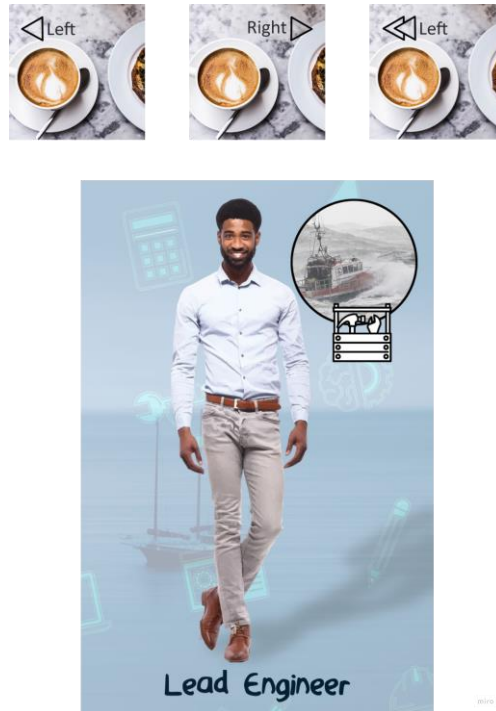


Figure 22: Character setup

The 'Project risk' and 'Risk threshold' piles are then prepared, the first one containing thirty-six risk cards and the second one forty-nine cards. The cards have been previously shuffled thoroughly. The leader token is then given to one of the players and the game can commence.

The first step in the 'Project kick-off' stage, as seen on the game aid, is the distribution of cards. This is based on the difficulty of the project, which is chosen by the leader. The minimum difficulty is one and the maximum is six, however the first project is required to have a difficulty of minimum three. If the chosen difficulty is of four or higher, the additional step mentioned previously is taken, where the leader chooses a threat to be removed from everyone's hand. This is exemplified in Figure 23. Once again, the other players can agree or disagree with the choice, and the leader can keep his initial choice or he can change his mind, with the second choice going into effect without further discussion. It is worth mentioning that using this tool it is not possible to remove 'PTSD' cards containing the chosen threat from the player's hand. This represents the end of the 'Project kick-off' stage.

In the figure above, the cards in each player's hand are visible for explanatory purposes, however, players are not allowed to reveal the cards in their hands to the other players at any time during the game.

- 1) Play a risk card- the player can play a card from their hand, either a card containing threats or a positive/negative character card; the threat cards are placed in the active threats area, whereas the character cards are placed next to the character.
- 2) Use your toolkit- the player can use their character's toolkit to remove a single threat card containing the corresponding threat type, from the active threat area, and discard it; the character is then turned around, with the toolkit facing downwards to show that it has been used.
- 3) Distribute knowledge- the player can use a knowledge token to remove one card from each player's hand containing a threat chosen by the player using the token; each player can choose which card they wish to remove as long as it contains the

said threat; 'PTSD' cards containing the threat can also be removed; this action is similar to the one in the project kick-off stage, however in this context discussion is not allowed.

- 4) Transfer- the player can chose to transfer to the next project is they finished all the cards in their hand or if they do not wish to play any further cards or take any other actions; during transfer, the player can chose whether they wish to give assistance to other players by placing an assistance token face-up on their character or if they wish to reset their toolkit; it is important to mention that if a player transferred, their character cards do not influence the project execution anymore.

When all the players have transferred the project is considered a success, the active threats are discarded, and the next stage can commence. However, if at any point during project execution three threats of the same type are present on the table, including 'PTSD' cards, the project is unsuccessful and all the players are required to transfer, the active threats being put back on top of the project risk pile.

The next step is the Lessons Learned stage in which assistance is considered. If a player has received a majority of assistance, then they are allowed, in the case of a successful project, to remove two negative character cards or to reset their toolkit. In the case of an unsuccessful project, only one negative character card is removed. However, if no player has a majority, then nobody is allowed to remove any negative character cards. Moreover, as mentioned earlier, if a player hasn't received any assistance, they are required to remove a positive character card from their character if they have any. This can be seen in the example below, in Figure 24. After all the assistance has been accounted for, the tokens are given to the corresponding players and turned with the back facing upwards once again.

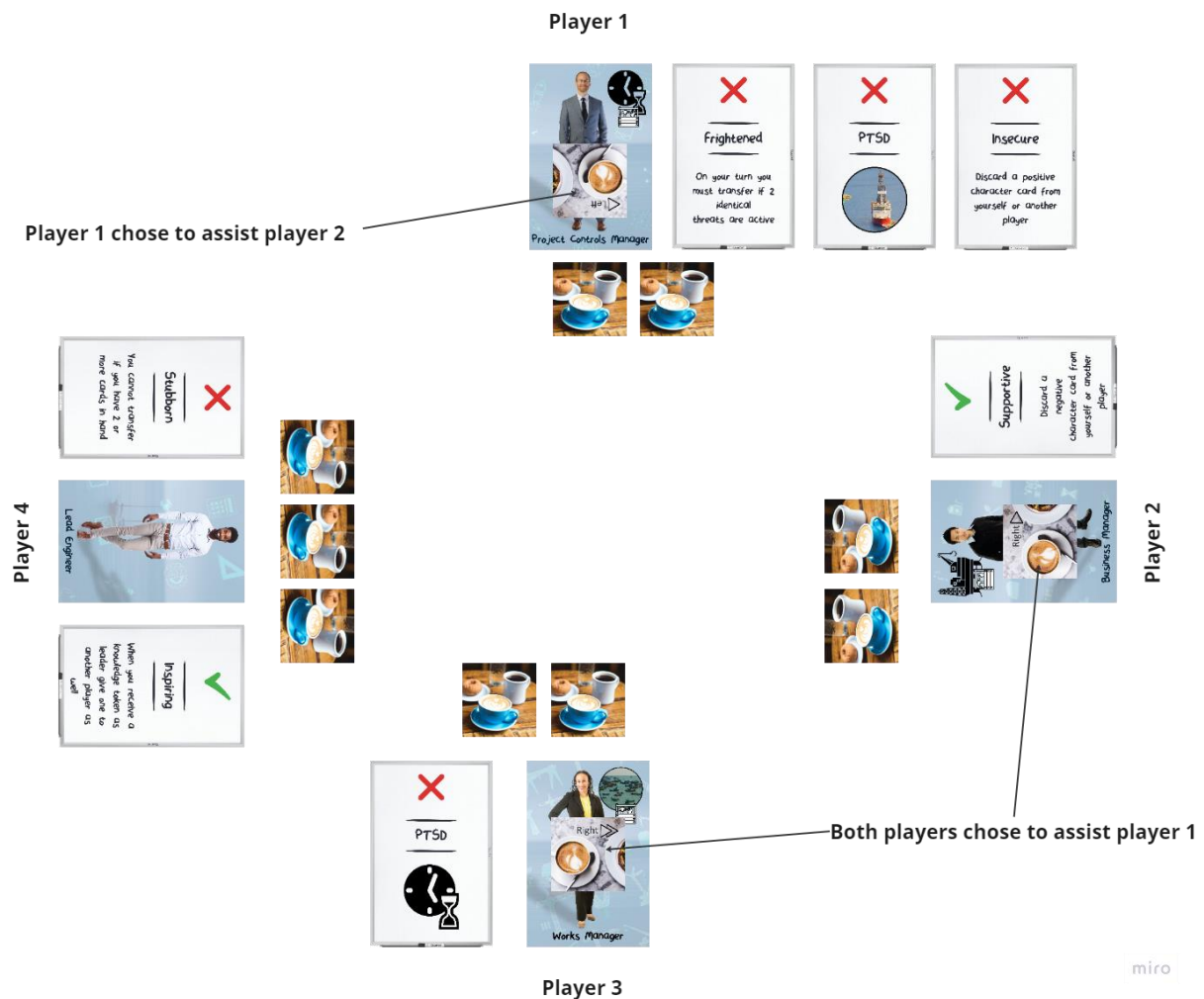


Figure 24: Example of lessons learned stage

As seen in the figure, players two and three decided to offer their assistance to player one, resulting in them having the majority of assistance which allows for the removal of two of the three negative character cards player one possesses. The players can discuss which two cards should be removed. In turn, player one decided to offer assistance to player two which allows them to keep the positive character card. However, since player four did not receive assistance from any other player, they are required to remove the positive character card.

This represents the end of the lessons learned stage. An essential point here is that if any player still has four negative character cards at the end of the lessons learned stage, the game is automatically lost.

The last stage is the project transfer, where the balances are settled, and the project is closed. Depending on the number of players, cards are being transferred from the threshold pile to the project risk pile, so for example, if there are four players in the game, the minimum number of cards transferred is four. To this are then added the number of cards left in the hands of all the players, meaning that, for example, if the players have four cards left in hand cumulatively, then the total number of cards transferred is eight. This is followed by the leader being passed one step clockwise and the previous leader receiving a knowledge token which



they can use in the next projects. The distribution of knowledge tokens is meant to resemble the acquisition of expertise by the leader after managing a project.

This marks the end of a project, and the process is repeated until victory or defeat are achieved. The attitude of the participants can be observed through multiple mechanics. Firstly, the choice of project difficulty acts as one of the indicators as it shows if the player wishes to take on more, or less risk. Moreover, the additional step in the kick-off stage for difficult projects shows whether the leader takes into consideration the opinions of others and their limitations based on their character cards. Secondly, attitude can be monitored in the execution phase through the choice of action, based on the situation. Additionally, the reaction of the players to the predefined attitudes given by the character cards and the way they choose to manage them provides insight. In this stage, the communication and collaboration between players are also observed as indicators of group risk attitude. Moreover, the transferring of the players is taken into consideration, particularly their choice between helping themselves and helping others based on the cards present. Here the achievement of assistance majority and the saving of positive character cards is followed as well. Lastly, in the lessons learned phase, the removal of negative character cards is observed alongside the discussion between players and strategizing.

#### 6.3.4. Game balancing

To ensure that the game is balanced in terms of game mechanics and that the difficulty is the desired one, testing was performed by playing the game multiple times, both individually and involving other players, as well as calculating several variables. Initially, some balancing was done by calculating the occurrence of each threat in the game as well as keeping the ratio between the cards in the threshold and project risk piles as mentioned previously. This was followed by calculations concerning the maximum number of possible projects and the maximum number of threats that can be removed throughout the game. This can be observed in Table 9.

Table 9: Threat removal

	3 players		4 players		5 players	
	Project runs out	Threshold runs out	Project runs out	Threshold runs out	Project runs out	Threshold runs out
<b>Max number of projects</b>	infinite	16	infinite	12	infinite	9
<b>Max threats removed from toolkit</b>	48		48		45	
<b>Max threats removed from knowledge</b>	45		44		40	
<b>Total</b>	93		92		85	

To calculate the number of threats that can be removed from the game it was first necessary to calculate the maximum number of projects that can be played. This was done by determining which pile would run out of cards first. As observed above, if the players would only choose a project difficulty of one and finish all the cards in their hands, that would lead to the same number of cards being transferred from one pile to the other at the end of each project and the project risk pile would never run out of cards. Therefore, the maximum number of rounds would be dependent on the threshold pile. The formula used to calculate the number of rounds needed to empty the threshold pile is as follows:

$$\frac{\text{Nr. of cards on threshold pile}}{\text{Nr. of players}}$$

The resulting number was then rounded down because the last project would not take place if the threshold pile were empty after the distribution of cards. The reasoning behind the formula is that, as explained earlier, at the end of each project cards are being transferred from one pile to the other, depending on the number of players.

The numbers were then used to calculate the maximum number of cards which can be removed through the use of toolkits and knowledge tokens. For the toolkits it was assumed that each player could remove one threat each project and would reset the toolkit at the end of the project. The calculation for knowledge tokens was similar, the only change being that the first project was not counted. This was done because players receive knowledge tokens only at the end of the projects and therefore would not own one in the first project. As seen above, the number of cards which can be removed during a game is similar for all three instances, with a small advantage for three and four player games

To calculate the number of threats which could be removed through the extra kick-off step a different approach was needed, because a minimum difficulty of four would be required to use this step. This influences the maximum number of rounds, which was calculated using multiple iterations. The result can be seen below in Table 10.

