Designing a tool to increase Collaborative Innovative Capacity in public - private organisational partnerships

Ir. D. Sommers

TU Delft

Designing a tool to increase Collaborative Innovative Capacity in public - private organisational partnerships

An application of design based research for innovation in railway infrastructure management

by

Ir. D. Sommers

Student number: 4858530

A thesis to fulfill the degree of

Master of Science
in Communication Design for Innovation

at the Delft University of Technology,
to be defended publicly on Friday January 27, 2022 at 16:00.

Supervisors:	Dr. É. Kalmár,	TU Delft AS
	Dr. M.C.A. van der Sanden,	TU Delft AS
	Dr. S. Fazi,	TU Delft TPM
	Ir. mr. M. Kuhlmann,	ProRail

Abstract

Collaborative Innovation can serve to elevate the production potential of firms and organisations as well as preparing them for the future. This process of two organisations collaborating together is very complex and becomes even more difficult when organisations are large and very different in their organisational culture or function. This research describes the design of a tool to aid Collaborative Innovative Capacity in public - private organisational partnerships. The research is based on a case study within the Dutch national rail infrastructure management organisation and focuses on the relationship between this organisation and its maintenance contractors.

Through literature research and semi-structured interviews the studied situation is found to consist of two parties trying to innovate together using an imperfect collaborative system. Their separate, struggling relationships with this system are not shared or understood by the other party. This gives rise to a wall of misunderstanding. The designed tool is based on the assumption that through better understanding of the barriers which are present in the other party's struggling relationship with the collaborative system, the wall of misunderstanding can be lowered which in turn increases Collaborative Innovative Capacity in the public - private organisational partnership.

This tool takes the form of a serious game which presents players with scenarios which (potentially) hinder them in their game objective. These scenarios are representations of real-world barriers to innovation. Through confronting players with scenarios which are related to another organisational role than the one they occupy in their professional life, they should gain new perspectives about the struggling relationship of the other party with the collaborative system. Thereby lowering the wall of misunderstanding and increasing Collaborative Innovative Capacity. The results of the design and preliminary testing show that the developed serious game does have an effect in the form of gained attitudes towards the importance of sharing different experienced barriers towards innovations with one another. However measurements show no actual newly gained insights into practical barriers which were not already known to the players. While further research, more extensive testing and measurements, and further specification and expansion of scenarios can be undertaken to increase the value of this tool, after reconsideration a revised design objective is formulated which focuses on the interaction between the participants and relaxes its rigid view on the wall between them. This could yield a tool which is more in tune with the essence of the problem which would also cause it to be much simpler in nature.

Contents

List of Figures

List of Tables

1

Introduction

Innovation is one of the most important drivers of organisational success. Organisations who do not innovate stall and deteriorate. Innovative capacity therefore is a determinant for the viability of an organisation or company. Innovative capacity is the measure of how well an organisation deals with the introduction of new products, ideas or processes (Koc & Ceylan, 2007).

When one is not just working by themselves on a product or process but also in collaboration with others, this process of innovation becomes a collaborative effort, or Collaborative Innovation (CI). Collaborative Innovation is necessary to understand and access the intelligence of competitors, customers and other collaborative stakeholders, it stimulates understanding of influences from the outside world like governmental regulations or trends in society, and it also promotes self-examination of internal organisational capabilities (Swink, 2006).

Collaborative Innovation is also complex and requires creativity, flexibility of thought and a willingness to accept ideas from the other party which one may not feel comfortable with immediately. This process, and these qualities are profound and take a lot of time and practice to get acquainted with. This process of Collaborative Innovation therefore is made even more difficult when it is practiced on the level of large companies working together, and even more so when these companies have to cross the private-public boundary of industries. Collaborative Innovation in these settings can be halted by certain sets of barriers like the lack of proper business infrastructure and administration or high costs without proportional perceived benefits (Nečadová & Scholleová, 2011). Innovation in this context can also be experienced as being very disruptive to the core processes of the organisations involved because all parties are already under a lot of pressure to reach their respective optimal outcomes of the collaboration. The innovations studied in this research pertain to innovations (or changes) in the way in which two parties collaborate in a professional setting, which are innovations in process rather than in product.

This research is performed within ProRail, the Dutch railway infrastructure manager. The Dutch railways are governed by one infrastructure manager, ProRail, which is a semi-governmental agency and in this research is considered to be the public party in the public - private organisational partnership. This infrastructure manager works with many other organisations, like the government itself, the transportation companies who transport people and freight across the infrastructure, adjacent infrastructure managers of, among others, Belgium and Germany and many more. One of the other parties ProRail works with is the maintenance providers. These are contractors who are hired by ProRail to carry out one of ProRail's core tasks: rail maintenance. These contractors have a lot of in-depth technical knowledge and experience in maintaining large systems. The contractors in this research are considered to be the private party in the public - private organisational partnership. The relationship between ProRail and its maintenance

contractors is in many ways a traditional client - contractor relationship. ProRail sets out a tender for a maintenance contract for a certain region of the infrastructure for a limited amount of time. This tender includes requirements regarding the performance of the maintenance, this is called Performance Guided Maintenance (PGM). All contractors can then submit their bid in which they detail what the performance is they can deliver at what price, after which ProRail can choose the best offer. This process is required by European legislation. This all makes the collaboration between the contractors and ProRail a rather complicated one and therefore Collaborative Innovation even more complicated.

1.1. Research aim

While new ideas within either ProRail or its contractors often arise, they rarely see a follow-through in terms of actual development. This complaint is the root of this research. Because of the reasoning described above which states that innovative capacity is important for business, Collaborative Innovation is important to stimulate this innovative capacity in collaborative environments and the Dutch rail infrastructure management being a very complex collaborative environment, the aim of the research is to design a tool to aid the Collaborative Innovative Capacity (CIC) for public - private organisational partnerships.

1.2. Research questions

To guide the research a central research question is formulated and to further detail the answer to that central question, three sub-questions (SQs) are presented:

RQ: *How can a tool aid the Collaborative Innovative Capacity for public - private organisational partnerships?*

- SQ1: *What methods for positively influencing Collaborative Innovative Capacity are identified in the existing body of knowledge?*
- SQ2: *What barriers for Collaborative Innovation are experienced in the studied public - private partnership?*
- SQ3: *How can a serious game tool raise awareness barriers for innovation as experienced by others in the studied public - private partnership?*

1.3. Research outline

This research is one of the design-based variety. The separate methodological steps (described in Chapter 2) all combine into the overall design process. The design process is often regarded to take the shape of a double-diamond (Council, 2007). As described in Figure 1.1, this format is sometimes extended beyond the second diamond. All diamond sections are based on the principle of diversion and conversion. The first phase of diversion is the Discover phase, here the researchers try to take in as much information as possible to understand the wide context beneath the problem. In this research that phase includes the first exploration into the topic of the collaborative partnership between ProRail and its contractors, subsequently the literature research serves to expand this understanding with more data. The back end of the first diamond is the Define phase, in which this broader exploration is distilled down towards a problem or goal definition. In this current research this phase included the conducting and processing of interviews with individuals who work in the studied context. This yields a goal definition and an overview of barriers for Collaborative Innovation. Then the second diamond starts with the Develop phase, here ideas for solutions are formulated. In this research this included the operational design of a game using the Triadic Game Design methodology to find the requirements for the tool.

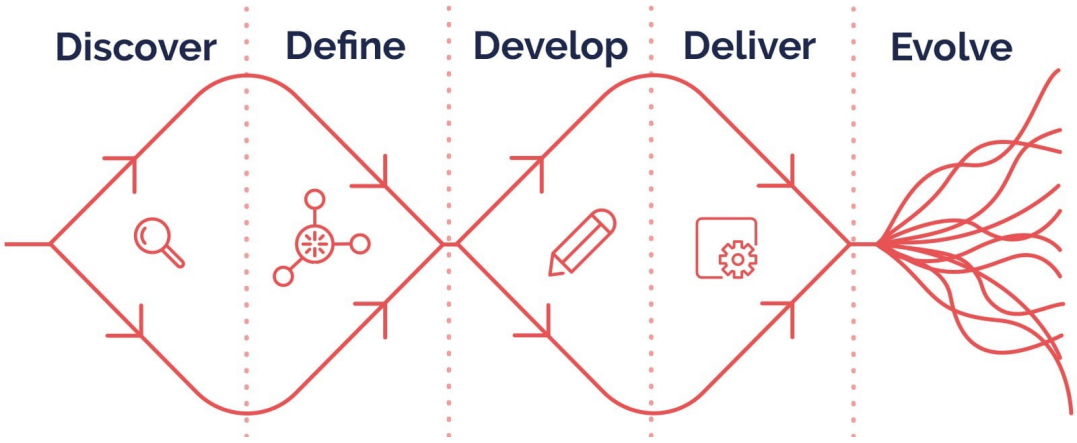


Figure 1.1: Double diamond description of the design process (adapted from (Roberts, 2019))

Finally the Deliver phase ends the second diamond. In this phase the final product takes shape and is tested. In this research that involves the two prototype tests and iterations to come to the final form of the delivered game. This ends the design process in most academic research. Afterwards more iterations can be performed to further analyse and improve the result to that point (in Figure 1.1 this is indicated by the Evolve phase). This research, while brief, does include a third diamond which resulted from the testing and reconsiderations regarding the tool purpose and goal.

The following chapter describes the methodology used in this research. This methodology chapter describes the four main phases of the research which were used to answer the three sub-questions described above. Thereafter the results of those four research steps are described followed by the discussion of those results. This discussion then also encompasses the aforementioned third diamond which will be elaborated upon in Chapter 4. Once the results are put into the proper context, recommendations are made for further design opportunities and the broader collaboration environment studied and finally the conclusion chapter is used to answer the research questions and summarise the effects of the research which is performed.

This all constitutes the outline of this research. Figure 1.2 details the different steps and their respective products visually.

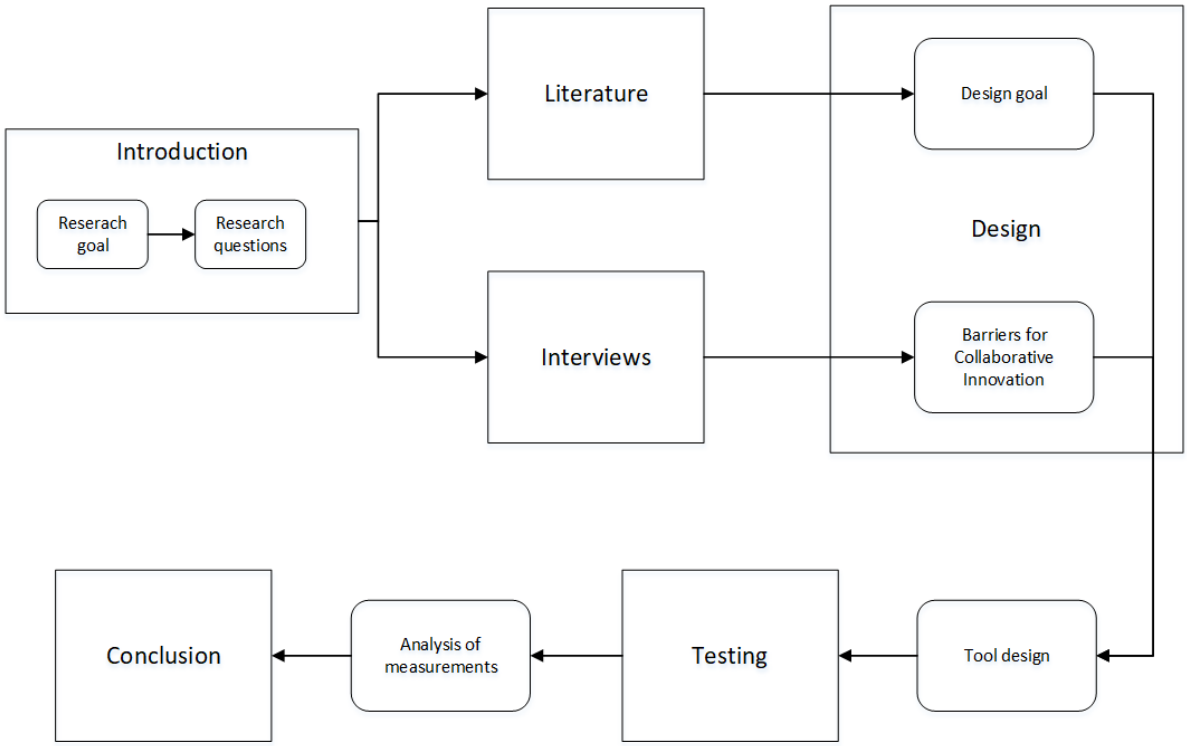


Figure 1.2: Outline of the research

2

Methodology

To answer the three sub-questions stated in the previous chapter, four major steps are undertaken. In the Discover and Define phases, the literature study and interviews answer the first two research questions respectively. The last sub-question is answered in the Develop and Deliver phases by the operational design and testing of a tool. The order of research activities is visually represented in Figure 1.2.

2.1. Discover

In the Discover phase a narrative literature study is performed. The goal of the literature study is to give an overview of possible methods which can be used to positively influence Collaborative Innovative Capacity in private - public organisational partnerships. The current state of literature offers a host of research into this topic and related topics and a proper overview of this state-of-the-art is necessary to base the design upon. The literature study is structured around a few central topics: Innovation Readiness, Knowledge Sharing and Collaborative Innovation.

Literature is found using search engines Google Scholar and Scopus. The three major topics were sought for in different configurations in these search engines, moreover snowballing through the most promising results yielded subsequent material for the literature research. The last source of literature is the researcher's own experience and connections of academic supervisors or colleagues.

2.2. Define

To get a better idea of barriers for Collaborative Innovative Capacity in private - public organisational partnerships and more specifically the partnership of ProRail and its maintenance contractors, interviews were held with employees from both parties during the Define phase. The interviewed employees are all involved in the collaborative process between ProRail and maintenance contractors and have a lot of experience in the struggling innovative capacity of the partnership. Interviews were semi-structured in order to account for inherent flaws and/or oversights in the theoretical model. This form allows for spontaneous contributions in the conversation when the subject of the interview deems necessary or interesting (Strauss & Corbin, 1998). Each interview was structured to address the following topics:

- The experience and function of the interviewee in the studied context and a description of the collaboration in their own words based on their individual perspective.
- Knowledge sharing between the partners in the studied context, amount of knowledge shared as well as accepted in both directions and possible barriers to the sharing or accepting of that knowledge.