Table 10: Calculation of maximum number of projects for difficulty 4

	3 players		4 players		5 players	
	Project risk	Threshold	Project risk	Threshold	Project risk	Threshold
<b>Nr. of cards lost per projects</b>	5	7	7	9	8	12
<b>Nr. of projects</b>	7		5		4	
<b>Nr. of cards lost in total</b>	35	49	35	45	32	48
<b>Max threats removed from complex kick-off</b>	21		20		20	

It was determined that for three, four and five players the maximum number of projects would be seven, five and four respectively. This was checked against the number of cards in each pile, namely thirty-six and forty-nine, based on the number of cards removed from each pile, per project. This was then multiplied by the number of players, determining the maximum amount of removed threats, which proved almost identical for all instances.

Following the early-stage testing, as mentioned above, the game was played multiple times. All the information from the games was logged and analysed (APPENDIX 4: Game loggings). Below, in Table 11, an example of logging can be observed.

Table 11: Example of game testing

Project	Turn	Player 1	Player 2	Player 3	Player 4	Player 5	Comments
1	Kick-off	4-F+S	-	F+A	F+A		+5 cards
	1	S+F	M+W	PTSD T	M+F		
	2	PTSD W	PTSD A	A+T	Toolkit S(S+F)		
	3	Transfer(1)- right	PTSD S	Distressed	Jack (A+T)		
	4	-	Selfless	Transfer-right	A+F		
	5	-	Transfer- left	-	Transfer-reset		
	6	0 assist	1 assist	2 assist- Distressed	1 assist		
2	Kick-off	T+B	4-T+A	ALL	T+S		+7 cards
	1	T+S	A+T	M+B	W+B		
	2	Burnout	Stubborn	Supportive	Greedy		
	3	M+A+S	Transfer(1)-right	Transfer(1)-left	Dictator		
	4	Transfer(1)-left	-	-	Transfer-right		
	5	2 assist- Burnout	1 assist	1 assist	1 assist		
	6						
3	Kick-off	M+W	W+S	W+S	4-W+T+F		+7 cards
	1	Knowledge(M)-M+T	W+T	Supportive(PTSD-A),M+W(K)	A+W		
	2	Tongue-tied	Insecure-Selfless	T+F	PTSD F		
	3	Forgetful	Transfer(2)- left	Cool-headed	Transfer(1)-self		
	4	Efficient	-	Flimsy	-		
	5	Transfer-right	-	Transfer-left	-		
	6	0 assist- Efficient	0 assist	1 assist	3 assist-Greedy, Dictator		
4	Kick-off	2					4 from lost +6 cards
	1	M+T	M+T	Transfer(1)-right	S+F		
	2	Egotistic	Toolkit-M+T	-	M+W		
	3	Toolkit- S+F	S+F	-	Distracted		
	4	Transfer- right	M+W	-	-		
	5		right		left		
	6	2 assist- Tongue-tied, Egotistic	1 assist	0 assist-Cool-headed	1 assist		
5	Kick-off		3				3 from lost+7 cards
	1	Knowledge(M)-M+T	M+S	M+W, M+W(K)	Toolkit(S)-S+M, M+F (K)		
	2	A+F	S+F	PTSD M	Jack M+W, M+W		
	3	right	right(2)	left(1)	right		
	4	1 assist	0 assist	1 assist	2 assist-PTSD F, Distracted		
	5						
	6						
6	Kick-off			2			4 from lost+7cards, <b>LOST</b>
	1	Inspiring	Knowledge(F)-F+S	W+T	W+A		
	2	Frightened	S+T	Supportive- Flimsy, T+S	Pep talk		
	3	left	reset	right	left		
	4	1 assist	2 assist-Stubborn, PTSD S	0 assist- Supportive	0 assist-Jack		
	5						
	6						

### Legend

- M- Marine life
- A-Assets
- S- Schedule
- T- Marine traffic
- W-Weather
- F- Financial considerations

As seen in the table, every action taken by the players is logged for each turn of every project. For the kick-off, the leader is marked with orange, the difficulty of the project is noted, and the threat cards removed by the players if the extra step is taken, given the chosen

difficulty, are written down. For example, in the first project, player one was the leader, and the chosen difficulty was four, which led to the extra step. The leader chose to remove threats consisting financial considerations, leading to player one removing a threat card containing financial considerations and schedule, and players three and four removing one threat card containing financial considerations and assets each.

After the kick-off, the project execution commenced, and the actions of the players were written down. As an example, in project three, turn two, player one played a negative character card, followed by player two who also played a negative character card, but which required him to remove a positive card. On their turn, player three played a threat card containing two threats and player four played a negative character card, namely a 'PTSD' card, which adds an active threat. As seen above, the other actions are also logged in detail. When a toolkit is used, the corresponding threat type is noted alongside with the card removed from the active threat area. Similarly, when a knowledge token is used, the chosen type of threat to be removed is written along with all the cards removed by the players from their hands. A clear example is project five, turn one, when player number three played a threat card, but also removed another threat card because of the knowledge token played by player one, denoted with (K).

Moreover, when a character card is used, the effect is written down as well, as mentioned previously and observed further in project six turn two, when player three used their 'Supportive' card to remove a negative character card from their character. Additionally, for the transfer action, the choice between assistance and resetting one's toolkit is registered, alongside with the direction of the assistance when given.

This is followed by the logging of the lessons learned stage when the assistance is counted and written down. As seen in Table 11, the amount of assistance received by each player is noted alongside the character cards which were removed or the resetting of the toolkit. The transfer phase is then logged, indicating whether the project was successful or not by using a colour code, green indicating success and red failure. Additionally, the number of cards that need to be transferred from the threshold pile to the project risk pile are noted in the comments section, alongside other comments such as the indication of winning or losing the game.

As observed in the table above, threat cards were played thirty-six times, including kick-off, character cards were played twenty-two times while toolkits and knowledge tokens were used four and three times respectively. This showed a good distribution of actions and cards, and similar results were observed in the other loggings which can be found in the appendixes.

Throughout testing small adjustments were made such as preventing players to remove 'PTSD' cards in the extra kick-off step and detailing the influences of character cards on the gameplay and each other in such a way that they would not lead to imbalances or loopholes. The game was won both in three and four player scenarios, but this was achieved in less than thirty percent of the games, denoting that the high difficulty of the original game was kept.

The modifications brought to the base game both in terms of mechanics and design were meant to create a simulation which is as loyal as possible to reality. From the game stages and the characters to the limited communication, all the elements were designed so that the players would be confronted with a risk management process similar to the one they are used to. This aimed to ensure that the displayed attitudes and behaviours are similar or identical to the ones displayed in reality.

## 7. Workshops

After the development of the serious game was finished, two workshops were organized in which participants played the game and their risk attitudes, both individually and as a group were observed. A total of fifteen practitioners with various functions and various risk management involvement participated to the two workshops, twelve in the first one and three in the second one. In the first workshop, three games consisting of four people were played, whereas in the second one a single game with three players was played. The games were facilitated by three employees from DEME Group who also participated in the developing and balancing of the game and who had detailed knowledge about the mechanics and inner workings. The workshops were followed by an analysis of the gathered data and the drawing of conclusions.

### 7.1. Workshop organisation

The workshops consisted of three parts, a briefing which lasted for around ten minutes, the gameplay for which one and a half hours were allocated and the debriefing which took about twenty minutes. In the briefing part, the participants were introduced to the research, game elements and rules and were walked through the gameplay. Detailed information regarding risk attitude was not provided at this stage to prevent the alteration of behaviours. In the second part of the workshops, teams were formed, and the participants were asked to choose one of the six characters, after which the games commenced. The facilitators had a double purpose, answering any questions the players had about game rules and game mechanics as well as logging all the game events in a form identical to the one used for game balancing. A version of simplified logging was tested prior to the workshops for the scenario in which the facilitators did not have the necessary time to take detailed notes. In this version, only the action was noted with limited amount of detail, alongside with comments when necessary. This can be observed in APPENDIX 4: Game loggings. The two types of logging were used by the facilitators depending on the time constraints. During this stage observations were made both by the facilitators and the researcher regarding the behaviour of individuals as well as influences on the other players.

Besides the logging of the games and the observations made during the gameplay, two other methods were used to gather information in the last part of the workshops, namely the debriefing. This was done according to the indications given by the literature which states that debriefing depends on the purpose (Geurts et al., 1998). In their paper, the authors state that in the case of a research, the information should have only one direction, from the participants to the researcher, and besides discussion, the authors mention the use of questionnaires. First, the participants were asked to fill in such a questionnaire containing nine questions as seen below:

1. Did you enjoy the game?
2. What was the most difficult part of the game?
3. Are there any particular things that you liked/disliked (please provide examples)?
4. What was the biggest event/turning point of the game?



5. What was the tactic you employed?
6. How did you feel during the game?
7. How did your approach change throughout the game?
8. Were your decisions influenced by others at any point and if so, how?
9. In hindsight, would you do anything differently?

The first question was used as an icebreaker, to provide participants with a small break before being required to think back on the experience. The other eight questions were aimed at determining what the biggest challenges for the players were, what emotions they developed throughout the game and if certain events or players influenced their approach.

Lastly, a discussion was carried out between the researcher and the participants regarding game events and observations made during the gameplay. Here, the players were asked for their opinions and were encouraged to elaborate and describe certain decisions or behaviours in retrospective. Through these three types of data gathering, a high amount of information was acquired which allowed for a detailed analysis of the influence of risk attitude on decisions.

## 7.2. Workshop results

As mentioned before, the first method used to gather data was the logging of each of the four games using the same format that was used for game testing and balancing (C: Workshop loggings). This allowed for observations regarding the type of cards that were played, and the actions players took throughout the game. Ideally, the game should be won in the least number of projects, with the threshold pile being as big as possible. Additionally, the successful completion of a project did not necessarily represent success in the grand scheme of the game. If a project was completed successfully but the players were left with a lot of cards in hand, that would mean that extra budget was used, and negative influences would be exercised on the next project as well as on the game as a whole, resulting in more cards being transferred. Therefore, the main task for the players was to remove as many cards from their hands as possible, while also successfully completing projects. Below, in Table 12, statistics from the four games can be observed.

Table 12: Game statistics

	GAME 1	GAME 2	GAME 3	GAME 4
<b>THREATS</b>	16	26	28	26
<b>CHARACTER CARDS</b>	18	24	14	22
<b>TOOLKIT</b>	2	7	12	9
<b>KNOWLEDGE</b>	2	2	4	5
<b>SUCCESSFUL PROJECTS</b>	2	3	4	6
<b>FAILED PROJECTS</b>	2	2	1	1

Games one through three were played with four players, whereas game four was played with three players. The only team which won the game was team four, who, as seen in the table above, also played the biggest number of projects and had the greatest number of successful ones. As seen above, the distribution of cards and actions throughout the games differs significantly from game to game. In game one, participants chose to play a high number of character cards while avoiding playing threat cards, considering the 1.7 ratio of threat cards to character cards. This was a result of both the type of cards they were dealt as well as some risk aversity displayed by the players. The two other action options the players had at hand before transferring, namely the toolkits and the knowledge tokens were used very little. This was due to the small number of projects played, but mostly due to them being disregarded by the players given that these actions removed threats while the players were struggling to remove character cards. This was also noticed during the transfer phase, when players decided to mostly assist others in order to remove negative threat cards rather than resetting their toolkits. This led to fewer cards being played and removed, the loss of projects and ultimately the game.

In game number two, a similar scenario can be observed. The number of character cards and threat cards was comparable, although considerably more cards were played. This was a result of one more project being played compared to game one, as well as a higher difficulty chosen for the projects and the increased use of toolkits. Unlike the first game, here players made use of their personal toolkits to remove threats, which allowed them to play more cards. However, once again, the use of knowledge tokens was limited, the opportunity brought by these being disregarded. In this case, a more balanced approach was taken between giving assistance and resetting toolkits, which allowed for a better use of the latter. Although more successful than the first game, game two was also lost, even though the players managed to clear the project risk pile because they failed to empty their hands.

A big difference was noticed in game three, where players made use of all the options available and mitigated a high number of threats. Both the toolkits and the knowledge tokens were used intensively, whereas character cards were used much less in comparison to the other games, which proved useful given the 2.85 ratio of negative character cards to positive ones. A total of four successful projects were carried out by the players, with the only failure being the last project when the game was lost. This was associated more with bad luck rather than bad strategy, given that the players were faced with several trap cards which posed a lot

of challenges, but which also allowed for observing the change in attitudes in the given situation.

The last game proved to be the most balanced one of the four, and as mentioned earlier, it was also the only one which was won. Here, the players played a high number of both threat and character cards, while also making the most out of their toolkits and knowledge tokens. A total of seven projects were played, with only one being unsuccessful, which was a result of a negative character card. The success of the game was attributed to the balanced approach chosen by the players and the use of all the tools at hand. The fact that only three players took part in this game could also be considered an influencing factor, but the results do not conclusively point to that outcome.