- Generation of ideas and acceptation of those ideas in both parties. Innovation readiness more generally and the possible barriers or incentives for innovation readiness.
- Interactions of the previously discussed topics and processes

To aid the ease of the researcher as well as interviewee as well as other practical concerns, all interviews were held digitally using MS Teams. All interviews were recorded and transcribed, recordings were deleted as soon as transcription was completed with the exemption of an audio recording of the interviewee being informed of the data handling process of this research and consenting to voluntary participation in the research as described. These audio recordings were subsequently stored on a secure server to be deleted after completion of the research. The transcripts were anonimised and can be found in Appendix A.
In total six interviews were held with professionals in the field. The following people were interviewed (in no particular order):

Interview 1 An operational manager within ProRail, experienced in dealing with the execution and management of the daily operations as described in the contracts between ProRail and specific contractors

Interview 2 A project manager within one of the contractors who is responsible for managing and negotiating the contracts and possible deviations from those contracts with ProRail

Interview 3 A maintenance engineer within one of the contractors who is an expert on the operations which form the service provided for ProRail. Moreover this engineer can be considered an expert in generating new ideas to perform the maintenance tasks and operations surrounding it

Interview 4 A senior policy advisor from a branch organisation which represents many different types of private contractor companies in industries like infrastructure, water-management and other large construction projects. This person is very experienced in the interaction between the government, public entities like ProRail and private companies like the contractors

Interview 5 Another operational manager from ProRail, similarly having a lot of experience dealing with management of operations in collaboration with the contractors

Interview 6 A strategic manager within one of the contractors. This manager is responsible for not only the strategic development of maintenance operations but also for digitisation and innovation of those processes

Once all interviews were conducted, the transcripts were analysed through coding. An open coding method was adhered to in order to account for the semi-structured nature of the interviews. The codes were thereafter analysed both in their nature and relationship as well as frequencies of occurrence in general and within the different organisational groups interviewed.

2.3. Develop

In the Develop phase of this research, a tool in the form of a serious game is designed to aid in the Collaborative Innovative Capacity in the private - public organisational partnership. During the design of this game the third sub-question was answered. The insights from both literature as well as the interviews are combined to design the game to be as effective as possible.

The actual design began with a basis in the analysis of the results of the previous two steps (literature study and interviews). Further a method of analysis described in the Triadic Game Design process (Harteveld, 2011) was used to better translate the known context which the game was designed for to actual aspects of the game itself. The insights gained from the literature and interviews, together with the results of the Triadic Game Design methodology then were used as input for a collaborative brainstorming session with a professional serious game developer in order

to flesh out a first concept. This first concept was built out further until breaking point at which the concept was revised into the next conceptual game. This second prototype of the design can be seen as the base for the final result.

The designing involved visual processing both on paper and using the online collaborative whiteboard platform Miro, further resources were taken from MS Visio. This provided the opportunity to iterate quickly as well as roughly testing the prototype.

2.4. Deliver

In the Deliver phase the developed game is tested. Testing was performed continuously throughout the Develop phase already by the researcher personally, but during the Deliver phase it is also done formally on two separate occasions using test subjects to test both game mechanics and effectiveness of the designed tool. All tests with exception of the last one served as input for iterations of the game design as well as input for further recommendations in terms of future research and application of the result of this research.

Testing with actual test subjects was performed using the Miro boards in which the tool was developed as well as MS Teams to adequately communicate among players and researchers during the tests. All tests happened in an online remote fashion. The first live test was performed using players which are not directly involved in this research or in the studied public - private organisational partnership. The second test included only test subjects who are directly involved in the studied public - private organisational partnership. Two of the four participants were employees of one of the maintenance contractors of ProRail. The other two participants were employees of ProRail itself. Some, but not full, overlap was present between the participants in the interview section of this research and the game test session. Both game test sessions were recorded, recordings were only used for the researchers' review purposes and will be destroyed upon completion of this research.

3

Results

This chapter describes the results of the four major sections of this research: the literature study in the Discover phase, the interviews in the Define phase, the operational design of the tool in the Develop phase and testing in the Deliver phase. The Discover phase will be presented first which will lead to a literature-based interpretation of the researched partnership and its innovation problems. Next the Define phase will be used to inform the game design of barriers and constraints to include. Then in the Develop phase the actual operational game design process is reported and fourth the testing and finalisation of the design is presented in the Deliver phase.

3.1. Discover

The literature study performed in this phase serves to inform the research about the factors which have a stimulating or hindering effect on Collaborative Innovative Capacity in the private - public organisational partnership. These factors, from experience in the field of both innovation studies as well as the practical collaborative process between public an private entities include Innovation Readiness and Knowledge Sharing practices. Moreover the literature study includes results from literature enquiries into the concept of Collaborative Innovation to see if and how the discovered factors are applicable to this specific research context. The findings are summarised and form the basis of formulating a design goal for the tool to be developed as a result of this research.

3.1.1. Innovation Readiness

Innovative efforts in industry, especially large-scale institutionalised industry, often run into resistance in the implementation phase. The magnitude of this resistance towards innovation, or rather the lack thereof, can be interpreted as Innovation Readiness.

Resistance towards innovation adoption is stimulated by short-term gains perspectives. These perspectives are more prevalent in corporate environments in which shareholders aim to gain a profit from their investments. On the other end of the spectrum companies that have a more long-term gain perspective, like family firms, may be more inclined to be willing to innovate in order to secure their long range market share (Holt & Daspit, 2015). Another threat of innovation is the frightful adherence to existing policies and practices (Van Dijk, 2021). This can be witnessed in family firms as well as in traditional governmental organisations. Another method of defining and measuring Innovation Readiness (IR) is presented by Holt and Daspit (2015), who posits a number of Innovation Readiness Factors, both of a Structural and of a Psychological nature. While their research is focused on family firms, they subdivide the factors to be Family related, Individual or related to the Firm. The factors in this last category can be applied to the situation studied in this research. Among the Firm Factors they report *Support Climate* and *Facilitation Strategies* as the

two structural factors of influence on IR and *Collective Efficacy* and *Collective Trust* as psychological ones. Specifically this *Collective Efficacy* is also described by Armenakis, Harris, and Mossholder (1993), who describe readiness for innovation to be supported by a sense of efficacy in the individuals that are supposed to carry out the innovation. Moreover Armenakis et al. (1993) argue that one of the strategies for one who seeks to implement an innovation is to manage external information. They state that the change agent can underpin messages of efficacy and of need for change through the use of external information sources. The drive towards innovating within an organisation is linked by King and Anderson (2002) to *social identity theory*. This link can explain both the motivation to innovate or the lack thereof. In both cases this motivation however does not come from within, it is not an intrinsic motivation to accept or reject innovative ideas. This link theorises that individuals, through a desire to belong, will always try to match the motivation to innovate of their environment. Especially in professional teams this effect can be seen, when one would be alone in trying to infer change within the organisation through innovation they may be viewed as an outsider or even a threat by the larger group. On the other hand when they refuse to go along with an innovative idea which the group at large agrees upon they may be viewed as dead-weight. In both cases the individual may be more inclined to drop their own intrinsic motivations to innovate and rather adopt those of their team.

One of the more interesting dynamics related to Innovation Readiness is the underlying motivation for an organisation to invest in innovation projects. This motivation is sometimes considered to come from one of two sources: a technology push or a market pull. Both methods represent an external motivation for the organisation in question. Technology push refers to innovation being motivated by other innovations of a technological nature, in this case a technology is developed after which the organisation or the industry finds a use for said technology. As an example: touchscreen technology was developed long before it was applied in our smart-phones. Market pull however can be considered to be the reverse process, where the market (or the users) present a need in the form of a specific problem which needs solving and the innovative industry fulfills this need by developing innovations in order to solve said problem. Large, (partially) governmental organisations often rely heavily on market pull to innovate (Van Dijk, 2021). This direction of the motivation to innovate relates directly back to Armenakis et al. (1993) who describe that Innovation Readiness not only relies on the *Efficacy* of the potential innovators but also on the *Discrepancy* they experience. With the discrepancy they refer to the difference between the current (as-is) state and the possible future (desired) state. A technology push could clarify this discrepancy towards potential innovators by showing the possibilities for future states, a market pull however is more focused on emphasising the shortcomings of the as-is state. Both are mechanisms which increase the awareness of the *Discrepancy* and thereby stimulate Innovation Readiness but both from a different direction.

3.1.2. Knowledge Sharing

To define Knowledge Sharing (KS), first a more clear understanding of what knowledge is should be obtained. Knowledge is widely considered to come in different forms. Ropohl (1997) distinguishes technical as well as technological knowledge. Technical knowledge pertaining to the practice of engineering whereas technological knowledge serves engineering science. A more widely accepted distinction of forms of knowledge is that between *tacit* and *explicit* knowledge (Reber & Lewis, 1977). Tacit knowledge is used to describe the type of knowledge that is hard, or even impossible, to describe on paper. It is knowledge that therefore is encoded within people which is very hard to decode in order to pass along easily. Tacit knowledge is often related to tactile operations, like building a chair. While books and texts exist on building one, the easiest way to learn is by doing.

Explicit knowledge on the other hand is very easy to describe in text. This type of knowledge is related more to objective than subjective knowledge. Objective knowledge can be a valuable resource to be used to decrease complexity in the process of innovation (Du Plessis, 2007). Sharing these types of knowledge is very valuable in an organisational context. The correct ways of sharing knowledge should be applied to the appropriate forms of knowledge. Through apt knowledge management new idea generation and thereby innovation can be supported and stimulated (Parlby & Taylor, 2000).

Knowledge Sharing itself is defined by Van Den Hooff and De Ridder (2004) as the process of mutual exchange of both tacit and explicit knowledge between individuals in order to create new knowledge. According to Radaelli, Lettieri, Mura, and Spiller (2014), employees who share knowledge will also be more active in creation (i.e. generation), promotion (i.e. championing) and implementation (i.e. realization) of innovations. Again, affirming the link between Knowledge Sharing practices and innovative behaviours.

It has been noted by a variety of researchers (Ardichvili, Page, & Wentling, 2003; Oldenkamp, 2001; Weggeman, 2000) that Knowledge Sharing has two components. Knowledge is provided or donated by a source or a carrier, and knowledge is accepted or collected by a receiver or a requester. Even though the sharing of knowledge is supported in many ways by modern technology, making it a very versatile process, Knowledge Sharing can in almost all cases be seen or modelled as a verbal conversation. One party has to state facts, ideas and opinions, but without a receiving party there has been no exchange. The receiving party is as much a part of the process as the source.

In De Vries, Van den Hooff, and de Ridder (2006) Knowledge Donating (KD) and Knowledge Collection (KC) are defined as: "knowledge donating, communicating one's personal intellectual capital to others; and knowledge collecting, consulting others to get them to share their intellectual capital" (p.116). In multiple instances has the positive influence of Knowledge Sharing practices on innovation capability been proven, e.g. Lin (2007) found both KD and KC to be significantly connected to firm innovation capability and Du Plessis (2007) stated it was "clear that knowledge management plays a significant role in innovation" (p.28) referring, in defining knowledge management, to Knowledge Sharing.

3.1.3. Collaborative Innovation

Collaborative Innovation is an affect of Collaborative Innovative Capacity. Collaborative Innovation is the exchange of knowledge between two parties for the sake of working jointly to plan and execute innovative tasks like Research and Development (Wang & Hu, 2020). While this many more definitions of CI are possible, this one displays in a clear manner the connection with knowledge sharing. After all, without sharing, no collaboration is established. This sharing of knowledge ties in with effects of mutual learning in Collaborative Innovation (Davis & Eisenhardt, 2011). In Davis and Eisenhardt (2011) another connection is made between Collaborative Innovation and trusting relationships, with frequent and clear interactions. The researchers state that these aspects can activate relevant capabilities in partners. Unlocking the existent capabilities in partners is a crucial step, especially in the studied relationship between two capable organisations who are trying to unlock their joint innovative potential.

Another way to do so is by bringing together different types of people. Creating a diverse network of collaborators is shown to improve innovation (Nieto & Santamaría, 2007). This diversity will bring about more varied perspectives and thereby more sharing of ideas and opinions. By having to actively exude effort to understand each other, Collaborative Innovative Capacity is improved. This effort does however require a shared attitudinal commitment. And with that shared commitment, a collaboration-level identity develops (Öberg, 2016). This again relates to the social

identity theory as referred to by (King & Anderson, 2002). All this required partners in the public - private organisational partnership to both be aware of these efforts to create collaborative innovations (Roy, Sivakumar, & Wilkinson, 2004). This organisational attitude and its accompanying leadership should be focused on creating a mutual understanding of the challenges and organisational barriers to innovation (Rowley, 2011). By being a leader who brings people together and removes any barriers or misunderstandings between partners, one is far more likely to be involved in successful innovative initiatives (Obstfeld, 2005). The opposite is also found. In Skippari, Laukkanen, and Salo (2017) managers in a collaborative innovative partnership who were observed to be dealing with a large amount of unresolved differences in their cognitive basis were associated with situations where individuals involved in the innovative partnerships indicated that while they did see the great benefits to Collaborative Innovation, it did not actually come to fruition. This is very similar to the studied relationship between ProRail and its maintenance contractors. In the exploratory period prior to this research as well as during the interviews (see Section 3.2, many people involved in the organisational relationship indicated no aversion towards innovative ideas in general, they did however indicate a very low level of trust in the success of innovative ideas. In Swink (2006) this low level of trust in innovative success is explained partly by individuals seeing the costs necessary for proper implementation of innovative ideas not to outweigh the the benefits. The effort does not seem justified to them. Through thorough communication and explanation of the costs and barriers for innovative ideas, one may see these as less of a problem and more resolvable. Moreover Swink (2006) note that relational barriers to Collaborative Innovation can also be problematic and can possibly be relieved by becoming more aware of other parties' innovation cultural norms and barriers.

A contributing factor to the propensity for individuals to abstain from proper knowledge and barrier sharing practices is *causal ambiguity*. Originally coined by Lippman and Rumelt (1982), this concept was researched by Simonin (1999) who analysed how causal ambiguity influences knowledge sharing levels in organisational partnerships. This research is then in Swink (2006) used to explain causal ambiguity as the inability to explain how things work and that this mechanism impacts the understanding of an organisational partner.

3.1.4. Findings

Organisations have to understand one another's shortcomings and barriers when innovating together. Misunderstanding of individual barriers to innovation is the biggest barrier to Collaborative Innovation. This understanding starts at the level of individuals participating in that innovative process.