Another observation made through the game logging was regarding the project difficulties chosen by the players. This can be seen in Table 13.

*Table 13: Project difficulty*

PROJECT	GAME 1	GAME 2	GAME 3	GAME 4
1	3	3	3	5
2	3	4	2	6
3	3	4	4	1
4	4	4	1	3
5		3	4	4
6				4
7				2

In games one and two all the projects had medium difficulty, although, as seen in the game logging, some situations dictated that more, or less risk should be taken, an example being the scenario when players still had a high number of cards in hand. In this case, the choice of high project difficulty only led to more cards being transferred from the threshold to the project risks because players would not be able to play all the cards in hand. On the other hand, in games three and four, the difficulty was more diverse, depending on the situation. It was observed that after one or two difficult projects, players would choose a smaller difficulty in order to get rid of the cards left in hand and prepare for another difficult project. Moreover, especially in game number four, it was observed that more difficult projects were taken at the beginning of the game, after which the difficulty was decreased and ultimately balanced. Another observation was that, after an unsuccessful project, participants chose the same difficulty or a higher one for the next project to compensate for the failure, given that the cards in the active threat rea were placed back on the project risk pile. As seen in the tables above, the teams which adapted their difficulty choice throughout the game were more successful.

As mentioned earlier, the second type of data gathering was the use of a questionnaire. The participants unanimously stated that they enjoyed the game and that it allowed them to immerse in the gameplay as it resembled in-practice risk management and decision making. Among their answers, participants stated that the level of difficulty and the

uncertainty were enjoyable, as well as the collaboration and dynamics of the game. On the other hand, some considered that the limited communication was difficult, and the understanding of the game took time.

Most of them agreed that the biggest challenge was posed by understanding the game mechanics and rules, which was the expected and desired reaction, given that this factor represented the real-life difficulty of acquiring information. This allowed them to make decisions when faced with uncertainty and lack of information. Some participants also mentioned communication as a challenge, given that this was limited. This was again done on purpose to mimic real-life, where communication is not always facile. This showed that practitioners have a strong desire to know and understand all the variables before making a decision. When that is not achievable and communication is not possible to attempt the acquisition of more information, a more averse approach is taken, confirming the findings from the interviews.

When it comes to the turning points in the games, participants mentioned multiple events. The one challenge that stood out was the presence and removal of negative character cards. The players stated that these cards had a strong influence on the game, and they found it difficult to achieve assistance majorities to remove them. Some even stated that they overlooked the transfer stage and how important this was. This showed that players initially overlooked the influence of their own characters 'attitude', as well as others on the game and struggled managing it. Another factor mentioned was the understanding of the game and strategy which, once achieved, allowed the players to improve their decisions and communicate better. Once again, this showed the strong influence the presence or lack of information has on decision-making. The players also mentioned the failure of a project, or the successful completion but with many cards let in hand as turning points which led to caution. This stands to show that pressure and fear of negative outcomes increase the aversion of practitioners towards risk.

Question number five was meant to determine what tactic was used by the players during the game. Here, most participants stated that their main goal was to remove the cards in their hands and mitigate as many of the threat cards as possible. This shows that practitioners are generally risk averse, and although this was indeed the correct approach, the successful completion of the game was also dependant on, as mentioned by them earlier, the character cards and good communication and strategizing. Some did mention assistance, help and communication as focal points, but these did not seem to be generally focused upon by all the players.

Another interesting insight was provided when players were asked about their feelings during the game. Although most participants mentioned excitement towards playing the game at the beginning, this quickly turned into them feeling challenged, stressed, and even frustrated throughout the experience. Some even mentioned that this frustration was caused by being unable to influence the choices of others. On the other hand, some players felt more comfortable as they got more positive character cards. This stands to prove the findings in literature which state that affective factors such as emotions have an important influence on the decision-making process.

Regarding the changes in approach and strategy, the participants stated that as the game advanced, the focus switched from getting rid of risks to a more balanced approach where all the tools available were used, particularly the lessons learned. Moreover, instead of focusing on the project at hand, players started thinking two steps ahead and focusing on the next projects as well. Additionally, some participants stated that communication and collaboration were improved, and that the project difficulty was moderated better throughout the game. Once again, this shows that practitioners become more comfortable with risk decisions once they get a better understanding of the situation and their limitations.

When it came to group decisions and influences, most participants agreed that their approach changed after discussions were held with the other players. Moreover, the situations others were faced with, such as owning negative character cards or having many risk cards in hand, determined the players to adjust their decisions so that help could be provided. Some also mentioned that receiving help themselves led to them playing more freely. This is similar to the findings in both literature and interviews where it is stated that decisions are strongly influenced in group settings and practitioners even search to be influenced when unsure as to what the best decision is.

The last question inquired whether the participants would do anything differently if presented again with the same situation. Although some said they would not change anything, some mentioned that better communication and discussion of strategy would be necessary. Others stated that the moderation of project difficulty and the use of lessons learned, and knowledge could have been done better. In general, participants agreed that the main improvements should be done in the area of communication and strategy, showing once more that information was the most important factor alongside the making of educated decisions, using all the tools available.

Apart from the two methods mentioned previously, information was also gathered through notes taken both during gameplay and the discussion in the debriefing. Firstly, a few patterns were noticed during the games. In each of the four games, one player was more vocal than the others, usually the one who understood the game mechanics faster. This did have positive influences on the game at times, when the said player helped the others understand as well, however, in some cases, the understanding was superficial, and it led to the player in case distracting the other players and negatively influencing the game. Moreover, in some cases, the vocal player used the received attention to gain help from the other players when it wasn't absolutely necessary. The same vocal players were the ones who showed frustration first which led to selfish behaviour, blame being assigned, and decisions being rushed. Oppositely, there were cases of players who understood the game mechanics quite early in the game and took a more observing stance, making decisions faster and being decisive while only communicating during turning points. This behaviour showed the influences some participants can have on the decision-making during meetings, which are both information driven as well as character driven.

Another observation was made regarding the age and gender of the participants, linked to the previous point. The older participants seemed to be less vocal and more observant, as well as more decisive in their actions. Instead of doubting their decisions and

asking for opinions, they would analyse the situations and act. Similarly, male participants were in general more decisive and independent, while female participants took more time to make decisions and often asked for help. Nonetheless, there were exceptions to these observations, caused by the individual character of the participants.

Secondly, the leadership for each project followed very similar patterns. The players who understood the game earlier, as well as the vocal ones chose higher difficulties for the projects and were more decisive when deciding on the extra step in the kick-off stage. However, some of those players, showed a slight disregard towards the opinions and situations of others, deciding on difficult projects although players still had many cards left in hand or negative character cards on the table. Similarly, when deciding which type of threat to be removed in the project kick-off, some players preferred to stick with their decisions although the others did not agree with their choice. Additionally, female participants had a tendency of choosing smaller difficulties for the projects, particularly in situations with higher pressure. This confirms the findings in both literature and interviews, which state that hierarchy is a strong factor influencing attitude as well as project choice and strategy.

A further observation was made concerning the changes in the attitude of players and their approach towards game base on the pressure and uncertainty. Initially, the players seemed relaxed, the only impediment to making decisions being the lack of understanding of the game. This reflected through rather quick and decisive decisions apart from some questions concerning the game. This, however, changed as their understanding of the game improved and the pressure increased. Although participants started making more educated decisions facilitated by the better understanding of game mechanics, as the players accumulated more negative character cards and the threshold pile became smaller, they became more insecure and rasher at the same time. This had both an upside and a downside on the approach. On one hand, participants started to communicate more and strategize, allowing them to make better decisions and help each other. As projects went on, the players started to moderate their choice of difficulty and, instead of focusing only on the projects at hand, they started to think ahead, and make decisions with regard to future projects and the game as a whole. On the other hand, because of the said insecurity, players started to ask for advice and help, although some of the decisions were either of an individual nature or did not require such discussion. The situation was worsened by chaotic communication and followed by frustration. These factors led to less-than-ideal decisions, such as inappropriate project difficulties, either too small or too high given the cards in hand and on the table, disregard of certain helpful actions such as the use of toolkits and knowledge tokens or certain positive character cards, and misuse of the lessons learned phase and removal of negative character cards.

Thirdly, it was noticed that players showed an increased aversion to loss, particularly in the later stages of the game. When faced with decisions that would require the loss of a positive effect in order to gain some benefits or because the game demanded it, participants were reticent to make those decisions and took a long time trying to come up with other options, although the hypothetical loss was not sizeable. There were however cases in which players made selfless decisions for the benefit of the game as well as times when participants

were indecisive, although they had positive character cards, merely because others had negative ones. This resembled the statements found in literature, noting that people are risk averse in the domain of gains as they do not wish to lose them.

Additionally, the limitation of communication to resemble reality proved frustrating for the participants. Some mentioned that this was very challenging and that given better communication, the game could have been won. This was also confirmed by the observations mentioned earlier, with decisions improving alongside the communication, as well as by the fourth team who managed to win the game. Their attempt was the longest of the four, which was a result of both individual decision time as well as the time spent communicating and strategizing together within the permitted limits. The players found this to be the key to their success, but did however mention that, although communication is essential, it should not distract others and it should be done as efficient as possible. This finding was in line with the result of the interviews, where it was determined that the communication and feedback between project stages as well as within meetings is not ideal and it should be more effective and efficient.

Lastly, when faced with scenarios in which their character would possess many negative cards, or in which the uncertainty of their decision was high, players preferred to transfer to the next project although they had cards left in hand. This resulted in more cards being transferred, therefore budget being used, although assistance could have been received from the other players. This confirmed the findings in the interviews where it was mentioned that in case of high uncertainty or lack of information, the price tag is being raised.

The two workshops resulted in a high amount of information through the four methods used. Moreover, the expected level of immersion was achieved which allowed for quality data to be gathered. This, alongside the findings from literature and interviews provided a strong foundation for the analysis of risk attitude and its influence on decision-making which can be observed in the next chapter.



## 8. Research results

As seen throughout the stages of this research, risk attitude has two dimensions, an individual one and a group one, both influenced by a multitude of factors. For the individual one, the most deciding factors is the degree to which a project is highly strategic or not. In the case in which it is strategic, the attitude inclines on the risk seeking side of the spectrum, as the appetite for the project is higher, and vice-versa. The second most important factor is the presence or lack-off information regarding the risk in terms of nature, probability and impact, as seen both in the interviews and workshops. Once again, if information is present, practitioners will have a more risk seeking attitude, whereas if it is not, they will become risk averse. Another influencing factor is the seniority of their position. As mentioned in the interviews, the higher the seniority, the more risk seeking the person. Another influence on individual risk attitude is exercised by the personal expertise and experience of the person, which if sufficient will determine a more risk seeking behaviour. Lastly, the setting in which the decision is made can also influence the attitude. As concluded from the answers given in the interviews and confirmed through observations made during the workshops, people have a tendency to be more risk averse when making decisions on their own, fact that changes once decisions are made in a group, under the perception of 'strength in numbers'.

When it comes to the group dimension, the first influencing factor is the presence of necessary expertise in the decision group. When this is sufficient, the chosen attitude is on the risk seeking side, whereas when it is not, participants take on a more averse attitude. Similarly, when a strong hierarchy is present the participants will be more risk seeking compared to an open discussion setting, although the differences here are small, as people are still more risk seeking given the beforementioned strength in numbers. However, if the communication is lacking, the attitude will once again be risk averse. On the other hand, in an open discussion, the efficiency of the communication is relevant, with attitudes shifting on the seeking side when efficiency is achieved. An example here would be participants taking turns when expressing opinions without interrupting others. Moreover, when presented with inefficient communication, practitioners will take a risk seeking or risk averse stance, depending on the correctitude of the information transmitted. This is based on the personal perception whether the information is correct or not and depends on the expertise of the individual. These conclusions concerning group attitude were achieved based on the observations made during the workshops in the different stages of the gameplay when players were required to make both individual and group decisions and the findings from literature. All these considerations can be observed and explained better using the influence tree in Figure 25.

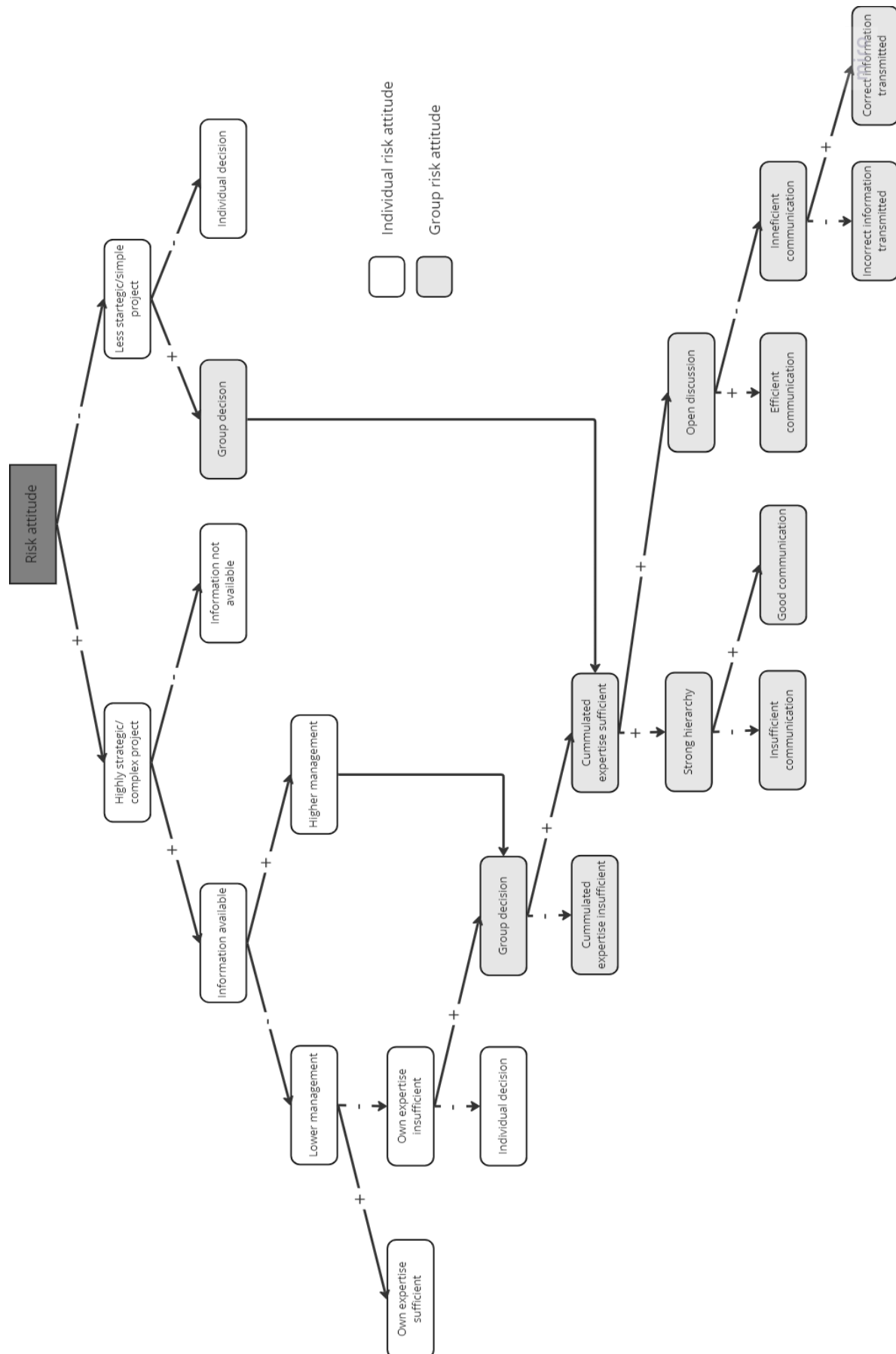


Figure 25: Influences on risk attitude in a decision-making setting

As seen in the figure, all the above-mentioned considerations have an influence on the risk attitude of the participants. The pluses and minuses on every arrow are an indication of whether the certain factors lead to a risk seeking or risk averse behaviour respectively.

Firstly, as mentioned before, if the chosen project has a strong strategic importance, the attitude will be risk seeking, given the expected high gains from the said project. As mentioned in the interviews, the strategy of the project is decided upfront by higher management, and an emphasis is put on the expected gains from the project. These would incentivise practitioners to be more accepting of risk and set higher risk thresholds. In the case in which the project is less strategic, the incentive of high gains disappears, and people take a more risk averse stance. This is in line with the literature mention that people are risk averse in the domain of gains (Schwartz & Hasnain, 2002), meaning that, since the expected gains from the project are limited, they do not wish to minimise them further. As seen in the figure, in this scenario, the next influence is the setting of the decision. It was determined that if the decision is made individually, practitioners tend to be more risk averse due to the fear of giving a wrong estimation that would make the company pay more than the said estimation. This changes in a group setting when the responsibility is shared and the participants take comfort, as mentioned previously, because of 'strength in numbers'. As seen above, in the case of a group decision, further influences are followed from the assumption that the cumulative expertise of the group is sufficient, given that the project is simple or of less strategic importance. This was noticed during the interviews, when practitioners mentioned that simpler projects receive less attention as the associated risks have been encountered before and it is assumed that they can be mitigated easily.

Returning to strategic projects, the next strong influence is exercised by the presence or lack-off information. This information refers to the nature of the risks as well as the probability of occurrence and the impact if the risk event takes place. If practitioners have the possibility of acquiring information regarding the risks at hand, the chances of properly mitigating the risks are increased which provides them with an incentive to take on the said risks. However, as mentioned in the interviews, if information is not readily available and it cannot be acquired through any means, a risk averse attitude is chosen and risks are avoided at any cost, usually by increasing the price tag for the said risks. This aspect is linked to the conscious factors from the triple strand mentioned in literature (Hillson & Murray-Webster, 2011).

The next ramification in the tree is provided by the seniority of the practitioners. It was observed that employees with higher management functions have a tendency of being more risk seeking due to their experience and due to their familiarity with high responsibility. During the gameplay, participants with hierarchically higher functions were more decisive when making decisions and, generally, took more risks. From here, influences are followed to the group setting due to the mentions from the interviews which stated that higher management participates in the risk management process through meetings. In the case of lower management positions, employees tend to be more risk averse because of the earlier mentioned fear of giving wrong estimates as well as a small aversity to responsibility which

was notice in both the interviews and workshops, as some participants were reluctant to make decisions due to the fear of making mistakes.

Further influences are provided by the own expertise and experience of the practitioners. When the risk at hand is within the specialisation of the person analysing it or if the said person encountered the risk before, then the chosen attitude is on the seeking side, as stated by several practitioners during the interviews. However, if the opposite is applicable, the person will become risk averse due to the fear of unknown. This however can be followed up by the aforementioned decision setting. The attitude will become even more averse given an individual decision because of the reasons mentioned earlier, whereas, in a group setting where the missing expertise can potentially be found, the attitude will switch on the seeking side. This is in line with the literature as well, where it is mentioned that risk attitude is influenced by the previous experiences of the person and that the presence of 'groupthink' can lead to more risk seeking behaviours (Murray-Webster & Hillson, 2008).

Moving on to group influences, the first factor is the expertise of the members. If this is insufficient considering the problem at hand, members will tend to be risk averse, and will try to source knowledge elsewhere. It was mentioned in the interviews that if a certain task or risk is part of a domain that the group does not have expertise in, external expertise will be employed. This was also observed during the gameplay, as participants took into consideration the availability of toolkits when making certain decisions such as choosing the project difficulty. Opposingly, when the necessary expertise is present, participants will consider the risks to be manageable and will be more risk seeking. This was particularly observed during the workshops, when players would play risk cards more freely if other players had their toolkits or other options available to mitigate those cards. In this scenario, further influence is caused by the setting of the meeting. When a strong hierarchy is present, practitioners are more risk seeking as the decision falls on the shoulder of the managers as well as because people with higher management positions have a more risk seeking attitude as mentioned previously. Here the communication becomes essential in influencing the attitude further. It was concluded during the workshops that in the case of good communication, participants are more risk seeking as they believe all opinions are considered and the solution will be found through collaboration. It was noted that after the communication was improved, the players played risk cards more easily as they could mitigate them with the help of their colleagues.

Similarly, in the scenario of an open discussion, although less than in the case of strong hierarchy, risk aversity decreases since influences are searched for at this point and because of the belief that the members can come to a positive conclusion if they collaborate. However, communication has, once more, a strong influence on the risk attitude. If efficient communication is achieved, practitioners will be more risk seeking as the necessary information is shared easily. In the opposite case, when the flow of information is impaired by factors such as people who monopolize the discussion, the quality of the information becomes essential. If the vocal participants transmit faulty information, or if certain opinions are overlooked, the tendency of the participants is to become more risk averse. Proof stands in the observations made during the four games, as participants made decisions faster and

were more certain about the removal of certain cards or the use of certain tools as their communication improved. However, in the opposite case, particularly when the discussion was monopolized, participants were reluctant to play risk cards and make decisions.

Similarly, to the literature, it was concluded that the individual risk attitude of the participants is the main consideration when analysing group risk attitude (Murray-Webster & Hillson, 2015). However, the communication within the group seemed to be more influencing than the power and culture mentioned in the literature. The participants to the workshops had different positions within the company and even some small cultural differences between them, however, this reflected more in the way they communicated rather than separately, as individual factors. Even though communication is strongly linked to the two principles, it is important to be considered individually, especially considering the findings in the interviews regarding feedback and lessons learned, where it was said that the flow of information is not ideal.

All the branches of the decision tree end in one of two possible scenarios. In the first one, the chosen risk attitude at that point is understood and moderated considering the situation at hand, and an appropriate risk decision is made from a risk attitude point of view. The second scenario involves an unmoderated risk attitude which leads to an inappropriate risk decision from a risk attitude point of view, and which can in turn lead to too much or too little risk being taken and which in most cases leads to more budget being needed. This can be observed when the attitude is not in line with the factual data associated with the situation, much like during the games, when players used tools to remove risks even though that was not required. The decision was not based on the facts of the game and limited their options in the following projects.

The decision tree can be used by practitioners to get a better understanding of risk attitude at any stage during the decision-making process, from a point of view of influences exercised during this process. However, the influences of the mentioned factors, whether they are towards risk seeking or risk averse behaviours, have not been given weights, but rather form an indication of behaviour. Moreover, the tree only mentions influences resulted by the process itself and not by external factors such as individual and national culture or pre-existing emotions. An example is the gender of the participants, as it was determined that male participants are in general more risk seeking than female ones. This was also observed during the gameplay, as female participants took more time on their turns and asked for help more often. These need to be considered separately and cumulated with the ones present in the decision tree.

As seen from the interviews and the workshops, an appropriate risk attitude can facilitate the choice of projects fitting the company strategy and capabilities and it can aid the proper analysis of risks and the development of fitting responses. Moreover, it can lead to a better communication and collaboration between employees in a group setting. In the case of attitudes which are not in line with the facts of the situation, both on the seeking and averse side, communication and collaboration have been observed to suffer. On one hand, if the behaviour is too risk seeking, it may lead to disregard of the limitations other participants have and ultimately to conflicts and frustration. Proof stands in the projects for which the

chosen difficulty was too high given that players already had cards in hand or had already used their toolkits, which ultimately led to difficulties. Oppositely, if the behaviour is too risk averse, opinions and opportunities might be overlooked, leading to unfavourable results and poor communication as seen in the workshops.

Efficient, and effective communication are essential for a proper moderation of risk attitude as it was concluded from the fourth game, where players managed to achieve this and won the game, although this was not the only factor which led to the win. It was observed that practitioners become more risk seeking as communication and collaboration are improved. This is a result of information being transmitted, which allows for the development of strategies as well as of expertise being employed when required. Moreover, the combination of approaches and attitudes allows for a more balanced decision-making and ensures that most, if not all possibilities, have been considered before reaching a conclusion.

On the other hand, external pressure and an increased project difficulty were shown to lead to more risk averse behaviours. Although the understanding of the game and the efficiency of the communication both improved throughout the game for all participants, as more cards were distributed and more negative character cards were played, the players started making unforced errors. Despite them being aware of all the tools at their disposal as well as receiving help and advice from others, players still made wrong decisions and overlooked opportunities simply because they felt pressured and were afraid of failure.