Individuals participating in Collaborative Innovation in organisational partnerships have a lack of understanding of one another. The people they are in contact with generally seem cooperative and are not seen as an enemy. The collaborative system in general however is seen as the large proponent of barriers towards innovation. The problem however is firstly that individuals often feel like they are not able to change that collaborative system, and secondly that most of these barriers are not shared among participants of different organisations. That may be a consequence of the barriers themselves being misunderstood or too complex to share or because organisational collaborative infrastructure is not in place to share the knowledge and experiences surrounding Collaborative Innovation. This creates a *wall of misunderstanding* which is non-directional and affects both partners equally in preventing successful Collaborative Innovation. Figure 3.1 shows a schematic depiction of this phenomenon. The breaking of this wall of misunderstanding is therefore, based on this literature study, suggested to be addressed in the design phase of the research.

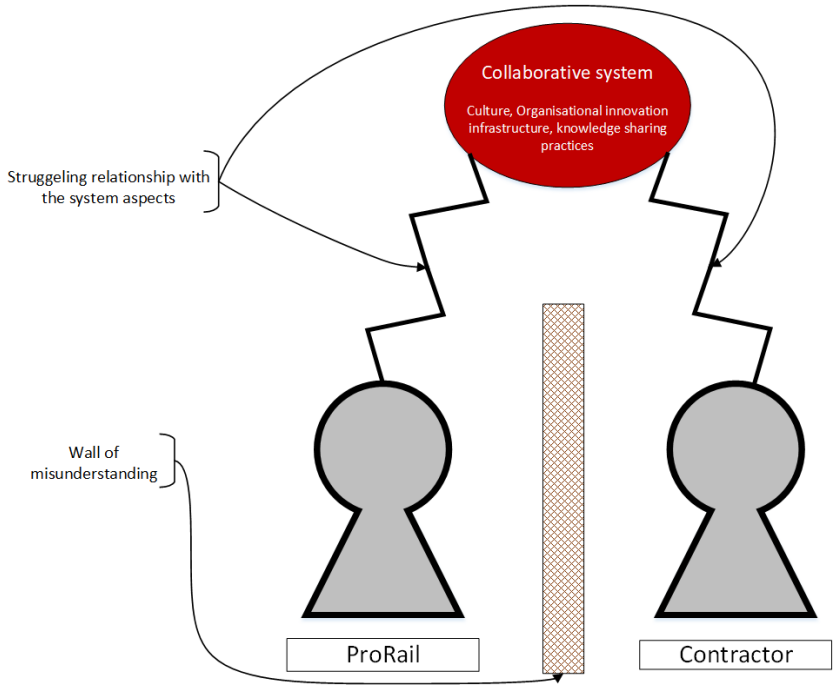


Figure 3.1: Schematic depiction of relationship between the contractors, ProRail and the system of collaboration and innovation

3.2. Define

As the findings of the previous phase state, a problem in this studied context is the misunderstanding of barriers of the organisational party in the Collaborative Innovation relationship. To deepen the understanding of the practical collaborative process of ProRail's organisation and its contractors, interviews are held. These can serve to identify which actual barriers are present in the system in order to seek to clarify these barriers to all involved employees. Six interviews in total were held, the description of the participants can be found in Chapter 2 and the transcripts of the interviews are found in Appendix A. A full codebook further explaining all codes is presented in Appendix B.

3.2.1. Coding

All interview transcripts were coded for further processing. Because of the semi structured nature of the interview an open coding method was used (Strauss & Corbin, 1998). This coding method accounts for unforeseen information and topics that may have arisen during the interviews. This free coding method resulted in 27 codes to indicate topics, concepts or opinions used during the interview. The full overview of all quotes coded in the interviews is presented in Appendix C. The codes were retroactively formed into a code-tree which is depicted in Figure 3.2. This code tree shows both codes and categories of codes. Interesting observations are that there are 13 codes which can fall in the category of barriers while only 6 fall in the opportunities category (6 codes can be categorised as both or neither and are therefore in the barriers/opportunities category). This could be an effect of the intent of the interview being the discussion of a certain set of problems (problems with Collaborative Innovation). By framing the interview as a problem discussion, the interviewee may be more inclined to phrase their arguments negatively, towards a barrier rather than an opportunity.

Figure 3.2: Code tree of interview analyses. Central concept Collaborative Innovative Capacity leads into the first two codes 'Barriers' and 'Opportunities', supplemented by a mixed form 'Barriers/Opportunities'. The third level is formed by categorisations (not used as codes) after which the fourth level of the tree describes the actually used operational codes

These codes form the first look into what barriers to Collaborative Innovation are present within the relationship between ProRail and its contractors. Table 3.1 presents a summary of the codes and their frequency of appearing in the interviews with subjects from all three organisation types. The frequencies indicated are the percentage of all codes given in an organisational category.
The relative ratios of codes appearing in each interview are indicated next to the absolute number of appearances, this yields insight into the amount of perceived weight certain concepts have within employees of different organisations. The code "Beaurocracy" for instance can be seen to appear with a relatively high frequency in the interviews with subjects working within ProRail or within the Branch-organisation but with a surprisingly low frequency in interviews with subjects working for the Contractor. This beaurocracy often is expressed in the context of ProRail not having a proper idea acceptance policy: "It's really peculiar that while I am the one who executes the contracts, and

Table 3.1: Code frequencies between interviewed organisations

Codes	ProRail		BranchOrg		Contractor		Total	
	absolute	ratio	absolute	ratio	absolute	ratio	absolute	ratio
Ambiguities in collaboration	4	4.8%	3	1.6%	2	2.8%	9	2.6%
Bad budgeting	5	6.0%	3	1.6%	1	1.4%	9	2.6%
Barriers	8	9.5%	16	8.6%	4	5.6%	28	8.2%
Beaurocracy	9	10.7%	18	9.6%	2	2.8%	29	8.5%
Benefit distribution	7	8.3%	22	11.8%	5	7.0%	34	9.9%
Changing contacts	2	2.4%	4	2.1%	1	1.4%	7	2.0%
Compliance	1	1.2%	8	4.3%	1	1.4%	10	2.9%
Continuity	0	0.0%	0	0.0%	4	5.6%	4	1.2%
CO-operation vs competition	4	4.8%	8	4.3%	1	1.4%	13	3.8%
Financial difficulties	5	6.0%	7	3.7%	4	5.6%	16	4.7%
Idea acceptation	3	3.6%	10	5.3%	3	4.2%	16	4.7%
Idea generation	4	4.8%	7	3.7%	3	4.2%	14	4.1%
Incentives	4	4.8%	9	4.8%	2	2.8%	15	4.4%
Interpretation of rules	1	1.2%	0	0.0%	0	0.0%	1	0.3%
Knowledge / information acceptance	0	0.0%	1	0.5%	1	1.4%	2	0.6%
Knowledge / information sharing	3	3.6%	12	6.4%	3	4.2%	18	5.3%
Lack of trust	1	1.2%	0	0.0%	5	7.0%	6	1.8%
Lack of understanding	0	0.0%	4	2.1%	8	11.3%	12	3.5%
Markets / Capetalisation	3	3.6%	15	8.0%	3	4.2%	21	6.1%
Non-innovative focus	5	6.0%	4	2.1%	4	5.6%	13	3.8%
Opportunities	2	2.4%	1	0.5%	0	0.0%	3	0.9%
Ownership	2	2.4%	8	4.3%	3	4.2%	13	3.8%
Personal contacts	2	2.4%	9	4.8%	1	1.4%	12	3.5%
Responsibility	5	6.0%	5	2.7%	2	2.8%	12	3.5%
Risk	1	1.2%	4	2.1%	5	7.0%	10	2.9%
Risk aversion	1	1.2%	4	2.1%	0	0.0%	5	1.5%
Speed	2	2.4%	5	2.7%	3	4.2%	10	2.9%
	84		187		71		342	

therefore see all the possibilities in that contract, nobody is receptive within ProRail for me to bring those ideas to" (interview 1). Or regarding legislation and resulting rules within the organisation: "The rules regarding what we're allowed are just set in stone. If the rules would be loosened up a little you might be able to do a little more, right now you have to be creative and try to utilize loopholes in the regulations" (interview 5).

Another noticeable code is the "Benefit distribution", this is named a lot in all interviews. Most of the mentions by the contractors include blame being directed towards ProRail: "A lot of responsibility is put on the contractor and a minimal amount at ProRail" (interview 2) or "looking at the contracts, and at the risks and fines and compare that to potential earnings it's totally off balance. If ProRail would infer all fines they could than we would just go bankrupt" (interview 3). Interestingly this blame is not denied but rather affirmed by the actual employees to indeed lie within ProRail: "if this is one's only income and ProRail won't change their tender award model, contractors will keep entering those tenders with lower estimates while they won't be able to deliver on those promises" (interview 1) or "Sometimes I wonder whether the contractors are able to earn any money on these contracts" (interview 5).

Finally the "Lack of understanding" code, one which is related to the schematic interpretation developed in the previous section (see Figure 3.1), is mentioned mostly by contractors: "The collaboration is stunted because everybody is preoccupied with their own interests" (interview 6). But also recognised by the branch organisation: "First please make sure you get everyone together and acknowledge that there is a problem" (interview 4).

An overview of codes which appear with a noticeably higher or lower frequency in interviews with subjects from a specific organisation when compared to those frequency in interviews with subjects

from the other organisation types is given in Table 3.2.

Table 3.2: Codes with noticeably deviating frequencies

Contractor	
Low	High
Barriers	Continuity
Beaurocracy	Lack of trust
CO-operation vs competition	Lack of understanding
	Risk
ProRail	
Low	High
Lack of understanding	Ambiguities in collaboration
	Bad budgeting
	Financial difficulties
	Opportunities
	Responsibility
BranchOrg	
Low	High
Non-innovative focus	Compliance
	Knowledge / information sharing
	Markets / capetalisation
	Personal contacts

3.2.2. Conclusion

The goal of the interviews was to gain more understanding of which barriers for Collaborative Innovation were present in the ProRail - maintenance contractor relationship. To this end all interviews held were transcribed and coded. These codes presented an overview of the problems which interviewees discussed and are therefore assumed to be the start of a registry of barriers, problems and opportunities which can be used for the design of the tool in the next phase of the research.

Most noticeable is that many problems were indicated which related to distribution of benefits between ProRail and contractors, Also beaurocracy and a lack of mutual understanding were frequently mentioned as problematic (although the latter only had a high frequency for the contractors). Codes which were recorded but only in very low frequencies were the interpretation of rules, knowledge acceptance (note that knowledge donating was recorded significantly more often), and continuity. The different frequencies in which these codes appear among the two different parties can be informative to the tool design in such a way that different roles may use different inputs for their barriers.

3.3. Develop

In the findings of the Discover and Define phases we state that one of the big problems in the Collaborative Innovative Capacity in the private - public organisational partnership between ProRail and its contractors is that there is a lack of understanding of each others' problems and barriers in innovation. This forms a *wall of misunderstanding* which prevents Collaborative Innovation. These barriers are not always the wrongdoing of the other party but they are a hindrance which has to be understood by all for Collaborative Innovation to be possible. That will therefore also be the goal of this tool:

The raising of awareness of barriers for innovation as experienced by the other party

This goal is translated and operationalised in the form of a serious game. A serious game is a concept which describes the use of games and playful elements with a serious and meaningful purpose (Harteveld, 2011). This supersedes regular game design which mostly has the sole purpose of fun and entertainment, on the other hand it also often lacks a lot of extended game design principles which regular games may utilise. The argumentation behind using a serious game format for the tool in this case is threefold:

1. The people involved should be motivated to participate in the activity. This is here achieved by making the activity of working on Collaborative Innovative Capacity more playful with a game.

2. A gaming environment requires people to be fully immersed and attentive to what they are doing, participating in a game does not allow players to temporarily pause and do other things or to pay attention to something else. This strengthens the messages and effects of the tool.

3. In playing a game players interact with one another. As one of the goals of the tool is to increase understanding of other people involved, it would be better for them to participate in the use of the tool together rather than separately.

3.3.1. Conceptualisation

This Develop phase traditionally is characterised by ideation and brainstorming of potential solutions (Clarebrough, Lee, & Ly, 2019). First the central analysis method of Triadic Game Design (TGD) is used. This analysis method is visually presented in Figure 3.3.

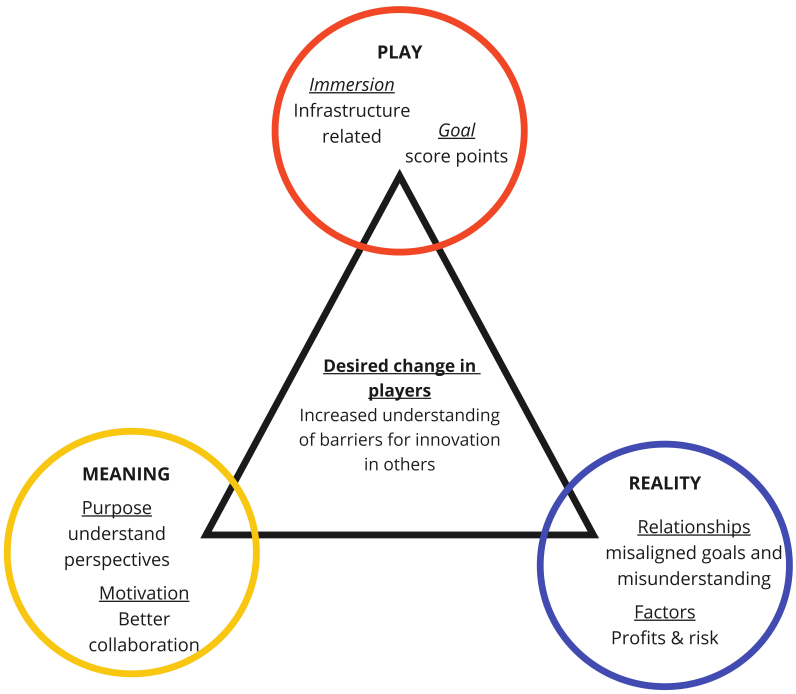


Figure 3.3: Analysis figure of Triadic Game Design, as adapted from (Harteveld, 2011)

This TGD method focuses on balancing three critical elements within a game: Play, Meaning and Reality. Each of these three elements propose their own dilemmas to consider. By considering first the separate dilemmas within the elements (i.e. how to deal with immersion in a game - Play, what relationships are important - Reality, what is the motivation for playing - Meaning), one can

better scope the design space in between the three elements. Within that design space then the aim of the game can be formulated.

This method in this research is used as a tool to better structure brainstorming of thought, not all dilemmas as suggested in (Harteveld, 2011) were fully expanded upon but a few can be seen in Figure 3.3. This resulted in the aim of the game which is also stated at the top of this chapter.
This analysis was followed by a formulating different game elements to be included:

- The game should be playable for four players. This number allows for small sessions with specialist teams and also suits the scope and magnitude of the research. Ideally the game would have capabilities for expansion towards lager player groups
- To represent reality a certain element of surprise or secrecy should be involved. The unknown nature of some of the barriers in the problem situation can in that way be represented and a possible reveal could increase the impact of the message
- Different roles could be very helpful to better represent the problem situation. The contractor and ProRail roles in the problem situation are very different and by assigning players these roles they may be better capable of seeing the perspective on the other side of the wall of misunderstanding (see Figure 3.1)
- All players should be treated as equal in the game. Although different roles may be at play, the fundamental game mechanics should not mean that players interact with the game in a wholly different or disproportional way. The level of interaction with the core material and therefore the core message of the game should be equal among the players.
- A common team goal would increase the team's awareness of the importance of working together towards the Collaborative Innovation. The common goal could also strengthen the barriers individuals feel because they may feel partially responsible for not reaching that goal.

After constructing these basic demands the first step in conceptualising the first version of the game was a brainstorm session with a professional serious game designer (Moens, n.d.) aided by discussing existing (serious) game mechanics which may have been applicable.

3.3.2. First prototype

After the brainstorm session a rough idea of a first version of the game was created. This version was a co-op tower building game in which the focus lay heavily on the influencing of different roles and their distinct powers and limitations. Players would be told to play the game in turns, each turn could include a build action or an action relating to gaining funds for building. The common goal would be to build a tower which is as high as possible. Additionally in this concept each player would receive a role which includes a personal objective and a set of constraints. Examples of personal objectives could be 'Earn the most amount of money' or 'Have the north side of the tower only consist of blue and red blocks'. Examples of constraints could be 'You can only build if the person who played the turn also built' or 'You may only build blocks on the uneven layers'. Further it would have been possible to expand this concept with perks for each role like 'Your build actions only cost half the usual amount of coins' or 'You can build two blocks at once'. These constraints and perks would be related to the barriers and opportunities as gathered in the interviews. All of these objectives, constraints and perks could then be related to particular roles within the studied public - private organisational partnership. When players would then receive a role in the game which is different from their actual role in the studied context, they would hypothetically be exposed to new perks and constraints they may not have thought about previously. This all to aid in the goal: *Raise awareness of barriers for innovation as experienced by the other party.*

However when getting further into the actual operationalisation of the game design and all the objectives, perks and constraints, the game quickly became unnecessarily complicated and too focused on very specific roles. In order to maintain playability players have to be able to become acquainted with the rules of the game quickly within the first time playing, moreover the message should be clear and unambiguous. The unnecessary complexity and specificity of this design made this playability unsatisfactory for the stated aim of the game. Therefore this design was retired.

3.3.3. Second prototype

The second prototype started with the same mechanic of creating a co-op game in which players have a common goal. To increase the immersion this task was redesigned to be the travelling of a train along a train track past some stations. The players would again get assigned roles which are not in line with their actual roles in their real-world occupation. These roles however would not be affecting the players in terms of their game mechanics. The turn-based game progression was adhered to in this prototype, however turns became significantly simpler. Each turn, a player was invited to roll a regular six-sided die which would yield the number of steps the train could take in their turn. After that, the player would have to draw from their personal stack of scenario cards. Each card contains the description of a scenario of a barrier or opportunity for innovation taken from experiences in the real world collaborative process through the interviews performed earlier in the research. Each scenario then had a consequence for the number of steps the player could actually take in that turn. An example of a turn could then be that the player would roll a 5, then they could draw a scenario which described the following: 'A great innovation is being proposed in one project, a nation-wide implementation of this idea however does not seem possible due to capacity issues within the contract teams'. This scenario then would have the consequence that this particular turn would be lost and the player would be allowed to move their train 0 places instead of the 5 they initially thought they would be able to move.

The goal of the game is to reach the end of the track which spans 5 stations with tracks of 4 steps in between each station. Scenarios are shuffled into a random order (per player) and players get to choose at random which scenario to pick for each turn. All scenarios and their accompanying consequences for this version of the game can be found in Table 3.3. A deck of six or seven scenarios was written for each player. These scenarios were either taken directly from experiences as shared during the interviews ('Local government is not willing to approve your plans') or inspired by those interviews and their findings as presented in the previous section.

The scenarios are divided over the four players with the intent to distinguish four separate roles. In the presentation of Table 3.3 the first two players are assigned a role within ProRail, this leads to scenarios being formulated from that perspective as well. Scenarios like 'Contractor has no funds left for extras' or Contractor will not share component failure data' are clearly formulated from a ProRail point of view. The third and fourth player are assigned scenarios from the perspective of the contractor ('You have an improvement proposal ready in your bid'). Among the two different organisations, also the function of the separate players are distinguished from one another. Player 1 and 3 are assigned a project manager role. This means that they are challenged with scenarios of a more operational nature ('A mechanic of the contractor causes a defect in an expensive piece of equipment' or 'An important spare part was not present'). Player 2 and 4 are assigned more strategic management roles, which again translates into the scenarios they are faced with ('EU legislation is restrictive' or 'You have lost multiple tenders and the current project turns out un-profitable'). The intended game design proposes that the players are not made aware of this division of roles. While the division of their roles in two separate organisations may become evident rather quickly through the scenarios the players encounter, their project management versus strategic management role division may not necessarily become clear quickly. The players will be asked to reflect on these roles after the game, at this point the instructor can reveal the game design's intended roles to inform a

more broad discussion.

Table 3.3: Scenarios and consequences in prototype 2.0

Player 1 **Scenario**		**Consequence**
Contractor has no funds left for extras		Lose turn
You share an investment with the contractors		+1 step
Your proposal has been lost, submit it again		Re-roll
The financial plan of a submitted improvement proposal is not deemed thorough enough by procurement, that will have to be re-done		-1 step
Procurement declines your proposal		Lose turn
You have found a great new relais on an industry fair, but you don't know who to reach within ProRail to actually incorporate it		Re-roll
A mechanic of the contractor causes a defect in an expensive piece of equipment, responsibility is taken internally at the contractor		+1 step
Player 2 **Scenario**		**Consequence**
Contractor will not share component failure data		Half steps
EU legislation is restrictive		Lose turn
You have initiated a collective information database		+2 steps
A great innovation is being proposed in one project, a nation-wide implementation of this idea however does not seem possible		Lose turn
It is difficult to judge financial proposals because of a lack of an assessment framework		-2 steps
You have found a new type of hectometer indicator in collaboration with the contractor. Sadly you do not posess the authority to implement this component nationally. You submit it for further review and don't year anything in reply for the next 4 years...		Re-roll
Player 3 **Scenario**		**Consequence**
Local management team changes		-1 Step
Your contact has a bad day		Re-Roll
Your improvement proposal had a solid financial plan		+1 step
The local government is not willing to approve your plans		Go back to last station
An important spare part was not present and you had not secured that the responsibilty would fall within ProRail		-2 steps
Your improvement proposal should have been a modification		-1 step
Together with a maintenance engineer you have developed a great solution to a nation-wide problem, sadly it is not possible to implement it profitably within your current contract		Lose turn
Player 4 **Scenario**		**Consequence**
Innovation-related profits are being reclaimed		Half steps
Risk is not shared		Re-roll
You had an improvement proposal ready in your bid		Extra roll
Your improvement proposal is only approved in the last year of your contract		Lose turn
Your proposal for a new relais shows that this component would last twice as long as the current one, the regional management agrees but the system-manager of ProRail does not want to risk it		Lose turn
A modification proposal is received with enthousiasm, but they want it to be adopted by multiple contractors at the same time, you are going to have to re-negotiate the proposal 4 more times...		Half steps
You have lost multiple tenders and the current project tuns out un-profitable, the head office therefore retracts funds for further investmensts		-3 Steps

All the previous constitutes the development of the second prototype. Once this first playable version was constructed, the testing started which included two iterations of tests and revision and a final user test of the last version of the game.

3.4. Deliver

The testing of the developed game in this phase consisted of three steps: a preliminary test for the developed prototype as described in the previous section, a more elaborate test involving actual test subjects for the revised prototype and a final user test for the re-revised prototype which is the final version of the developed game as produced in this research.

3.4.1. First iteration

Using the prototype which resulted from the Develop phase, a simple test version was built using MS Excel to test the game mechanics. This test consisted of multiple runs of the researcher playing as all four players. All turns were rolled through until the end of the game and observations regarding playability and enjoyment were noted.

The main observations from those preliminary tests were that the "Play" element from the TGD method was under-represented in this design. There was little for the player to interact with or to influence, the visual design itself was lacking and there was no element of competition. Moreover the repetitive nature of the turns made the game seem long and tedious.

This resulted in another revision of the game design. The main elements which were included

in the new design were:

- A visually engaging game board and scenario card which are interactive for all players using a digital Miro board. The game board was also expanded with six steps in between stations instead of four.
- The red die. Additionally to a regular die which is rolled by each player every turn, a red die is introduced which is used as a consequence for some of the scenarios. This red die has the values of -2 steps, -1 step, +1 step and +2 steps (and two blank sides for a six-sided die).
- A spinning wheel (see Figure 3.4). This wheel can, similarly to the red die be introduced as a consequence for scenarios. The wheel contains consequences of extra, or deducted steps as well as the (re-)rolling of either die and a blank option. These options are all present on the spinning wheel in differing proportions in order to yield a 60% chance of getting a consequence in terms of steps (with an expected value of -1.47 steps) and a 32% chance of getting the opportunity to roll another die. When considering the regular die to have an expected value of 3.5 steps and the red die to have an expected value of 0 steps this would yield an expected value for the entire wheel to be -0.33 steps.
- Expanding of scenarios with scenarios that are followed by a choice. An example of this form is the scenario "Suppliers want to see your user-data in order to pitch newer and better products for your operations" which would be followed by the choice to either share the data, with the consequence of having to spin the wheel, or to refuse sharing the data with the consequence of -1 steps.
- The formation of teams. Two teams were formed in order to increase the competitive nature of the game. To avoid conflation of the two in-organisation functions (the project manager and the strategic manager within ProRail for instance), the teams are cross organisational as well as cross functional. The first team will therefore be the project manager role of ProRail and the strategic manager role of the contractor. The second team will then be the project manager role of the contractor paired with the strategic manager role of ProRail. The two teams will share one pawn in the game and will compete to reach the finish line (the final station) first.

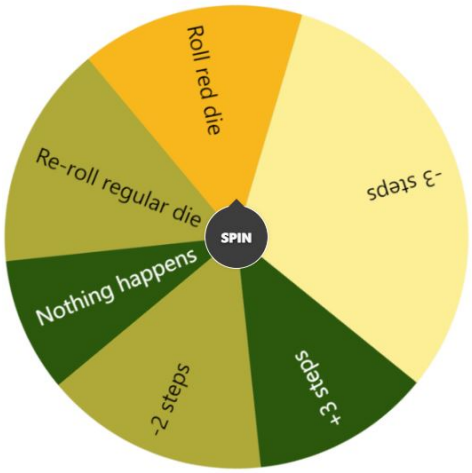


Figure 3.4: Spinning wheel

The visual style of the game was fully revised in this iteration. The game board and paws were designed using MS Vision and incorporated in the interactive online Miro board. Figure 3.5 shows

the design which incorporates a start station represented by a city, four intermediate stations and an end station represented by a farm barn. Each track in between two stations is 6 steps long, including the last step towards the station this makes seven steps which prohibits a player from reaching the station with a single roll of the regular die.

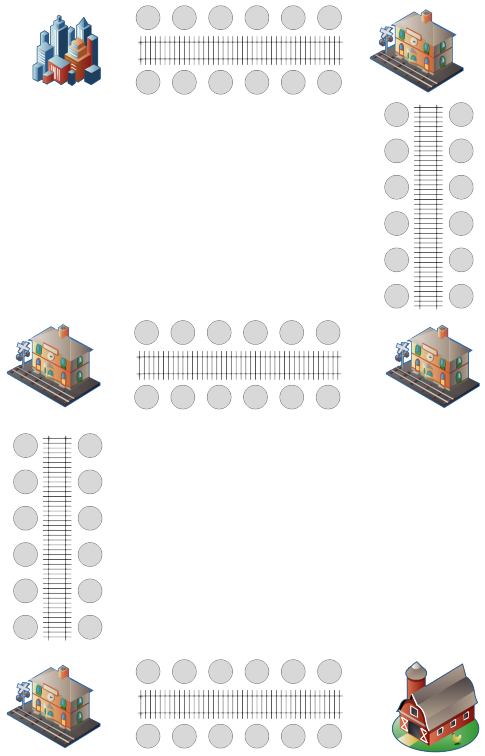


Figure 3.5: Game board in Miro after first iteration of testing. Designed using MS Visio

An impactful measure is the formation of teams in this version. The teams working together required a set of rules. The major alteration in this sense is that the game is divided into distinct rounds. Each round ends at the next station. This way teams get to win rounds and the game is able to be reset at the beginning of each round. Each round therefore starts with both teams beginning from the last reached station. They then get alternate turns, making the order of play: Player 1 (of Team1), Player 2 (of Team2), Player 3 (of Team1) and Player 4 (of Team2). The team that reaches the next station first will win that round and the assigned amount of points. Points are set to 1 point for each intermediate station and 2 points for the end station. If a team reaches the next station, the other team will be allowed to equalise the number of turns played. This also brings the capability for a tie at the end of a round, in which case both teams are awarded the appropriate amount of points. All this and other simple rules are presented to the players at the beginning of the game and are also available during play. The instructions and rules as presented to the players can be found in the rule book below:

Instructions[a]

Every turn consists of:

Roll die - Scenario - Consequence - Steps

Rules:

- Negative steps do not exist
- When half steps apply to an odd number of steps they round up
- If one team reaches a station the other team is allowed to even out the number of tuns played if applicable
- The new round is begun by the player who was at turn at the end of the last round
- Play nice
- Also play nice with the game instructor

[a] Rules to 'Rail's Perspective'

3.4.2. Second iteration

The second iteration of testing involved the actual real-life test with test subjects, of the version of the game as developed during the first iteration. The test subjects were unrelated to the research, contractors or ProRail and received a short introduction into the research context prior to the test. All test subjects agreed to the informed consent form as depicted in Appendix D.

The observations from the second iteration test are less impactful than the first. This is to be expected. Nonetheless they are important for further iterative design of the game. The main observation is that there was a lack of personal connection to the material as presented in the scenarios and consequences. Players were very focused on the scenarios that they drew, but they were almost equally as interested in the scenarios their teammate or even their competitors drew. While it can be regarded as positive that the element of "Play" seemed to have heightened the players' engagement in the game, the personal connection to the scenarios and consequences is paramount to reaching the aim of the game: *"The increase of insight into barriers for innovation as experienced by the other party"*. Moreover the game was observed by the players as well as the game instructor to be slightly too long. The final game design was therefore altered in three ways:

- The teams were re-arranged. The new teams are arranged by their organisation. The first team will therefore be both the ProRail functions and the second team will be both the contractor functions combined. The desired effect of this decision is that by strengthening the in-team bond through assigning people to the same organisations the players will be less inclined to engage with the other teams' drawn scenarios. Engagement with all material presented is positive but it should not water down the effect of one's personal scenario experiences.