Risk attitude has been observed, just like stated in literature, to have a strong influence on whether the risk management process is effective (Murray-Webster & Hillson, 2007). Starting from project choice and project strategy, risk attitude influences whether certain projects are accepted given the associated risks. If there is a strong desire for a project, then the decision makers are more risk seeking and are inclined to accept the project even if it is risky. This is seen through the setting of risk thresholds, which have higher limits if the approach is risk seeking. The identification and analysis of risks is, as well, strongly influenced by the attitude of the individual or group. Factors such as previous bad experiences could lead to uncertain events which are not relevant to the project at hand to be considered risks or fear could lead to a risk to be given a higher probability of occurrence than the reality of the situation dictates. Going further, when taking action regarding the said risks, the previously mentioned influences are also part of the decision and can lead to solutions that are either too careless or too conservative. Even in the execution phase an improper risk attitude can lead to over or under-mitigation of risks, as it was seen in the four games. More factors are added when the decision is made in a group setting. Here, a stubborn, closed-minded manager can make use of his higher hierarchical position to steer the decision in the wrong direction, or a risk averse vocal practitioner can prevent the transmission of correct information to the group. Risk attitude has proved to be an important factor that needs to be taken into consideration in every stage of risk management to ensure educated decisions are made.

## 9. Research limitations

The research was done in partnership with DEME Group, a company active around the world with thousands of employees from different backgrounds and specialisations. However, the time limitations for this research only allowed for the use of a small part of that potential. As mentioned in the research, risk attitude is influenced by a multitude of factors such as previous experiences, culture, and membership to various groups. Although multiple practitioners with different backgrounds, specialisations and positions within the company participated in the research, this was somewhat limited. Further research including a broader group of participants with more diverse cultural backgrounds, belonging to various ethnicities, nationalities, religions etc. would be necessary to broaden the understanding of risk attitude and its influences on the risk management process. Moreover, this research was developed based on the risk management process employed by DEME Group, a company that specialises in marine construction, therefore the focus was put on the said industry. Only its particularities and the culture of DEME were taken into consideration and, although most factors are of a general nature and can be translated to any construction industry, a broader scope including multiple companies with various specialisations and culture would be required to get a detailed understanding of risk attitude.

Another limitation was posed by the number of participants to the interviews and workshops. Although sufficient in order to create a practical view of the subject, the number of participating practitioners only allowed for a limited variety of influences to be analysed and taken into consideration when creating the results of this research. Therefore, a larger number of practitioners would allow, as mentioned previously, for a broader inclusion of cultures, characters and backgrounds exercising influences on risk attitude both individually and as a group.

The last limitation of this research is the depth in which the influences of risk attitude were analysed given the available timeframe. As mentioned previously, different factors have higher or smaller influences on risk attitude depending on the person and the situation. In the decision tree provided, these factors were not given weights and were only used as indications of behaviour rather than hard representations of attitude, which are difficult to quantify. The simulation of risk management through serious gaming also had a broad approach to risk attitude, offering insight on the general influences of the said factors, rather than detailed approaches for each individual factor. This provided a good understanding of the relation between risk management and risk attitude, but further, more in depth, research would be required to understand each factor individually.





## 10. Conclusion

Risk attitude has become a more and more discussed topic in the last years. Its influence on risk management and risk decisions has received increasing attention in literature and is believed to be one of the factors influencing projects success. This concept is part of a larger mechanism in which, alongside risk attitude leads to the formation of risk thresholds, a measure of the amount of risk a company is willing to take. These thresholds are, in turn, checked against the capacity of the company to carry risk to ensure that the correct thresholds have been chosen. If this is not the case, risk attitude can act as a control mechanism to rectify the problem.

There are two dimensions to risk attitude, an individual one and a group one, both influenced by various factors such as the presence of information, seniority of function, quality of communication or even the presence of a strong hierarchy within the company. All these factors can modify the position of risk attitude on the spectrum between risk seeking and risk averse which, if not moderated properly, can lead to too much or too little risk being taken.

To prevent this from happening, a decision tree was developed based on the findings from the literature, interviews and serious gaming workshops aimed at facilitating a better understanding of risk attitude and its influences on the decision-making process. As seen throughout this research, a highly strategic and important project will lead to practitioners being more risk seeking. However, if information and expertise regarding the risk at hand are not available, the attitude will switch on the averse side. Similarly, if the decision is taken alone, more aversity is employed, but if the decision is taken within a group, the members will have a more risk seeking attitude. The group setting can however also facilitate inappropriate attitudes, as the impression of “strength in numbers” and decrease in responsibility can lead to too much risk being taken. In this setting the quality and efficiency of the communication play a vital role as well, with attitudes being moderated better if the two are improved. These alongside the other factors analysed in this research need to be considered as risk attitude has influences on decisions in all stages of the risk management process, from identification and analysis of risks to implementation of mitigation strategies and feedback. The results hope to allow practitioners to better understand their decisions and the factors influencing them and to allow them to make better educated ones and to limit the negative influence of the human factor.

Although the research was done entirely within DEME Group and the focus was on their area of expertise, namely marine construction, the findings are of a wider applicability. The principles resulting from this research are based on generally accepted concepts and on the widely known and used risk management process. Some small differences may be observed as a result of differences in organisational structure and culture or particularities of the industry in which the results are applied, but the general concept can be transposed to most risk management processes.



## 11. Recommendations

### 11.1. Practical recommendations

From a practical point of view, it is recommended that companies and practitioners start taking into consideration the influences of risk attitude on their decisions. These influences have a strong impact both on an individual and group level and, even though some of the factors mentioned in this research are known by practitioners, they are not fully understood and considered. Trainings and workshops should be organised to provide employees with a better understanding of their own risk attitude and how their background, experiences and current life setting can influence the decisions they make on a daily basis. Furthermore, considering that many of these decisions are made in a group setting, it is important to raise awareness of group risk attitude and its influences on group decisions, particularly among higher management employees in companies with a strong hierarchical system.

Furthermore, companies should strive to achieve an efficient and effective communication of both project related information, which proved to be of paramount importance to altering risk attitudes, as well as personal circumstance such as attitude to facilitate collaboration and moderation of the said attitude, particularly in group settings. Additionally, awareness should be raised concerning the importance of seemingly mundane decisions and how they are influenced by attitude and the strong influences the hierarchy has on group decisions and group risk attitude.

### 11.2. Recommendations for future research

As mentioned previously, the scope of this research can be enlarged by further increasing the number of participants and ensuring that people with various cultures, religions, functions, backgrounds etc. are participating to provide a more detailed and encompassing view of risk attitude and its influences. Moreover, various companies from different industries and countries could be engaged to participate in the research to broaden the scope. Through this, various risk management approaches and organisational cultures and structures will be taken into consideration which will make the research more generally applicable.

Additionally, the simulation through serious gaming could be altered to facilitate the observation of individual factors influencing risk attitude as well as the changes in approach when these factors are modified. For example, time constraints could be added in the form of a time limit for each turn for each player to observe the influences of time pressure which was shown to result in risk averse behaviour. A different approach would be to develop a series of individual missions or objectives for each player that would result in an individual win alongside the group one, to increase the subjective factor as well as to observe the influence of selfish behaviour. The importance of each factor could be further researched leading to a hierarchical description in terms of the impact they have on risk attitude and the risk management process.



## 12. Personal reflection

I chose this research based on my increasing interest in Risk Management in the last year and a half as well as on an older interest of mine, psychology. I have always been fascinated by the human brain and how people think. This is also one of the reasons for which I chose to use serious gaming in my research, given that people respond better to interactive methods rather than a simple questionnaire. It is my strong belief that any good manager should have a capacity to understand people and the way they make decisions based on their perception. Afterall, everything we do is based on our own perception.

For this reason, risk appetite and particularly risk attitude became of interest and after some research I discovered that there is a lot of potential for improvement in understanding these principles. The construction industry is not immune to the influence of the human factor, which has become more and more of a hot topic in the past years. As stated in the research, many projects still fail although an abundance of control mechanisms are used, and some of these failures are a result of human error. Therefore, having these ideas in mind, I embarked on this journey to better understand how people form attitudes when they're faced with risks and how this influences their decisions.

The research had a rough start as I found it very difficult to convince a company to take on my idea, particularly as an international student who doesn't yet speak Dutch. Even after I did find a company, I had to delay it for almost two months so that the foundation could be built properly. I had a difficult time finding the proper way of constructing this research particularly because it involved human participation, but eventually, with the guidance received from professors the ideas began to gain shape. Looking back and knowing what I know now, I would probably do things a bit different and save quite some time, but this was a valuable lesson, nonetheless.

Even though the delay did pose a bit of an issues, I still managed to organise all the project activities quite well I would say, from interviews to game design and workshops. Although the timeline was tight, with almost no room for changes or further delays, all the activities took place according to the planning, with a small exception which was the printing of the game. This took a bit longer than expected, however the games were ready in time for the workshops and the result was very good. If I was to change something, it would indeed be allocating more time to game design.

Designing a serious game, although I've done it once before, was an absolute pleasure, especially figuring out a way to include all the principles we wanted into the game and ensuring the mechanics were functional and balanced. The feedback provided by the company supervisor and two other employees was invaluable and although the process was time-consuming, the end result couldn't have been reached without their help. Working alongside experienced professionals was a fantastic experience that allowed me to learn a lot from them and from their way of thinking and approaching challenges. From base game choice to the final version of the game, it was a constant cycle of ideas and feedback which helped me keep an eye on the bigger picture and not get lost into details. Moreover, the help received from the GameLab at TU Delft was essential for the game development, especially

the game mechanics. Although this stage went pretty well, the amount of work was quite high and there was no room for downtimes, which luckily was not the case, but for future reference, more time should be allocated as stated before.

The interviews were a very interesting experience as well and the time allocated for them was in my opinion sufficient. Choosing semi-structured interviews was also a good decision, allowing me to discuss the subjects with the interviewees beyond the pre-written questions. It was very educative to receive an abundance of information regarding the risk management process used at DEME and the way meetings and communication take place. This allowed me to get a better understanding of the process both for the game design and for my future career. The only major change I would do here is writing the findings in the report earlier, particularly as report writing is not my strongest suit. I mistakenly postponed the writing of the report until the second half of the research, when the schedule got even tighter which led to a heavy workload.

Probably the best part of the research were the two workshops in which the serious game was played by employees from the company. Not only was it rewarding to see that the game fit the purpose and provided me with the information I was looking for, but it was also very rewarding to see people enjoy the game and immerse in the experience. It was also fascinating to watch people's behaviours change throughout the game and how that influenced their decisions. However, organizing these workshops proved quite difficult, especially given that I couldn't facilitate any of the games, activity which was done by the three employees who helped me with the game design. Therefore, this was dependant on their availability and given the large number of people who participated in the first workshop, some had to wait which was not ideal. This was a small hiccup, based on some unexpected events, but better planning and bigger margins could have helped avoid the situation.

The overall experience was an incredible source of knowledge that helped me learn a lot about undergoing a graduation project and writing an academic paper, about the way people work in a company, particularly how they interact with each other and about myself. I do have a tendency to be a control freak which helped me plan everything and prepare for various situations, but which also made me struggle at times and occasionally miss the bigger picture. This project allowed me to develop professionally and besides observing other people's attitude, I also got to observe my own, and how I perceive and approach risks and challenges. Thankfully, with the guidance provided by the committee members and others who have helped me throughout this research, the idea became reality and for that I am grateful. The skills I have learned during these months and the skills I now know need improving or learning altogether will surely help me in my future professional life.