- The game board was redesigned. The major alteration to the game board was the decrease from five stations to four. This decreases the amount of rounds played and increases the competitiveness between teams through a more high-paced gameplay. Moreover the direction of play was re-arranged. This followed on a remark made by one of the test subjects who stated that it would be a more realistic scenario to travel from the farm to the city as public transport is more often associated with travelling towards urban areas rather than away from it. While it may be possible to argue against this statement in a factual sense, the goal is to increase player engagement with the story of the game. The final alteration to the

game board was to add train signage lights at each station to indicate who won that round. Each sign has two lights which at the start of the game are blank. After a team has won a round the accompanying sign will turn either red, green or both in accordance with the winning team's colour.

- Expansion of the scenario deck. The players in the test indicated three separate sentiments: 1) the scenarios that provided a choice for the players were regarded as very positive as they increased interaction between the player and the game. 2) there were too many scenarios that declared the consequence "lose turn"; this consequence, while impactful, decreases playability as it stagnates not only the turn but gameplay overall. 3) the red die and spinning wheel options are very positive; these elements were reported to increase a sense of surprise and uncertainty primarily and made the players reflect more extensively on the consequences of a scenario.

The redesign that followed as a result of the aforementioned test produced the final version of the game for this research. This also marked the moment the game received its name: **Rail's Perspective**. After its aim, to raise awareness of the perspective of others, and its use-context, the rail infrastructure management industry. Rail's Perspective also received, as mentioned, a new version of its game board, which can be seen in Figure 3.6.

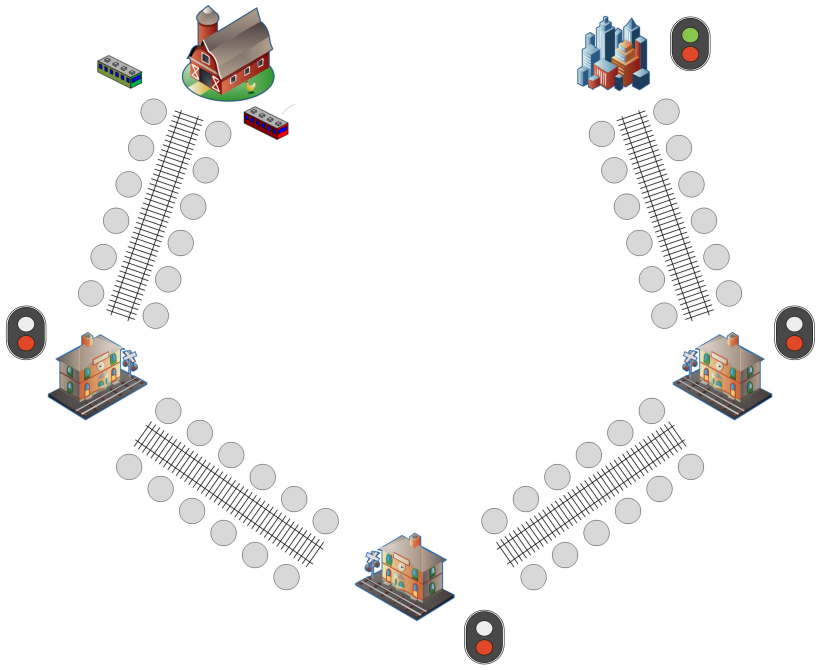


Figure 3.6: Game board of the final version of Rail's Perspective

Also the scenarios deck was revised to include more player-choice scenarios and less "lose turn" consequences. The "lose turn" consequences were replaced by "spin wheel" or "roll red die" options to increase engagement and the experience of randomness which is also present in the real-life situation. This resulted in a final scenarios deck of eight scenarios per player. The full deck including all consequences is reported in Table 3.4.

Table 3.4: Scenarios and consequences in the final version of Rail's Perspective

Player 1 **Scenario**	**Consequence**
After the first half year of a contract, the contractor turns out to have run out of budget for extra modernisation projects	Try to get more investment yourself: Spin wheel Postpone modernisations: -3 steps
You execute a joint investment with the contractor	+1 step
Your improvement-plan has been forgotten, submit it again	Roll the red die
The financial plan of a submitted improvement proposal is not deemed thorough enough by procurement, that will have to be re-done	-1 step
The contractor wants a joint investment for an innovation which will benefit them financially as well	Co-invest: Spin wheel Do not invest: Half steps
Procurement declines your proposal	Lose turn
You have found a great new relais on an industry fair, but you don't know who to reach within ProRail to actually incorporate it	Roll the red die
A mechanic of the contractor causes a defect in an expensive piece of equipment, responsibility is taken internally at the contractor	+1 step
Player 2 **Scenario**	**Consequence**
In PGO 4.0 more rewards for extra work is considered as a substitute for the fines on shortcomings	More rewards: Spin wheel Focus on fines: Roll red die
A great innovation is being proposed in one project, a nation-wide implementation of this idea however does not seem possible due to capacity issues within the contract teams	Half steps
You need data for the re-consideration of further automisation of monitoring of assets, this data however is property of the contractor who is not willing to share it	Half steps
A contractor is prepared to invest in a new component and to share this innovation after his contract period, legislation from the EU wil not permit you to agree, you have to decline the proposal	Lose turn
You have initiated a collective information database	2 extra steps
Contractors structurally submit unrealisticly low bids for tenders, you are considering adjusting the tendering-model to this	Don't adjust: -2 steps Adjust: Spin wheel
It is difficult to judge financial proposals because of a lack of an assessment framework	-2 steps
You have found a new type of hectometer indicator in collaboration with the contractor. Sadly you do not posess the authority to implement this component nationally. You submit it for further review and don't year anything in reply for the next 4 years...	Roll the red die
Player 3 **Scenario**	**Consequence**
A shared innovation fund is set up with ProRail for a project, co-investing means less risk for you, but also means that you lose the sole right to any developed innovations	Participate in fund: Spin wheel Don't participate: Roll red die
Unexpectedly the regional management team changes within ProRail because of understaffing elsewhere. You will henceforth have to work with this completely new team	Spin wheel
The contact you are about to discuss your submitted proposal with has just had a very unfriendly conversation with his/her supervisor. He/She does not feel like collaborating constructively today.	Roll the red die
Your improvement proposal included a solid financial plan, it is therefore processed very quickly	+1 step
Even though you had just convinced ProRail and other involved parties of your plan, the local government will not approve an alteration to an overpass	Go back to last station
An important spare part was not present and you had not secured that the responsibilty would fall within ProRail	-2 steps
Your improvement proposal should have been a modification	-1 step
Together with a maintenance engineer you have developed a great solution to a nation-wide problem, sadly it is not possible to implement it profitably within your current contract	Lose turn
Player 4 **Scenario**	**Consequence**
The benefits which follow from an innovation you developed are being reclaimed by ProRail	Half steps
A proposal which include a slight risk is approved by ProRail but they are not willing to co-invest, the risk is not shared	Proceed with proposal: Roll red die Retract proposal: -1 step
You had an improvement proposal ready in your bid	Extra roll
Your improvement proposal is only approved in the last year of your contract	-2 steps
Suppliers want to see your user-data in order to pitch newer and better products for your operations	Share data: Spin wheel Refuse: -1 step
Your proposal for a new relais shows that this component would last twice as long as the current one, the regional management agrees but the system-manager of ProRail does not want to risk it	Lose turn
A modification proposal is received with enthousiasm, but they want it to be adopted by multiple contractors at the same time, you are going to have to re-negotiate the proposal 4 more times...	Spin wheel
You have lost multiple tenders and the current project tuns out un-profitable, the head office therefore retracts funds for further investments	-2 steps

3.4.3. User test

The final step in the testing and the end of the second diamond in the double diamond description of design based research (see Figure 1.1) is the user test. This test served the purpose of testing the actual effectiveness of the designed tool. The user test was performed by having four employees of ProRail and one of its maintenance contractors play a full set of round of Rail's Perspective. The test subjects partially overlapped with the participants in the interviews (Chapter 3.2).

Subject 1 A contract manager within one of the contractors who is responsible for managing and negotiating the contracts and possible deviations from those contracts with ProRail. This is considered a strategic management function for this research.

Subject 2 A maintenance engineer within one of the contractors. This engineer is applied within the contractor's organisation on a project-basis and is therefore considered to have a project-function for the sake of this research.

Subject 3 A contract specialist in a project management function from ProRail. This project manager is a specialist on the Performance Based Maintenance (Prestatie Gericht Onderhoud).

Subject 4 A tender manager within ProRail. Even though this tender manager works on separate projects, they are considered to have a strategic function within ProRail as the tender management function concerns itself with the mid- to long term goals of the company.

Because the division of subjects over teams is based on having the largest disparity between their real-world roles and their in-game roles, the teams were labelled as Red and Green which corresponds to their train color within the game. The division of test subjects over teams can be found in Table 3.5.

Table 3.5: Team and role division for the user tests

	Subject 1	Subject 2	Subject 3	Subject 4
Real-world role	Strategic management	Project management	Project management	Strategic management
Real-world organisation	Contractor	Contractor	ProRail	ProRail
In-team role	Project management	Strategic management	Strategic management	Project management
In-team organisation	ProRail	ProRail	Contractor	Contractor
Team	Red	Red	Green	Green

Measurement
In order for the user test to have a verifiable, tangible result, a means of measurement had to be in place to test the actual effectiveness of the game. This measurement was performed using a short survey which was filled out by all participants directly after the game was played. The researchers made sure to prevent any lengthy discussion about the gameplay and the game in general once the game had finished before any of the participants had filled out the survey. This to prevent players influencing each others' answers. The survey consisted of six questions:

1. What is your first reaction to the game you just played?
2. What barriers/constraints did you experience while trying to reach your destination?
3. Were any of these barriers/constraints new to you? (if so, which?)
4. What role do you think you were assigned during this game?
5. What new skills, knowledge and/or attitude did you gain during this game?
6. Any tips for the researchers?

The main method of measurement of the effectiveness of the game lie within question 2 and 3. Question 2 measures to what extent the barriers as presented in the scenarios actually came across correctly to the players moreover it records whether the players actually retained the message within. Question 3 then test whether those messages actually meant something new to the participants. As the aim of the game is to actually gain an increased understanding of barriers and constraints of other parties this is the main measurement for determining the effectiveness of the game.
The results of this survey are presented in Appendix E. The answers are summarised here:

Question 1 The overall first reaction was positive. Players all indicated that the game was fun. Terms like "interactive", "realistic", and "interesting reactions" all hold positive relation to the aim of the game.

Question 2 The reported barriers players experienced were few and generalised. All answers touched upon points which were indeed addressed in the scenarios (finance and beaurocracy for instance) but not many barriers were named explicitly.

Question 3 The most notable observation is that out of all participants, only one reported one single barrier to be new to them (subject 3 reported the barrier of EU legislation to be new to them).

Question 4 When asked what function players thought they were assigned it seemed not clear what was meant by function. Two of the participants merely indicated the organisation which they had been assigned in the game. The other two reported the correct function (tracemanager being a type of project manager).

Question 5 When asked about newly obtained skills, knowledge and/or attitudes, three of the players indicated attitudes which are very supportive of the aim of the game. "to understand each others' world better" could be considered paraphrasing the actual aim of the game as stated in this research. "the dependence upon the client in realising innovations" also is a statement which supports the idea that the sought after effect of the game was reached at some level.

Question 6 Tips players gave mostly concerned the gameplay mechanics, these can serve as input for further iterations in the game design.

This final result of the user-test yields a mixed image. While the answers to question 2 indicated that a certain level of understanding of the presented barriers and constraints was present, the answers to question 3 showed that the actual effect, the *increased* understanding of others' barriers/constraints, was not reached. Nonetheless the answers to question 5 showed that the players did report an attitude of increased awareness of the importance of Collaborative Innovation and understanding each others' barriers.

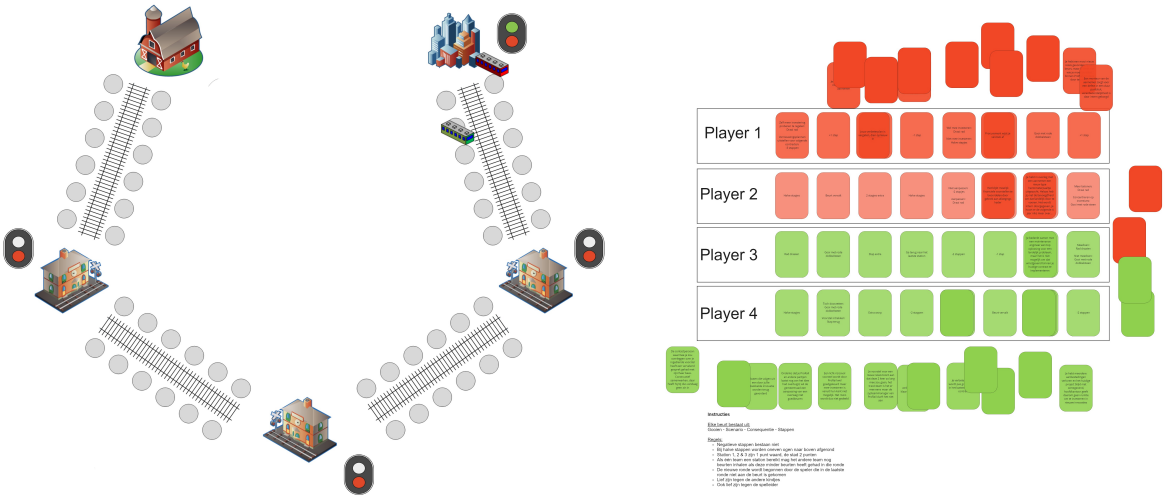


Figure 3.7: Game board of Rail's Perspective after a played game

4

Discussion

This section critically discusses all four of the design phases. It discusses the methods as well as the results of each and tries to shed a critical light on both aspects. This analysis of the research performed gives rise to new insights into the applicability of the produced game design. This leads to a third diamond in the diamond shaped model of design based research. More explanation of this extra step is presented in Section 4.5.

4.1. Discover

The literature section formed the Discover phase of the double diamond model. This section included the processing of literature found through searches in academic databases as well as found literature which was collected through personal channels over the course of this research.

4.1.1. Method

To find the literature two main search engines were used. These both worked well and are tried and tested methods for finding scientific literature in the field of innovation sciences and professional communications. The main topics sought could be considered to have been rather limited. Three main topics were researched and while capacity for research is bounded, more broad searches would have yielded more insight into for instance the design methodologies which would have been possible. Another extra topic of research could have been the processing of the interview data. Nonetheless a bound of useful insights were gained from the research as presented in Chapter 3.1 which lead to the eventual formulation of the aim of the designed game.

4.1.2. Results

The result of the literature study formed the main conclusion that barriers for Collaborative Innovative Capacity are wildly different and that a common understanding of the hindrances and opportunities in the collaborative innovative effort are crucial to the success of that effort. This is an effect of Innovation Readiness being influenced by Knowledge Sharing in the form of sharing the experiences and barriers one endures with individuals from across the isle when participating in the Collaborative Innovation process. This result is highly significant for this research and lead to the design of an interesting game. Yet it is unsatisfactory in the sense that it is only one of the many ways in which to influence Collaborative Innovative Capacity. This concept is so broad and undefined that it is difficult to identify what aspect/measure/behaviour would influence it in the most efficient way. While the found conclusion of influencing CIC by means of the sharing of innovation barriers is regarded as valuable, it is not the only conclusion which could have been found if the literature study would have been more broad and generalised.

4.2. Define

The interviews, similarly to the literature, served in the first diamond of the design process but in the Define stage. These interviews were all held digitally through MS Teams and full transcripts can be found in Appendix A.

4.2.1. Method

The interviews were performed in a semi-structured manner, bordering on the unstructured. This was applicable because of the free-spirited nature of the conversations and the new unprompted ideas and insights that this brought. In the end six interviews were processed in this research. More conversations were held but did not return as part of the results of this research. ProRail itself is a company employing over 4000 people. The maintenance contractors are of a similar size. Six interviews therefore is not enough to draw any conclusions or claim any generalisation. While this does not necessarily cause a problem for the qualitative research as is the case here, a larger sample size would most certainly increase the validity of claims resulting from the interviews section.

The coding was performed in an open fashion, meaning that interviews were coded while reading through the transcripts. Each time a quote was deemed relevant, it was marked with a code. If no suitable code for that quote was available, a new code was created. This method allows for quick processing of large amounts of data which was very useful in this research as the interviews were rather long and capacity of the researcher was limited. Nonetheless this method has its downsides. As the researcher codes in the moment, not all codes are relevant to the final conclusion. If possible, an exploratory round of coding followed by analysis, drawing of a preliminary conclusion, followed by another more targeted round of coding to validate that conclusion would have been a more thorough method of processing the interview data. This might have yielded a more clear overview of existent barriers in the observed population which would have given the researcher the opportunity to directly use those barriers in the tool design rather than using the input to create scenarios by creative association.

4.2.2. Results

As stated above, results from the interviews, similarly to the results of the literature are very general and unstructured. The interviews are analysed thoroughly and interpreted by the researcher. Thereafter the findings are distilled into conclusions which are difficult to relate directly to some of the results of the interviews in terms of objective data. While again, this is not uncommon in qualitative research, a link to objective data produced by the interviews would provide a higher amount of validity to the conclusions of the interview section and thereby to the underlying foundation of the game design. The underlying material however (the transcripts) are not lost and can still be used to perform further, more structured and thorough analysis in other research endeavours.

4.3. Develop

The operational design phase of this research determined the form of the first half of the second diamond in the double diamond description of design based research, the Develop phase. The operational design started off from the conclusions of the Discover phase, specifically the objective of the tool to be designed: *The increase of insight into barriers for innovation as experienced by the other party*

4.3.1. Method

The operational game design relied heavily on the designers' intuition. This intuition was assumed to be based on experiences during this research and prior education in design-based research. Moreover the researcher was involved in the Collaborative Innovation process between ProRail and

its contractors for close to a full year.

The choice for designing a serious game, while a valid option, was not the only option to help aid in reaching the goal which was formulated. Three arguments were presented for this choice which can be shortly summarised as: 1) it made the act of participating playful, 2) it forced players to participate fully and be attentive or without distraction and 3) the players would have to interact with one another. Other formats like a test or a movie might have been capable of fulfilling the same functions while requiring no complicated scheduling of four (or more) players to be present at the same time. Yet, the serious game concept was one which was already familiar to the researcher and one which seemed feasible to execute during the research.

The conceptualisation phase of the design process was lead by the TGD methodology. This method encourages designers to analyse the game to be designed as from three different points of view: Play, Meaning and Reality. This method served very well to channel the impressions and findings from the Define stage to the Develop stage of the double diamond. Retrospectively it may have had more potential than was actually utilised in this research. The fast paced nature of the research (an effect of the limited time available for it) caused the TGD methodology to only be applied to such an extent that it was useful but left a lot of the specifics up to be filled in later in the design process. Though some room for iterations and trial and error is constructive, more emphasis on the analysis step at the start of the design could possibly have served to build a better foundation for the game to be designed upon.

The consultation of a professional game designer to help in the brainstorming phase of developing a prototype is seen as a very positive step. The deficiencies of knowledge in serious game design were thereby quickly resolved and this lead to the fast development of a first prototype. Even though the first prototype was retired quickly it still propagated some of the core game mechanics and ideas through to the final version.

4.3.2. Results

The result of this phase was the developed prototype. The first prototype was retired after it was deemed to be unplayable and over-complicated. This effect can be attributed to the urge to increase the experiential learning factor. This first prototype was developed with the idea in mind that the player would really be submerged into a specific role and would experience the barriers to progress for themselves in a very visceral way. The nature of the game being a metaphor for the real situation however combined with this desire to create a very real experience caused a demand for complexity which was not possible and therefore caused the metaphor to break down.

The second prototype took all of the best elements of the first prototype and applied them in a more manageable way. Many improvements were still possible for this prototype, most of which were also implemented in the Testing phase of the research. Some of the more positive elements of this prototypes were its easy to follow rules and structure and its relation with rail infrastructure.

Overall the Develop phase was very productive and produced a satisfactory result. However, the exploratory nature of this phase was not fully exploited in this research. This was mostly due to time and capacity constraints. Nonetheless, a more broadly oriented brainstorm exploring more than two different conceptual prototypes could have found even more valuable prototype proposals to further investigate. Larger brainstorm sessions with multiple people involved from different disciplines would have greatly supported this effort.

4.4. Deliver

To further develop the prototype which resulted from the Develop phase, testing was performed. Testing formed the Deliver phase in the double diamond model and was performed in three stages which saw two iterations upon the original design of this second prototype.

4.4.1. Method

The testing itself of the game designs was done in some tests without test subjects (only the researcher's own experiences testing the game while portraying all roles involved), and two test with test subjects, of which one included test subjects who are employed in the actual research context. This means that only for a single session, only four test subjects were consulted directly about the developed game. As the intended application of the game in the industry would involve only these test subjects and their peers to play, more tests with that intended user group would be very beneficial.

At the end of the user-test after the game was played, subjects were presented with a survey. This survey was meant to measure in an objective manner the effectiveness of the game in the aim it was developed for. This survey yielded some interesting results but also showed that some of the questions may have not been as thorough or clear as they should have been. The question regarding the role players were assigned was not answered correctly by all. Additionally the questions regarding the barriers and constraints learned anew and the question pertaining to newly gained knowledge, skills or attitudes contradicted one another slightly.

A more extensive questionnaire which would be more elaborately designed and possibly tested would yield better, more understandable and therefore more valuable results in this regard. While this research was restricted in terms of time and left no room for developing a better measurement device, further research on the proposed design would greatly benefit from doing so.

4.4.2. Results

The second iteration started with a full play-through with test subjects who were not related to the research. While this was a very valuable test, the main outcome may have been compromised by the choice of test subjects. The main finding was that there was a lack of connection to the material as presented in the scenarios and consequences. This was later not observed anymore, while one might be inclined to assign this positive effect to the changes made in the design after the previous test, it may very well have to do with the test subjects in the user-test being connected to the source material and the research context on a daily basis. They have a more in-depth knowledge of the problems which are addressed in this research and may therefore be more quick to internalise the issues when presented to them.

The results showed that almost none of the barriers were new to the subjects. This may have to do with the depth of the detail of the researchers' understanding of the context situation. Possibly if the scenarios would have been more detailed and real to life they may have been less obvious which would have contributed to this factor of effectiveness of the game.

During the open discussion at the end of the gameplay all subjects agreed that constructive discussion about scenarios would greatly improve the ability to cognitively process the message presented by the game. This discussion would also have an effect on the length of the game and turns, but the overall opinion of the user-test group was that the added benefit of more discussion during the game would outweigh the lessened number of turns which could be played.

4.5. Discuss & aDvise

Design based research is always an iterative endeavour. Designs have to be proposed, developed, tested, evaluated and in many cases re-designed. While this process has already taken place in the research described, the results of the four design phases as discussed in this chapter lead to subsequent conclusions and a new proposed design iteration. This section will present the rationale behind this new iterative step. This new iteration will form a third diamond in the diamond shaped model for design based research. This third diamond will start with a Discuss phase. In this phase the system interpretation as presented in the Discover phase (first half of the first diamond) and the design goal (the result of the first diamond) are critically discussed and reconsidered and the phase ends with the re-formulation of the design goal. The second half of this third diamond is the aDvise phase. This phase is used to propose a re-design of the developed tool. It does not encompass a full new design like presented in the Develop phase, but will present and propose some ideas for new design directions. The overview of this third diamond in the larger diamond shaped model for this research can be found in Figure 4.1.

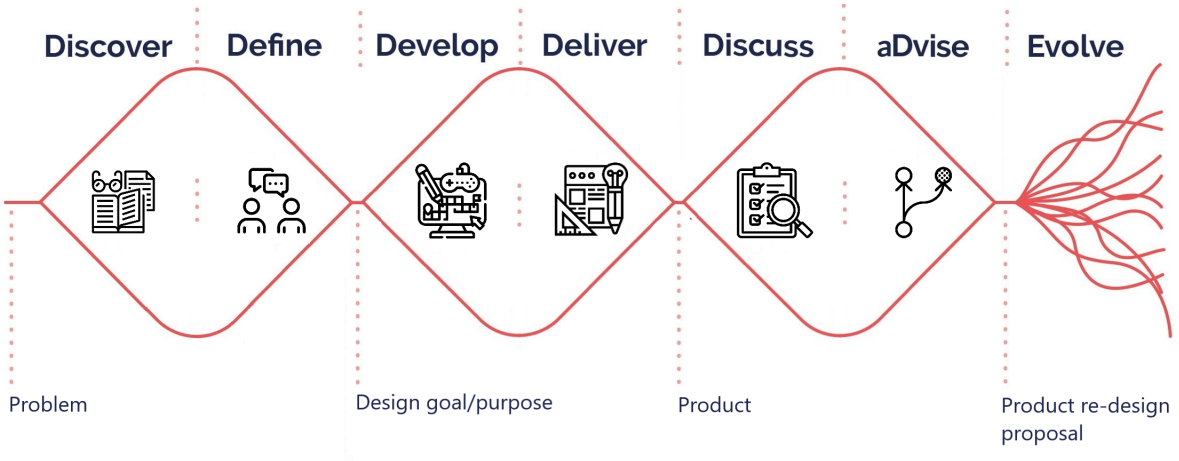


Figure 4.1: Revised diamond shaped model of this research including the third diamond

4.5.1. Discuss

Some reasoning for reconsideration of the design rationale and the resulting designed tool are described as in the following:

- The aim of the game was not in depth enough. It did not reach the true underlying problem. The deeper problem lay within the interaction between the people who are trying to collaborate and innovate together but struggle to do so. This interaction is highly abstract and basic and to get to the simplest form of the studied problem this layer has to be touched upon in the game design itself.
- The results of the game displayed little effectiveness in terms of the actual increased insight into the other party's barriers. Which suggests that the form of the game design may not be fully optimal.
- The players did however indicate that they appreciated the discussion element of the game. Every time a scenario was drawn a short discussion ensued which seemed highly engaging to the players (this was both reflected in observations by the researcher and in the results of the measurement after testing). Discussing these barriers and the way in which different collaborators experienced them in their own particular way turned out to be highly engaging and refreshing.

- The players moreover in the measurement results spoke of more inclination to "understand each other's world better" (Subject 1 Appendix E). While this was not formulated explicitly as the goal for the designed game, it can be interpreted as a positive effect as well as an indicator for a deeper problem which could be underlying to the one this game design is directly addressing.

Section 3.2 proposed, as a result of the literature study, a schematic interpretation of the studied system and relationships (see Figure 4.2). The Wall of misunderstanding, in light of the reconsiderations, may be a coarse formulation of a complex relationship between partners which obscures more deep-rooted interactions and their consequences. This wall may not be uniform or static, it may be constructed of many different issues, problems and environmental factors, the challenge may therefore not necessarily be to simply lower this wall, but rather to rearrange it, give it another form factor or allow partners to look over or though it. If even temporarily.