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## APPENDIX 1: Factors influencing risk perception and risk attitude

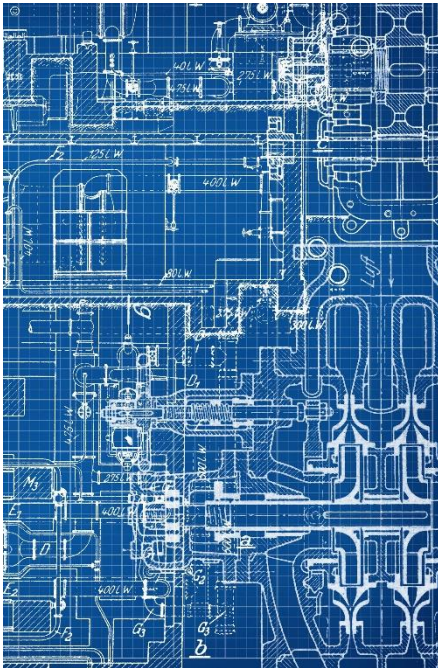
Conscious factors (situational and rational)	Subconscious factors		Affective factors (emotions and feelings)
	Heuristics	Cognitive bias	
<b>Familiarity</b> I've/we've done something like this before, or I've/we've never done something like this before  <b>Manageability</b> I/we know what to do to manage this, or I/we don't know what to do to manage this  <b>Proximity</b> If it happens it will happen soon so we need to sort it now, or It wouldn't happen for ages, we've got time  <b>Propinquity</b> If it happens it would really matter to me/us personally, or If it happens it would affect objectives, but it wouldn't really matter to me/us personally  <b>Severity of impact</b> It it happens the effect would be huge (or insignificant)  <b>Group dynamics and organizational culture</b> The norms of how this particular group behaves	<b>Intuition</b> Feels right, I won't look for any more data  <b>Representativeness</b> This must be like this other one I've seen before  <b>Availability</b> Most recent data is most memorable. Closely linked to reality traps where 'too much value is attributed to existing situations, blinded by what is, we cannot see what might be if we could disengage from reality'  <b>Confirmation trap</b> Undue confidence – selective perception: trust me, I'm a ...?  <b>Lure of choice</b> Biased by options that include future alternative judgements – keeping options open  <b>Affect heuristic</b> Seeking pleasure, avoiding pain  <b>Anchoring</b> Attach illogical significance to available data, first impressions last  <b>Group effects, e.g. groupthink</b> We all think this way	<b>Prospect theory</b> A bird in the hand is worth two in the bush, double or quits  <b>Repetition bias</b> Undue importance is given to repeated data – it must be true!  <b>Illusion of control</b> Exaggerate personal influence, discount luck  <b>Illusion of knowledge</b> Some knowledge or relevant experience masks what isn't known, particularly if the person feels they 'should' know  <b>Intelligence trap</b> Ability to mentally construct and verbally reason (IQ) means that the conclusions must be correct  <b>Optimism bias</b> Delusional optimism driven by cognitive biases and/or perceived organizational pressures and norms  <b>Fatalism bias</b> Ignore probabilities, focus on impact of outcomes – always optimistically, that is, the best case will happen  <b>Precautionary principle</b> Ignore probabilities, focus on impact of outcomes – always pessimistically, that is, the worst case will happen  <b>Hindsight bias</b> Fail to learn – 'I knew it all along'	<b>Fear (dread, worry, concern...)</b> Of the consequences of something happening  <b>Desire (excitement, wonder...)</b> Of the consequences of something happening  <b>Love (lust, adoration, attraction...)</b> I want it/want more of it  <b>Hate (dislike, disgust...)</b> I don't want it/want less of it  <b>Joy (happy, carefree...)</b> Life is good, more good things are possible  <b>Sadness (depressed, morbid...)</b> Life is bad, more bad things are probable

## APPENDIX 2: Early-stage design of event cards



## APPENDIX 3: Game elements

### A: Risk cards



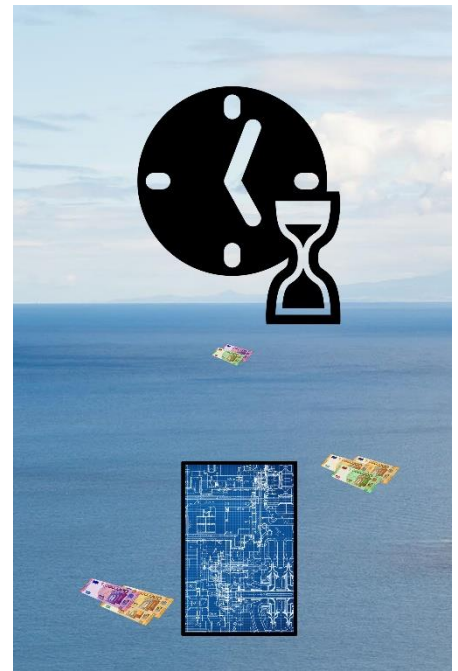
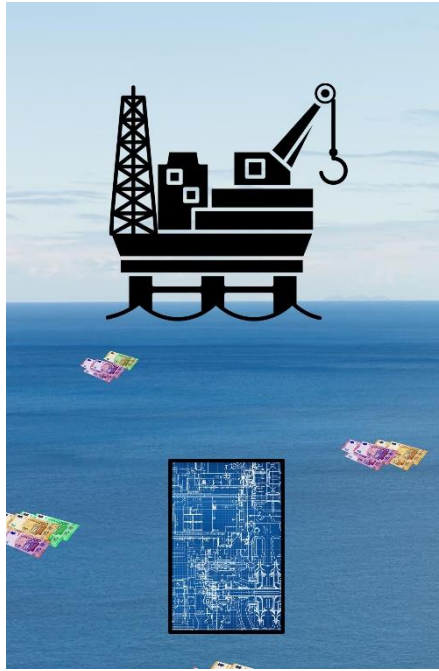
(Back of risk cards)

### A1: Threat cards

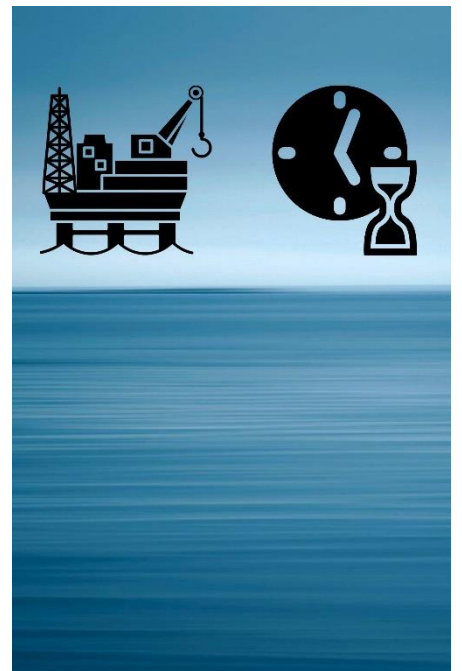
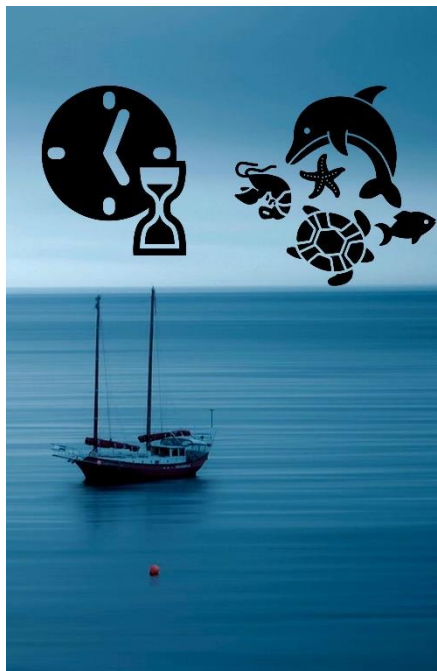
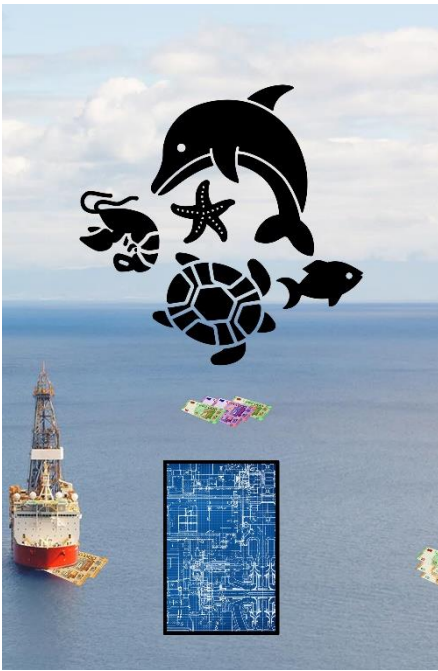


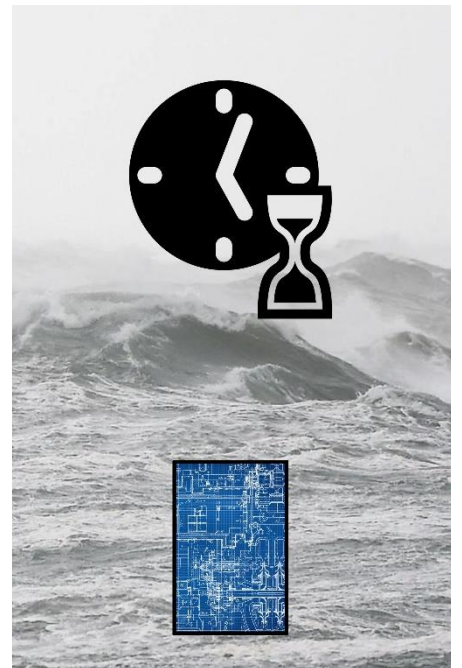




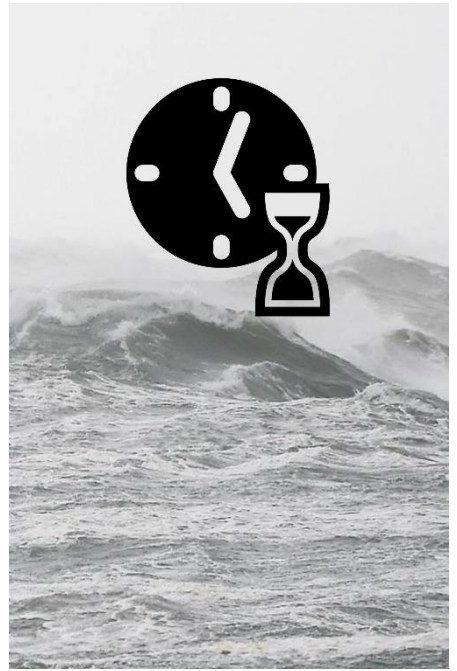












## A2: Character cards



### Burnout

Counts as 2  
negative  
character cards



### Cool-headed

At the start of a  
project, you draw  
one less card



### Distracted

Before transferring  
remove one of your  
assistance tiles from  
the game



### Dictator

Take the project  
leader role and keep  
it, preventing the  
distribution of  
knowledge tokens



### Efficient

After your transfer  
you can remove a  
card from another  
player's hand



### Distressed

During transfer draw  
your assistance tile  
randomly





Flimsy

Other players cannot transfer as long as they have any cards in hand



Supportive

Discard a negative character card from yourself or another player



Insecure

Discard a positive character card from yourself or another player



Inspiring

When you receive a knowledge token as leader give one to another player as well



Jack of all trades

Remove a threat of your choosing from the table



PTSD



Egotistic

You may transfer only if your hand is empty or if you are the last one still in the project



Forgetful

After your transfer you must draw a risk card and play it



Unnerved

When the threshold drops flip one extra card (min 4)





PTSD



Selfless

Your assistance tile  
always counts as 2  
tiles



Stubborn

You cannot transfer  
if you have 2 or  
more cards in hand



Greedy

Your assistance tile  
is always  
directed to yourself



PTSD



Tongue-tied

You may no longer  
communicate with  
other players in any  
way; you may not use  
a knowledge token



Over-achieving

At the start of a  
project, you must  
draw 2 extra cards



Pep talk

When the threshold  
drops flip one less  
card (min 2)



PTSD



X

PTSD



X

Frightened

On your turn you  
must transfer if 2  
identical  
threats are active

X

PTSD



B: Characters

Front side





Back side



## C: Assistance tokens

### Front side



### Back side



## D: Knowledge tokens

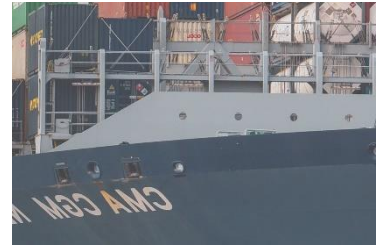


E: Project risk pile and Risk threshold pile cards

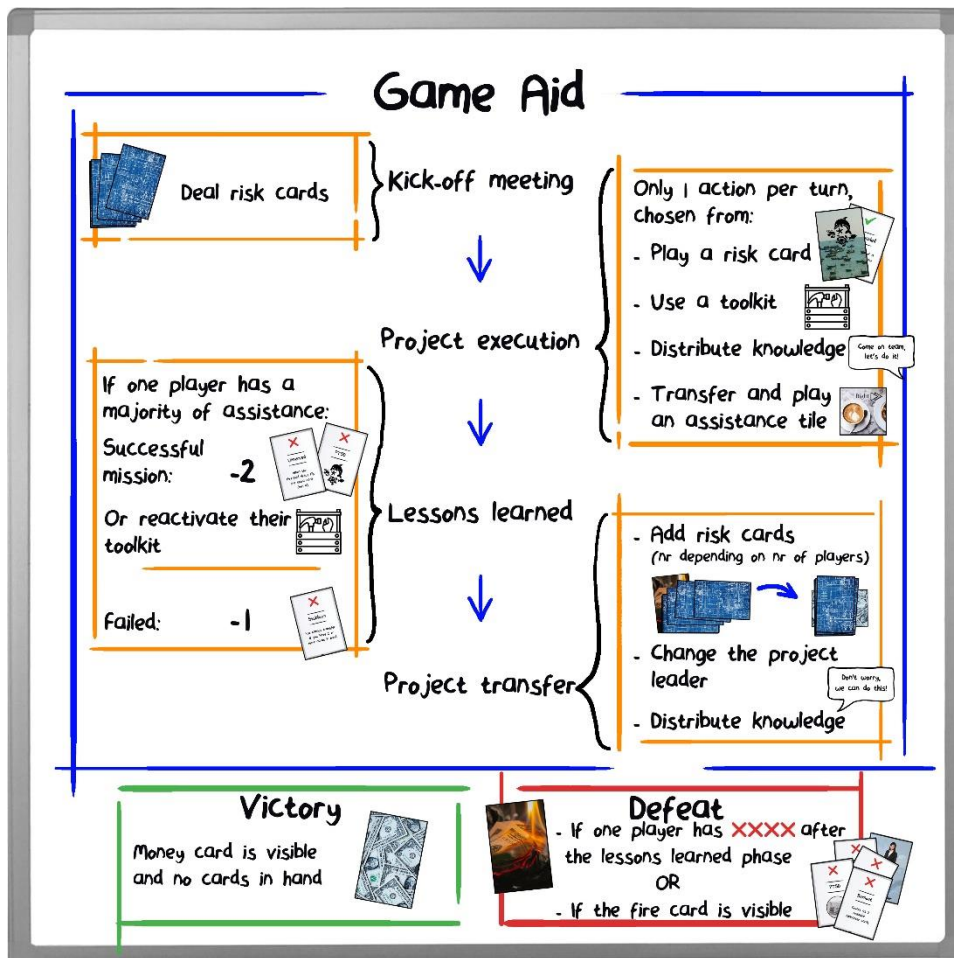




F: Leader token



# G: Aid card



## APPENDIX 4: Game loggings

### A: Game balancing

Project	Turn	Player 1	Player 2	Player 3	Player 4	Player 5	Comments
1	Kick-off	4-F+S	-	F+A	F+A		
	1	S+F	M+W	PTSD T	M+F		
	2	PTSD W	PTSD A	A+T	Toolkit S(S+F)		
	3	Transfer(1)- right	PTSD S	Distressed	Jack (A+T)		
	4	-	Selfless	Transfer-right	A+F		
	5	-	Transfer- left	-	Transfer-reset		
	6	0 assist	1 assist	2 assist- Distressed	1 assist		
2	Kick-off	T+B	4-T+A	ALL	T+S		
	1	T+S	A+T	M+B	W+B		
	2	Burnout	Stubborn	Supportive	Greedy		
	3	M+A+S	Transfer(1)-right	Transfer(1)-left	Dictator		
	4	Transfer(1)-leftt	-	-	Transfer-right		
	5	2 assist- Burnout	1 assist	1 assist	1 assist		
	6						
3	Kick-off	M+W	W+S	W+S	4-W+T+F		
	1	Knowledge(M)-M+T	W+T	Supportive(PTSD-A),M+W(K)	A+W		
	2	Tongue-tied	Insecure-Selfless	T+F	PTSD F		
	3	Forgetful	Transfer(2)- left	Cool-headed	Transfer(1)-self		
	4	Efficient	-	Flimsy	-		
	5	Transfer-right	-	Transfer-left	-		
	6	0 assist- Efficient	0 assist	1 assist	3 assist-Greedy, Dictator		
4	Kick-off	2					
	1	M+T	M+T	Transfer(1)-right	S+F		
	2	Egotistic	Toolkit-M+T	-	M+W		
	3	Toolkit- S+F	S+F	-	Distracted		
	4	Transfer- right	M+W	-	-		
	5		right		left		
	6	2 assist- Tongue-tied, Egotistic	1 assist	0 assist-Cool-headed	1 assist		
5	Kick-off		3				
	1	Knowledge(M)-M+T	M+S	M+W, M+W(K)	Toolkit(S)-S+M, M+F (K)		
	2	A+F	S+F	PTSD M	Jack M+W, M+W		
	3	right	right(2)	left(1)	right		
	4	1 assist	0 assist	1 assist	2 assist-PTSD F, Distracted		
	5						
	6						
6	Kick-off			2			
	1	Inspiring	Knowledge(F)-F+S	W+T	W+A		
	2	Frightened	S+T	Supportive- Flimsy, T+S	Pep talk		
	3	left	reset	right	left		
	4	1 assist	2 assist-Stubborn, PTSD S	0 assist- Supportive	0 assist-Jack		
	5						
	6						
7	Kick-off						
	1						
	2						
	3						
	4						
	5						
	6						
	7						

Project	Turn	Player 1	Player 2	Player 3	Player 4	Player 5	Comments
1	Kick-off	6-W+T	W+M	W+S			+7 cards
	1	Pep-talk	PTSD-S	F+S			
	2	W+M	T+A	Efficient			
	3	Jack-T+A	Distressed	Transfer-Right, PTSD(F)			
	4	T+A	W+T	-			
	5	Transfer-left	Transfer-left				
	6	0 assist- pep talk	2 assist-Distress, PTSD(S)	1 assist			
	7						
2	Kick-off	T+M	4-T+S	T-S			+6
	1	F+M	T+S	F+A, T+A			
	2	Jack(T+A), Unnerved	Insecure- Efficient	W+M			
	3	Tool-F+M	Tool-W+M	W+S			
	4	M+A	PTSD-A	Tool- F+A			
	5	Transfer-reset	Transfer-right	PTSD-W			
	6	-	-	Transfer-reset			
	7	1 assist-Unnerved	0 assist	0 assist			
3	Kick-off	F+M	W+M	6-F+M			+9
	1	T+A	Knowledge-T+F+W	F+S, PTSD-T			
	2	Knowledge-W+F	Inspiring	W+S			
	3	Forgetful	F+T	Tool-F+S			
	4	Egotistic, Jack-T+A	Transfer-Right	F+T			
	5	Dictator	-	Transfer-left			
	6	Transfer-right	-	-			
	7	2 assist-Dictat, Egotistic	0 assist- Inspiring	0 assist			
4	Kick-off		3				+10
	1	Jack-A+S, F+A	F+S	A+S			
	2	Cool-headed	T+S	Tongue-tied			
	3	Transfer-right	Distracted	Frightened			
	4	-	Transfer-2 right	Transfer-left			
	5	1 assist	0 assist	2 assist-Fright, PTSD(W)			
	6						
	7						
5	Kick-off			2			+4
	1	T+M	F+A	W+S			
	2	Supportive	PTSD-A, Greedy	F+W			
	3	Knowledge-W+A	W+A, Knowledge-F+M	Burnout, F+A			
	4	Transfer-right	Transfer-reset	Over-achieving			
	5	-	-	Transfer-reset			
	6	0 assist- Coolheaded	0 assist	2 assist-Burnout, Tongue			
	7						
6	Kick-off	3					LOST
	1	PTSD-M	Flimsy, ALL	Knowledge- F+T			
	2	T+M	W+A	S+M			
	3						
	4						
	5						
	6						
	7						

Project	Turn	Player 1	Player 2	Player 3	Player 4	Player 5	Comments
1	Kick-off	4-W+A		T+A			
	1	W+A	T+M	F+M			
	2	Efficient	PTSD-A	T+S			
	3	Tool-T+M	W+M	Tool-T+S			
	4	Transfer-reset, Over-achiev	Transfer-right	Transfer-reset			
	5	1 assist	0 assist	0 assist			
	6						
	7						
2	Kick-off	W+S	4-W+S	W+M			
	1	T+S	T+F	F+A			
	2	PTSD-M	W+S	Tool-T+S			
	3	Tool-T+F	Egotistic	Transfer- right			
	4	F+M	Transfer-2 left	-			
	5	Transfer-left, T+A	-	-			
	6	1 assist	2 assist-PTSD(A), Egotistic	0 assist			
	7						
3	Kick-off		W+F+T	4-ALL			
	1	Inspiring	Burnout	A+S+M			
	2	Knowledge-T+M	Selfless	F+W			
	3	PTSD-T	Dictator	F+W			
	4	Transfer-right, F+M	Transfer-right	Tongue-tied			
	5	-	-	Transfer-reset			
	6	2 assist- PTSD(T,M)	0 assist-Selfless	1 assist			
	7						
4	Kick-off	T+S	4-T+M				
	1	Greedy	F+M(trap), Cool-headed	W+A			
	2	Forgetful	Supportive-Dictator	Unnerved			
	3	Jack-F+M	Transfer-left	Insecure-Inspiring			
	4	T+M	-	Transfer-left			
	5	M+A	-	-			
	6	Transfer-self, Flimsy	-	-			
	7	2 assist-Forgetful, Greedy	0 assist-Cool-headed	1 assist			
5	Kick-off			3			
	1	T+W	Distracted	W+A, Supportive (Insecure)			
	2	Jack(r), F+A	S+M	Transfer-right			
	3	Transfer-right	Stubborn	-, W+M			
	4	-	Transfer- left	-			
	5	0 assist- Efficient	1 assist	2 assist-Unnerved, Insecure			
	6						
	7						
6	Kick-off	2					
	1	T+A	Knowledge	W+S			
	2	Distressed	Pep-talk	PTSD-F			
	3						
	4						
	5						
	6						
	7						
							WON

Project	Turn	Player 1	Player 2	Player 3	Player 4	Player 5	Comments
1	Kick-off	4-A+T	A+F	-	ALL		
	1	S+W	B+T	Unnerved	A+W		
	2	A+M	S+T	Dictator	Stubborn		
	3	Toolkit S+T	Egotistic	T+F	Burnout		
	4	Transfer-right	Transfer-left	Supportive(Dictator)	Transfer-left		
	5	-	-	Transfer-left	-		
	6	1 assist	0 assist	1 assist	2 assist- Stubborn, Burnout		
	7						+6 cards
2	Kick-off	S+W	A+W	A+W	4		
	1	S+W	M+T	Cool-headed	A+W		
	2	M+F	Toolkit-A+W	Frightened	M+T		
	3	S+F	S+W	Transfer-right	Toolkit-S+F		
	4	Transfer-left	Transfer-reset	-	Transfer-right		
	5	0 assist	2 assist- Egotistic	1 assist	1 assist		
	6						
	7						+10 cards
3	Kick-off	2	-	-	-		
	1	S+T	M+F, M+W (K)	S+M	Knowledge (M)- M+W		
	2	Distressed	A+F	Transfer- 2 left	Pep-talk		
	3	Transfer-reset	Transfer-left	-	Distracted		
	4	-	-	-	Transfer-right		
	5	1 assist	0 assist	2 assist- Unnerved, Frightened	0 assist- Pep-talk		
	6						
	7						+7 cards
4	Kick-off	PTSD (M)	4-M+W	M+T	M+T		
	1	S+F	S+W	A+T	W+F		
	2	Toolkit-S+F	Over-achieving	A+T	Transfer-reset		
	3	Inspiring	Jack- A+T	S+F	-		
	4	S+T	Toolkit-S+W	Flimsy	-		
	5	Tongue-tied	Transfer-left	Transfer-left	-		
	6	2 supp- Tongue-tied,	1 supp	0 supp-Cool-headed	1 supp		
	7	0 assist-Inspiring	1 assist	1 assist	1 assist		+6 cards
5	Kick-off	A+F	PTSD (A)	4-A+F	-		
	1	Knowledge(T)-PTSD (T), M+W(K)	Knowledge(M)- M+F, W+T(K)	Knowledge(W)	Selfless, PTSD (W)(K), M+F (K)		
	2	PTSD (S)	Forgetful	Efficient	S+T		
	3	Transfer-right	PTSD (R), Jack (S+T)	Insecure	M+T		
	4	-	Transfer- right	Transfer-left	Transfer- left, W+T(Efficient)		
	5						
	6						
	7						WIN