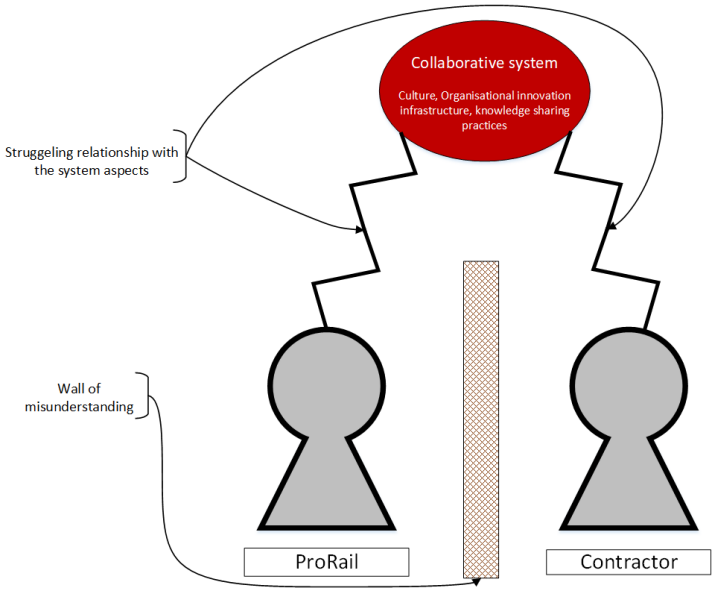
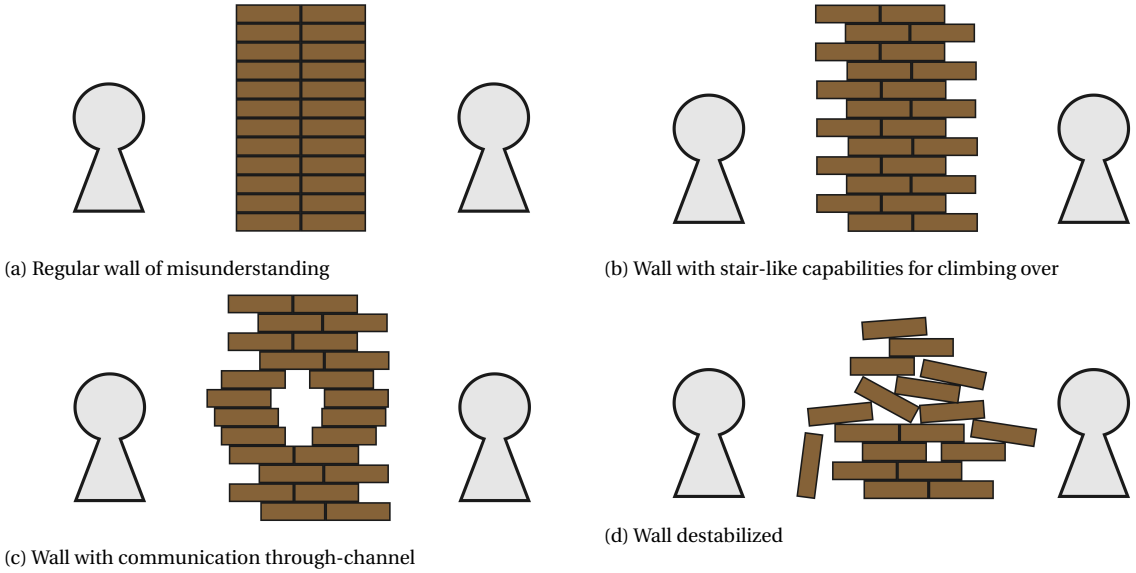


Figure 4.2: Schematic depiction of relationship between the contractors, ProRail and the system of collaboration and innovation (for reference only; identical to Figure 3.1)

By adopting this new view of the wall of misunderstanding we can visualise the desired effect a tool or game may have in the studied situation (see Figure 4.3).
Now, a very important question at this point in the reconsideration is 'how to enable the participants to manipulate this wall?'. To manipulate the wall as shown in Figure 4.3, one would have to handle and re-arrange the separate building blocks. In this metaphor the building blocks are all the different barriers people face in their collaborative innovative process. To handle those building blocks, they have to be known, people in the relationship have to be aware of them and they have to be actively worked on or discussed to manipulate. Some of the observations from the interviews however, along with the results of the game test sessions, showed that maybe the problem does not lie within the knowledge of the barriers, but in the capability or willingness to work on them. For example:

During interview 6 (see Appendix A) the interviewee talks about a Chief Technology Officers meeting (CTO) which ProRail, the maintenance contractors and several suppliers of materials undertake periodically. The interviewee has a very positive attitude towards these meetings, partially because they are focused on the capabilities rather than the barriers. "It's a matter of finding what we *can* do, rather than what we *can't*, and collaborating with a clear boundary".



(a) Regular wall of misunderstanding

(b) Wall with stair-like capabilities for climbing over

(c) Wall with communication through-channel

(d) Wall destabilized

Figure 4.3: Four possible (re-)configurations of the wall of misunderstanding

Moreover the interviewee in this case enthusiastically describes that "we purposefully do not discuss the contracts at those meetings, because as soon as we start talking about the contracts the collaboration grinds to a halt".

This method of avoiding difficult situations and topics directs us towards the deeper problems in the interaction between partners and subsequent problems in Collaborative Innovative Capacity. A tendency to not discuss barriers because they are assumed to be known by all players already, to be un-resolvable or because the resulting discussion, while very comfortable and cause for a generally positive atmosphere during meetings, may have a detrimental effect on the productivity of the collaboration. It may make everybody involved feel nice, but it is not the most fruitful in the long term. Having problems and barriers fester will cement them even further in the wall of misunderstanding and will prevent the manipulation of that wall.

Following this reasoning further, there is a need to provide the collaborators with a method of discussing problems which may be uncomfortable. Opening one of these discussions is an act of great vulnerability. As described in Figure 4.4, the natural balance of tension within an innovative collaboration can be disturbed when running into one of the described barriers. When this barrier does not get resolved immediately, a new *increased* status-quo of tension gets established. This effect, when not structurally addressed, accumulates over time as more barriers arise until the tension is at such a high status-quo that regular innovative endeavours succumb to its pressure. The alternative however - addressing the barriers openly and discussing them in a constructive manner - is also a very daunting task. As again shown in Figure 4.4 tensions often tend to rise dramatically when someone tries to discuss a barrier which is assumed to be unsolvable by the rest of the partners involved. After the discussion however, even when the barrier itself is still present, it is more open and different views on that barrier are shared and known between partners. This decreases tensions to levels below the status-quo of when the barrier was taboo. This would provide the participants with more capability of manipulating that specific brick in their wall of misunderstanding, causing a more fruitful and cooperative environment for innovative collaboration.

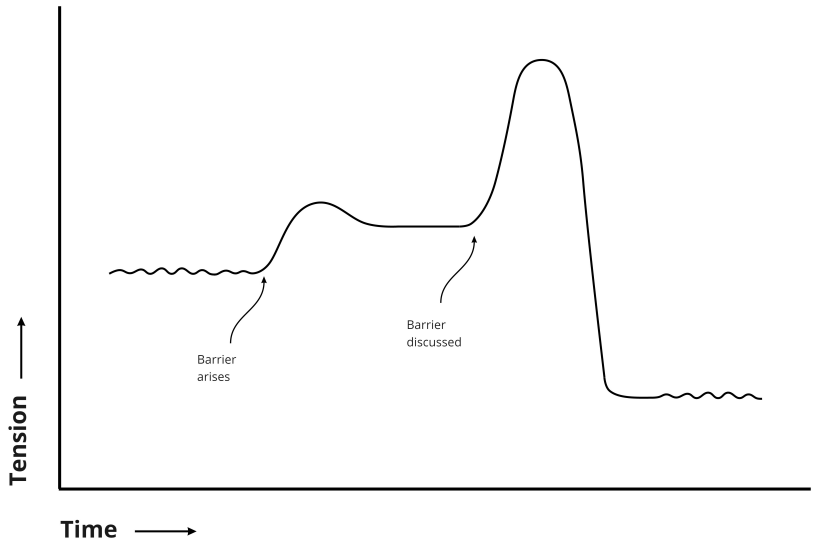


Figure 4.4: Graph representing the build of tension over time when encountering a barrier for innovation and the effect of discussing this barrier openly

The act of discussing a barrier to collaborative innovation, whether it is already presumed to be known by all partners or not, is a very vulnerable one. It takes a significant amount of courage to bring up problems which may frustrate other partners because they could think it is trivial that this barrier will not be resolved by further discussion and therefore see it as a waste of time and resources.

In summary the interpretation of the studied collaborative system to surround a rigid static wall of misunderstanding which should be eliminated is deemed inaccurate. Rather it may be a wall composed of all the small little barriers partners face in the collaborative process which need to be handled and manipulated in such a way to not necessarily remove the entire wall, but to make it compatible with collaborative innovation. The problem with manipulating this wall lies not with the barriers being unknown to participants, but with the barriers not being openly discussed in the first place, leading to them becoming cemented in the process and preventing ideas regarding the handling of these barriers to flow freely. The challenge herein is to provide the partners with tooling to lower the vulnerability necessary to start an open and honest discussion when a barrier is present in the innovative process, without fear of negative reactions or consequences from other partners involved. By together openly acknowledging the barrier itself the tension in the relationship can be lowered without even necessarily having to fully resolve the barrier.

A newly revised game design objective could therefore be:

To promote the ability of partners to openly discuss problems and barriers for innovation without fear of judgement or negative consequences.

4.5.2. aDvise

This research does not encompass enough time and resources to fully develop and test new prototype(s) to suit this new design objective. Recommendations for further development and possible design concepts, which forms the aDvise phase, are proposed in the this section.

The revised design objective was formulated based on reconsiderations following from the test results and renewed insights on the studied collaborative innovative system. This goal is more

basic than the original aim of the game and therefore the application of this objective in a design requires a more simple design which can be applied in a more wide range of situations. Inspiration for the design can be taken from common games in which players adopt a vulnerable role. An example of this are ice breaker games like "Never have I ever" or "Two truths and one lie". These types of games force players to take a vulnerable position towards the entire group while still assuring them the environment is safe and supportive.

Another factor to take into account is that the resistance to the initiative, taken by a collaborator who wants to discuss a taboo barrier, should be met with little resistance. The presentation of the initiative should therefore be un-intrusive while still garnering the attention of everyone involved. Inspiration for such a design may be found in wake-up lights. This invention is an alarm clock which, in stead of a loud alarm or music, slowly increases the intensity of the light it emits while simultaneously playing a soothing sound (rolling waves on a beach or kindly chirping birds) which also slowly increases in volume over a set period of time. This causes the user to be alerted to wake up without a sudden harsh alarm which may scare or startle. Similarly the tool to be designed should allow a user to bring up their initiative to discuss a difficult topic in a gentle manner.

When searching for a broad context, organisation wide one can start by explicitly formulating a common goal to discuss all barriers upfront in an honest and nonjudgmental manner. Not only the barriers which may be clear, obvious and resolvable. But also and especially the unspoken and institutionalised ones. This can structurally be tackled using methods like a suggestion box for barriers; a barrier box. Participants in a project could anonymously enter the institutionalised problems they encounter in this box thereby reducing the hesitance to bring up problems publicly in a group setting and its accompanying risk of being seen as the troublemaker. This barrier box could subsequently be opened (during one of the Project Start Up sessions for example) by an outside adviser or appointed chair to purposefully discuss these unspoken barriers among the participants. While this method could circumvent the pressures that accompany the introduction of a difficult discussion topic by a single participant, it does not deal with it. Meaning that it does not empower the participants to work through (or with) this difficulty but takes it out of the equation completely. This makes for a more comfortable environment for discussion as nobody feels personally responsible for the used time and resources, but this also means that personal learning is not stimulated as much as it could have. This option contains some aspects of the introduction games like having a game leader and taking deliberate time out of one's program to spend on this issue.

A way in which the personal learning can be incorporated while still trying to lower the hesitance to publicly step forward could follow from taking a smaller level perspective. That of participants from different parties simply having a regular work meeting, using a signalling type tool. This tool could take the form of a light which can turn on, or a flag which can be raised or an object which can be placed in the middle of the conference table. This signaling device would be the (maybe literal) red flag which indicates that someone has observed an important issue or barrier which is not explicitly being named and discussed. This can be very valuable as it raises awareness to the ease of skipping over things which are assumed as obvious and set in stone, which in turn can create impact on all participants when they experience a sense of relief after the topic is discussed. On the other hand this method does still require someone to take personal responsibility for bringing up a difficult issue. While the tool itself and everyone's agreement to the use of said tool can relieve it slightly, it will always be obvious that one person is the "troublemaker". As discussed before this will also increase the personal learning. This option is stronger related to the aforementioned wake up light principle. The signal could be a gentle one and does not have to be addressed the very second it

turns on, the group can choose to finish the topic at hand after which they can discuss the issue being signalled at length.

5

Recommendations

To increase the value of this research, not only is the end product (the serious game) delivered to the client (ProRail), but also a set of recommendations. Despite a third diamond composed of a Discussion and aDvise phase yielding a proposed re-design this chapter formulates recommendations regarding the original product which resulted from the first two diamonds in the design process. This can serve any who are inclined to take the developments from those stages in the research further despite the reconsiderations presented in Section 4.5.

5.1. Design

The design of the tool came in the form of a serious game called Rail's Perspective. Figure 5.1 depicts the full game board as used in the tests. The game is designed for ProRail in the context of Collaborative Innovation in the rail infrastructure sector. Though the game is delivered ready-for-use, some recommendations are formulated for the client to increase its value to the users.

5.1.1. Use of the game

In the process of collaboration between ProRail and its industrial partners, most projects incorporate a Project Start-U p (PSU). This event is an opportunity for the involved people from both parties to come together, sometimes for multiple days, to discuss the project to come. This also aims to get to know everyone involved on a personal level and figure out what the best mode of collaboration will be. These gatherings are often overseen by an outside instructor who is knowledgeable on the front of professional collaboration. Rail's Perspective would be a great candidate for one of the collaborative exercises to be undertaken during such a PSU.

Moreover, these projects, in a similar vein include a Project Follow-Up (PFU) at the end of the project. This would be a great opportunity to use Rail's Perspective as a tool for reflection. By playing the game at both the PSU and PFU a comparison can be made which would be incredibly interesting from both a corporate (how well have we come to understand each other?) as from an academic point of view.

5.1.2. Scenario database

In the final version of this research the game incorporated four different roles: the project manager and the strategic manager from both organisations. These roles followed from the direct research context and due to time and capacity constraints of this research, no more roles were investigated. However, many different individuals are involved in the collaborative innovative effort of ProRail and its maintenance contractors. The incorporation of these other roles can be easily established

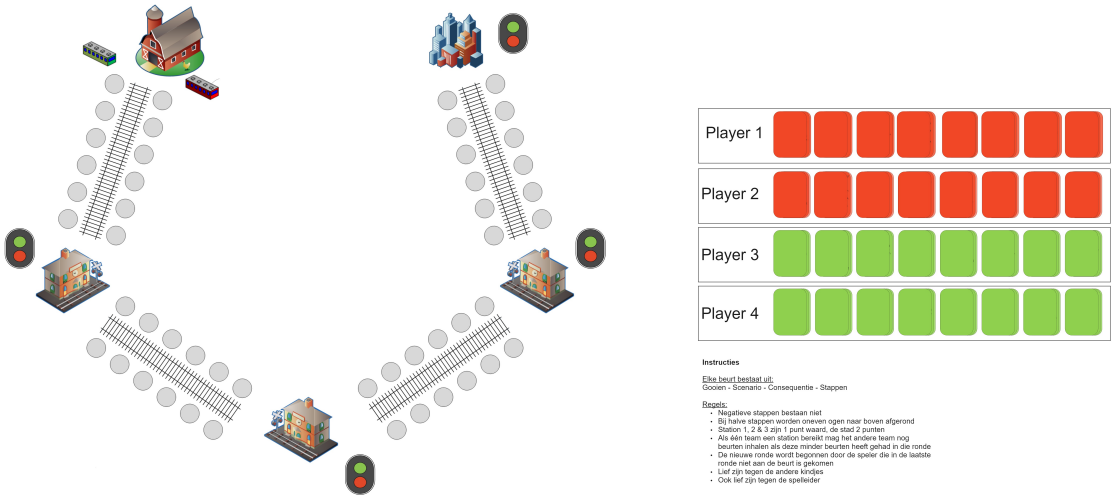


Figure 5.1: Game board, including scenario cards, of Rail's Perspective

through expansion of the scenario sets.