## B: Example of simplified logging

Project	Turn	Player 1 (T)	Player 2 (A)	Player 3 (M)	Player 4 (S)	Player 5	Comments
1	Kick-off	2					
	1	threat	threat	threat	tool		
	2	character card +	character card -	character card +	threat		
	3	transfer-p4, removed card from p4	transfer-p1	transfer-p2	transfer-reset		
	4	1 supp	1 supp	0 supp	1 supp		
	5						
	6						+3
2	Kick-off		4-Agreed				
	1	threat	threat	threat	threat		
	2	character card -	character card -	character card +	transfer-p3		
	3	transfer-p4	transfer-p2	Transfer-p2	-		
	4	0 supp-remove +	2 supp- remove 2x-	1 supp	1 supp		
	5						
	6						+10
3	Kick-off			4-agreed			
	1	threat	knowledge F	character card -	threat		
	2	threat	tool	transfer-p4	character card -		
	3	threat	threat	-	character card -		
	4	character card +	transfer-p3	-	character card -		
	5	transfer-p4	-	-	transfer-p3		p4 drew card after transfer>project lost, draw in support-
	6	0 supp-remove +	0 supp	2 dupp	2 supp		no body removes cards ->+10
4	Kick-off				4-agreed		
	1	knowledge w	threat	knowledge T	threat		
	2	character card -	character card -	tool	threat		
	3	character card +	threat, trap-character card -	transfer-p2	character card +		
	4	transfer-p2	transfer-p3	-	transfer-p1		
	5	1 supp	2 supp- remove 2x-	1 supp	0 supp		p2 removed + card from p4 instead of p3 who had more cards in hand, +11
	6						
5	Kick-off	6-agreed					
	1	character card +	threat	threat	knowledge-A		
	2	character card-	character card-	character card -	character card +		
	3						
	4						p2 has to transfer and there are not enough cards for next project so the game is lost
	5						
	6						
	7						



## C: Workshop loggings

### Game 1

Project	Turn	Player 1	Player 2	Player 3	Player 4	Comments
	Kick-off	Difficulty 3				
	1	Threat	Character card	Character card	Threat	
	2	Character card	Threat	Threat	Character card	
	3	Character card	Transfer to P3	Character card		
	4	Transfer		Transfer	Transfer	
	5	1 assistance token	2 assistance tokens	1 assistance token	no assistance token	
	6		1 card in hand			
	Kick-off		Difficulty 3			Leader is trying to influence the others
	1	Threat	PTSD Traffic	Threat	Possitive character card	
	2	Negative character card	Threat	PTSD Weather	Use positive card to remove threat Play PTSD	
	3	Negative character card (now has 3)	Threat	Negative character card (now has 4 negative character cards)	Transfer + remove 1 negative card from P3's hands (trap card)	
	4	Transfer	Negative character card (now has 2)	Threat - Project Lost		Project was lost
	5	1 assistance token	1 assistance token	2 assistance tokens (remove 2 negative cards)	no assistance token	
	6					
	Kick-off			Difficulty 3		P2 influencing: thinking bout the game mechanics more than the others
	1	Knowledge token - remove weather	Threat	Threat	Possitive character card	
	2	Possitive character card	Transfer	Threat	remove 1 threat + use tool kit (on threat removed from the table)	
	3	Threat		Transfer	Threat	
	4	Transfer			Transfer + reset tool kit	
	5	1 assistance token	1 assistance token	1 assistance token	no assistance token	No removal of negative cards at the end of the game
	6					
	Kick-off	1 card removed	1 card removed	1 card removed	Difficulty 4 - remove marine life	There were only 14 cards left on the project risk pile (win-pile)
	1	Threat	Knowledge token used	Threat	Threat - use positive card to remove thread from the table	
		1 card removed	1 card removed	1 card removed	1 card removed	
	2	Negative character card - has 4 negative cards now!	Toolkit	Negative character card - has 4 negative cards now! ==> Game over		
	3					
	4					
	5					
	6					2 players have 4 negative cards on the table
	7					Game over

## Game 2

Project	Turn	Player 1	Player 2	Player 3	Player 4	Comments
	Kick-off	Difficulty 3				
	1	Positive character card	PTSD	Threat	Threat	
	2	Negative character card	Negative character card	Threat	Positive character card	
	3	Threat	Transfer (to p1)	Tool kit	Tool kit	
	4	1 assistance token	2 assistance tokens	Threat	Threat	
	5			Transfer	Transfer + reset tool kit	
	6					
	Kick-off	1 card removed	Difficulty 4 - remove schedule		1 card removed	
	1	Threat	PTSD - Traffic	Threat	Threat	
	2	Tool kit	Negative character card	Negative character card	Knowledge token: remove weather	
	3	Threat	Tool kit	Threat	Negative character card	
	4	Transfer	Transfer	Transfer	Transfer	
	5		1 assistance token	2 assistance tokens	1 assistance token	
	6					
	Kick-off	1 card removed	No card removed	Difficulty 4 - remove schedule 1 card removed	1 card removed	Leader proposed to remove schedule, 2 disagreed but the leader decided to go with the first choice
	1	Threat	Knowledge token - remove marine life	PTSD	Negative character card - dictator - took over leader	player 1 still had a knowledge token in hand but played a threat instead
		1 card removed	1 card removed	1 card removed	No card removed	
	2			Negative character card (had already and added 1)	Threat + trap ==> 3 threat of same risk	Project was lost
	3	reset toolkit	2 assistance tokens	1 assistance token		
	4					
	5					
	Kick-off	1 card removed	No card removed	1 card removed	Difficulty 4 - remove Marine life Removed 1 card	Leader decided the team should take more risks - difficulty 4
	1	Threat	Threat	Threat	Positive character card	
	2	Negative character card	Positive character card	Negative character card - has 4 negative cards now	Positive character card - remove threat of table	
	3	Use positive card to remove negative card of P3 Use of knowledge token	Threat	Transfer + reset tool kit	Transfer	
		1 card removed	1 card removed			
	4	Negative character card	Threat			
	5	Transfer	Negative character card			
	6		Positive character card			
	7		Tool kit			
	8		PTSD			
			Transfer			
	9	2 assistance tokens	1 assistance token			
	Kick-off	Difficulty 3 (9 cards were left)				player 1 changed to a player who played the game earlier
	1	Threat	Threat	PTSD	Negative character card	
	2	Use positive card to remove negative card of P3 + use of tool kit	Threat	Threat	Threat	
	3	Threat	Transfer	Transfer	Tool kit	
	4	Threat			Use positive card + play threat	
	5	Transfer			Negative character card	
	6				Transfer	
		1 assistance token		2 assistance tokens		
			1 card left	3 cards left		Game over: 4 cards left in hands + 4 cards to flip from the threshold pile ==> there were only 6 cards remaining on the threshold pile

### Game 3

Project	Turn	Player 1 (PM)	Player 2 (FM)	Player 3 (PCM)	Player 4 (WM)	Comments
	Kick-off	Difficult 3				
	1	W+T	S+F	M+T (trap card)	toolkit used => removed W+T	trap - extra S+W on table
	2	A+F (trap card)	Support Left	Support Left	Reset toolkit - no support given	trap - extra M+F on table
	3	Support Right				
	4					
	5					
	6					
	7					
	Kick-off		Difficult 2			
	1	Knowledge used	A+W	M+T	F+W	removed A+W with Knowledge
	2	F+M	A+W	M+T	toolkit used => removed W+T	
	3	toolkit used => removed M+T	toolkit used => F+W removed	Support Left	A+T	
	4	T+F+W	Reset toolkit - no support given		Neg character - Frightend	
	5	Reset toolkit - no support given			Reset toolkit - no support given	
	6					
	7					
	Kick-off			Difficult 4		Removed Assest as highest risk
	1	S+W (trap card)	toolkit used >A+F removed	PTSD - Assets	M+T (trap card)	trap (1) S+F; trap (2) A+F
	2	Pos character - Cool-headed	Knowledge used	Toolkit used => S+F removed	S+T	removed W+T;W+S;W+M
	3	toolkit used => removed M+T	A+T	PTSD (Finance)	toolkit used => removed W+T	
	4	Reset toolkit - no support given	Neg Charcter - Overachieving	PTSD (Marine)	S+F	
	5			Reset toolkit - no support given	Support Right	
	6					
	7					
	Kick-off				Difficult 1	
	1	PTSD Schedule	T+A (trap)	Toolkit used => S+T removed	S+T (trap card)	Trap (1) Distressed; trap (2) A+W
	2	M+F (trap card)	M+W	Knowledge used	Neg character - Greedy	Trap (3) Pep talk
	3	toolkit used => removed M+W	S+T	Transfer Right	Reset toolkit - no support given	
	4	Reset toolkit - no support given				
	5					
	6					
	7					
	Kick-off	Difficult 4				Removed Weather as highest risk
	1	M+A	S+T	Neg character Stubborn	M+F	
	2	Toolkit used => removed M+A	Pos Character Effective	Neg character Dictatore	Pos Character Supportive	Removed Stuuborn
	3	M+W	Use Effective	Neg Character Insecure	toolkit used => removed S+T	removed A+F with Effective
	4	PTSD Traffic	Transfer right	T+F	Knowledge used	removed Effective with Insecure
	5	Transfer Left		Reset toolkit - no support given	S+M	
	6				Reset toolkit - no support given	
	7					Risk Treshold empty

## Game 4

Project	Turn	Player 1 (PM)	Player 2 (BU)	Player 3 (Lead Eng)	Comments
	Kick-off	Diff 5 card			Kick-off Remove Schedule as 2nd choose
	1	W+M	W+A	Toolkit W used	Removed W+M
	2	W+M+S+F+T+A	Toolkt A used	W+M (trap) => Jack of all Trades	Positive character; Removed W+M+S+F+T+A
	3	T+S	Pos character Efficient	Neg Character Frightend	
	4	Toolkit M used	F+A	T+A	Removed W+M
	5	Tranfser left	Neg Character Unnerved	Transfer; reset toolkit	
	6		Transfer; Removed Unnerved; reset toolkit		
	7				
	Kick-off		Diff 6 cards		Kick-off removed F (F+T; F+M; F+W)
	1	T+M	W+M	Toolkit W used	Remove M+W
	2	LL Weather removed	W+S	Pos Character Selfness	Removed (W+S(trap); W+T)
	3	Pos Character Pep Talk	Pos Character Cool-headed	PTSD Finance	
	4	Neg Character Insecure	Neg Character Stubborn	Neg Character Dictator	
	5	PTSD M	Transfer left + played Efficient	PTSD Schedule	Efficient removed Flimsy from P3
	6	PTSD T		Transfer; reset toolkit	P3 removed Dictor & PTSD Fin
	7	Tranfser; Reset toolkit			
	Kick-off			Diff 1 card	1 Card 'to clean our hands'
	1	Neg Character Over-achieving	M+F	Neg Character Distracted	
	2	Transfer Right	Transfer Right	Transfer left (counted double)	P1 removed PTSD M & Insecure
	3				P2 removed Efficient
	4				P3 Removed
	5				
	6				
	7				
	Kick-off	Diff 3 card			
	1	T+F+W	PTSD Assets	Transfer left (counted double)	
	2	F+W	W+M*		Due to Stubborn no transfer; No 2 weathers on tabe
	3	Transfer Left	Transfer left		P1 removed W + Over-achieving
	4				
	5				
	6				
	7				
	Kick-off		Diff 4 card		Kick-off removed Traffic(F+T; W+T; A+T(trap))
	1	LL removed Weather	F+M	LL removed Schedule	LL removed S+F; S+W;S+F(trap) LL removed W+A; W+M
	2	Played Supportive	Neg Character Egotistic	T+A	Supportive removed Egotistic
	3	Toolkit Marine used	Toolkit Asset used	F+S	F+M removed; T+A removed
	4	T+S	T+A	Transfer left (counted double)	
	5	Neg Character Forgetfull	transfer; reset toolkit		
	6	Pos Character Inspiring			
	7	Transfer; reset toolkit			
	Kick-off			Diff 4 card	Kick-off removed S+T; S+A+M
	1	Played Supportive card	LL remove Fin	F+A	LL removed (A+F(trap);F+W;T+F+W) Removed Frighted with Suport card
	2	Toolkit used	T+M	S+M(trap)	M+S removed; trap no effect as vicotry deck empty
	3	F+M(trap)	Toolkt used	Neg Character Burnout	
	4	Transfer right	PTSD Weahter	A+S	
	5		transfer; reset toolkit	Transfer	P3 removed S+Distracted
	6				P1 removed Inspiring
	7				
	Kick-off	Diff 2 card			
	1	Played Support card	M+T	LL remove Marine	Removed Asset with Support; LL removed M+T; M+A
	2	A+W(trap)	Neg Character Distressed	Toolkit W used	A+W removed with toolkit
	3	A+F	Toolkit Asset used	Transfer left (counted double)	A+F removed with toolkit
	4	W+A			
	5	Game won, all cards played, Victory deck empty			
	6				
	7				