Moreover, the understanding of each others' barriers is an issue which can be addressed in a host of other processes and disciplines. This means that the developed game could be applicable in these other contexts as well. Similarly as the addition of other roles into the game, this would require more scenarios to be written. More scenarios could also make the game more flexible in terms of number of players and number of teams.

While all other applications of Rail's Perspective would require extensive further research and development, it would be significantly less effort than developing a whole new game. The largest feat in this process would be the addition of the new scenarios. That production step could possibly be aided greatly by implementing a *scenario database*. This database would be a digital repository for instructors, team leaders or managers who want to play the game with some of their colleagues. They would be able to browse the desired roles and contexts and find associated scenario cards to match their specific circumstance.

This database could be filled from two sources: spontaneous contributions and focused brainstorming sessions. The spontaneous contributions would come from people who played the game before. After each gaming session the players would be provided with a link or login details for this database, they could then immediately input any ideas they have for scenarios into this database. In the days, weeks or months after they've played the game they could always return to the database if they run into a problem or situation which they may find suitable as an addition to the scenario decks. The focused brainstorming sessions would be a more intentional and possibly more productive means of developing more scenarios to use in the game. These brainstorming sessions would have to include professionals from the research context to actively discuss their input and process that input into different scenarios to add to the database.

5.1.3. Round-based play

The flexibility of Rail's Perspective in its current form is still to be explored. One of the functionalities to make it more flexible, is to separate the scenario decks for separate rounds. In the current form, the game consists of four rounds, each round being the same. With exception that the last round is worth more points. But, if one were to separate the rounds by theme, they would be able to structure debate better and to focus on multiple specific problems in one single play-through.

Imagine a construction project which is being setup where a large overpass over a combination

of highway and river is planned. Examples of different topics per round could be: Construction operations, Material sourcing, Stakeholder interaction, and Responsibility distribution. By having enough scenario cards (see the previous recommendation 5.1.2) one would be capable of touching upon all these aspects of this complicated project within a single play-through of the game.

5.2. Collaboration

The main product of this research is the developed serious game. But the main subject of this thesis is the aid to Collaborative Innovative Capacity. A few recommendations for ProRail and other organisations dealing with CIC problems in a private - public partnership are therefore formulated.

5.2.1. Positivity

This research focused mainly on *barriers* for CIC in a private-public organisational partnership. This point of view is based on literature and interviews and it is a natural tendency to try and address problems first rather than opportunities. However, many opportunities for positivity are present in the world as well as in this research context and these are rarely exploited. Also during the interviews, a lot of negativity was relayed to the researcher by the participants. An outlet for negative feelings is beneficial for the individual, but letting a spirit of negativity foster among one's employees will decrease productivity and, more importantly, work enjoyment. By focusing on positive aspects of one's work and trying to promote thoughts of a positive nature, behaviour can be influenced as well. Courses, coaches and regular meetings which address these social and psychological effects may seem like a large investment of everyone's time into a topic which is not directly related to the core business of an organisation, but it could drastically impact the overall satisfaction of the workforce which has a positive effect on the functioning of an organisation.

5.2.2. Structural investment

The main finding of the first diamond of the double diamond shape of this research, is that the situation consists of two parties trying to innovate together using an imperfect collaborative system (note that a perfect system of collaboration does not exist). Their separate, struggling relationships with this system are not shared or understood by the other party. This gives rise to a wall of misunderstanding. See Figure 4.2 (a repeat of Figure 3.1) for the visual representation of this situation. The premise of the tool designed in this research is that through better understanding of the barriers which are present in the other party's struggling relationship with the collaborative system, the wall of misunderstanding can be lowered which in turn increases Collaborative Innovative Capacity in the public - private organisational partnership. That sharing of knowledge and experiences regarding one's personal barriers for innovation however can be shared in many more ways and contexts than a serious game like the one designed in this research. By incorporating this sharing of experiences with extra-organisational partners in the workflow of one's firm in a structural manner, the same effects as reached through playing the game could be established in a constant incremental way. This could take the form of regular meetings with the involved individuals with the sole purpose of discussing innovation constraints. These meetings would require adequate guidance in order to secure a safe and nonjudgmental atmosphere. Another form could be a centralised platform, physical or digital, in which people could share their experiences and learn from one another. Again this should be monitored by experts in the field of innovation and communication. All these options would require significant investments from all involved parties, and that is exactly what this recommendation puts forward. To invest structurally in getting these barriers for innovation which are experienced throughout organisations on a daily basis, above ground and out in the open.

6

Conclusion

This chapter reflects on the performed research, it re-iterates the main findings and the take-aways for innovators in the private or public sector. First, the research questions are answered.

6.1. Research questions

To guide the research a central research question was formulated and to further detail the answer to that central question, three sub-questions are presented. The three sub-questions are answered first after which the central research question is answered.

> SQ1: *What methods for positively influencing Collaborative Innovative Capacity are identified in the existing body of knowledge?*

The existing literature on Collaborative Innovation is a wide field of very dispersed singular research efforts. Little consolidation is formed which makes it difficult to draw overarching conclusions about this topic. However, the research performed found that the situation can be described as two parties who try to collaborate using an existing collaborative system. This system is constructed by both organisations' innovative culture and corporate customs. During the exercise of innovation, individuals from both organisations experience struggles with this system. This struggling relationship of both parties with the existent collaborative system cause a decrease in Innovation Readiness. By not discussing or analysing each others' struggling relationship with the collaborative system a *wall of misunderstanding* is formed. The opportunity addressed by the design in this research is that this wall of misunderstanding can be lowered by better understanding the barriers and constraints which are experienced by the other party in this struggling relationship with the collaborative system. By sharing knowledge about one another's experience the Collaborative Innovative Capacity should therefore increase.

> SQ2: *What barriers for Collaborative Innovative Capacity are experienced in the studied public - private partnership?*

The interviews are used to study the public - private partnership between ProRail and its maintenance contractors. While the sample used for the interviews is not a fully representative one for the total population of people involved in ProRail's partnerships with private companies, it is considered to be a thorough first step. These interviews showed a lot of frustration and above all, misunderstanding among the different parties involved. The barriers expressed by the participants from the user groups of ProRail, contractors and a Branch Organisation were partly overlapping and partly unique. Thereby again showing that experiences differ on each side of the wall. All

different categories of barriers were reported with the occurrence frequencies which could form input for the subsequent design step. This however can not be considered to be an exhaustive overview of the barriers present in the relationship. Nor can the identified barriers be taken on face value as more in-depth analysis of each barrier could yield new insights, nuances and possible underlying problems to take into account in further developments.

> SQ3: *How can a serious game tool raise awareness into barriers for innovation as experienced by others in the studied public - private partnership?*

The answer to this question is formed by the designed tool, the serious game called Rail's Perspective. This serious game tool is designed to help individuals involved in the partnership between ProRail and its maintenance contractors to learn about barriers for innovation which people experience. The idea is that the barriers that are presented to the players are new and thereby increase insight into the experience of the other party in the partnership, lowering the wall of misunderstanding. The measurements however showed only secondary evidence that the test subjects actually developed new attitudes towards the collaborative innovative process.

> RQ: *How can a tool aid the Collaborative Innovative Capacity for public - private organisational partnerships?*

One of the main methods of aiding the Collaborative Innovative Capacity for the studied public - private organisational partnership is the increasing the understanding and insight in the barriers towards innovation experienced by the other party. This should theoretically increase the capability to work together to resolve those barriers and thereby collaboratively increase the innovative capacity. A tool was developed which, by means of serious gaming would aid this cause. The players are presented with a playful and engaging game and are presented with other perspectives and the consequences thereof. The experiential learning factor should then embed the experience of this other perspective within the player. This newly gained experience of a previously unknown barrier towards innovation can enable the player to increase CIC through consciously working on lowering these barriers during the innovative process.

The actually designed game showed during testing that, while the participants reported having experienced few to no barriers that they were not previously aware of, most did obtain a new attitude which related to Collaborative Innovation and understanding each other's barriers better. This tool can therefore be considered to be moderately effective in this current research. An important note however is that further testing with more elaborate measurement methods is strongly advised before drawing any definitive conclusions regarding the effectiveness of this particular tool design.

Alternatively a subsequent iteration in the design process is proposed and started in the form of a Discuss and aDvise phase in this research. This iteration based on the insight that the initial design goal was not focused on the core interaction of explicitly naming and discussing, possibly taboo, barriers among one another. This led to the reformulation of the design goal and accompanying suggestions for further design research. Both the tool developed in the Develop and Deliver phases and the ones suggested in the Discuss and aDvise phases can therefore be seen as topics to evolve further in the design process.

6.2. Reflection

The research performed and reported on in this thesis has spanned five months with prior to that a nine month period of research on another topic while performing in the same context (ProRail - maintenance contractor collaboration). It has yielded a very practical result in the form of a playable serious game. First test results point towards the game having some positive influence on

Collaborative Innovative Capacity within the private - public organisational partnership but more extensive testing is necessary. The game moreover provides many directions for improvement, expansion and further research. This is regarded as a success. In terms of academic and theoretical contribution this research is not as productive. While the literature research and interview stages yielded some insights into what factors could influence CIC these were not classifiable as a break-through. This research turned out to be a design-based research which is characterised as usually having less academic contribution in the classical sense, the design implications and insights however can be fertile ground for new design and research in this field. The overall sentiment of the researcher regarding the added value of this thesis is therefore a positive one.

References

Ardichvili, A., Page, V., & Wentling, T. (2003). Motivation and barriers to participation in virtual knowledge-sharing communities of practice. *Journal of knowledge management*.

Armenakis, A. A., Harris, S. G., & Mossholder, K. W. (1993). Creating readiness for organizational change. *Human relations*, *46*(6), 681–703.

Clarebrough, B., Lee, J., & Ly, M. (2019, May). *Design for a situation, not a disability.* https://chelseaabbott.com/design-for-a-situation-not-a-disability.

Council, D. (2007). Eleven lessons: Managing design in eleven global companies-desk research report. *Design Council*.

Davis, J., & Eisenhardt, K. (2011). Rotating leadership and collaborative innovation: Recombination processes in symbiotic relationships. *Administrative Science Quarterly*, *56*(2), 159-201.

De Vries, R. E., Van den Hooff, B., & de Ridder, J. A. (2006). Explaining knowledge sharing: The role of team communication styles, job satisfaction, and performance beliefs. *Communication research*, *33*(2), 115–135.

Du Plessis, M. (2007). The role of knowledge management in innovation. *Journal of knowledge management*.

Harteveld, C. (2011). *Triadic game design: Balancing reality, meaning and play*. Springer Science & Business Media.

Holt, D. T., & Daspit, J. J. (2015). Diagnosing innovation readiness in family firms. *California Management Review*, *58*(1), 82–96.

King, N., & Anderson, N. (2002). *Managing innovation and change*. Thomson.

Koc, T., & Ceylan, C. (2007). Factors impacting the innovative capacity in large-scale companies. *Technovation*, *27*(3), 105–114.

Lin, H.-F. (2007). Knowledge sharing and firm innovation capability: an empirical study. *International Journal of manpower*.

Lippman, S. A., & Rumelt, R. P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. *The bell journal of Economics*, 418–438.

Moens, S. (n.d.). *Suzanne moens - serious game designer at raccoon serious games*. (Retrieved 08-01-2022 from https://www.linkedin.com/in/suzanne-moens/)

Nečadová, M., & Scholleová, H. (2011). Motives and barriers of innovation behaviour of companies. *Economics & Management*, *16*(2), 832–838.

Nieto, M., & Santamaría, L. (2007). The importance of diverse collaborative networks for the novelty of product innovation. *Technovation*, *27*(6-7), 367-377.

Obstfeld, D. (2005). Social networks, the tertius iungens orientation, and involvement in innovation. *Administrative Science Quarterly*, *50*(1), 100-130.

Oldenkamp, J. (2001). Succesvol overdragen van kennis (successful knowledge transfer). *Lemma BV, Utrecht, Netherlands*.

Parlby, D., & Taylor, R. (2000). The power of knowledge: a business guide to knowledge management. *Online], cited*.

Radaelli, G., Lettieri, E., Mura, M., & Spiller, N. (2014). Knowledge sharing and innovative work behaviour in healthcare: A micro-level investigation of direct and indirect effects. *Creativity and Innovation Management*, *23*(4), 400–414.

Reber, A. S., & Lewis, S. (1977). Implicit learning: An analysis of the form and structure of a body of tacit knowledge. *Cognition*, *5*(4), 333–361.

Roberts, N. (2019, May). *What the hell is human centered design?* https://yellcreative.com/what-is-human-centred-design/.

Ropohl, G. (1997). Knowledge types in technology. In *Shaping concepts of technology* (pp. 65–72). Springer.

Rowley, J. (2011). Innovation for survival: From cooperation to collaboration. *Advances in Librarianship*, *34*, 207-224.

Roy, S., Sivakumar, K., & Wilkinson, I. (2004). Innovation generation in supply chain relationships: A conceptual model and research propositions. *Journal of the Academy of Marketing Science*, *32*(1), 61-79.

Simonin, B. (1999). Ambiguity and the process of knowledge transfer in strategic alliances. *Strategic Management Journal*, *20*(7), 595-623.

Skippari, M., Laukkanen, M., & Salo, J. (2017). Cognitive barriers to collaborative innovation generation in supply chain relationships. *Industrial Marketing Management*, *62*, 108-117.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research techniques*. Citeseer.

Swink, M. (2006). Building collaborative innovation capability. *Research-technology management*, *49*(2), 37–47.

Van Den Hooff, B., & De Ridder, J. A. (2004). Knowledge sharing in context: the influence of organizational commitment, communication climate and cmc use on knowledge sharing. *Journal of knowledge management*.

Van Dijk, W. (2021, August). *Hprorail summerschool met wouter van dijk (directeur assetmanagement)*. https://www.youtube.com/watch?v=R-g4CXj9qSc.

Wang, C., & Hu, Q. (2020). Knowledge sharing in supply chain networks: Effects of collaborative innovation activities and capability on innovation performance. *Technovation, 94-95*.

Weggeman, M. C. D. P. (2000). *Kennismanagement: de praktijk*. Scriptum Management.

Öberg, C. (2016). What creates a collaboration-level identity? *Journal of Business Research*, *69*(9), 3220-3230.

A

Transcripts

To ensure the anonymity of the interviewees involved in this research, the transcripts were redacted in the public version. More information or full transcripts can be requested by contacting the researcher.

B

Codebook

Table B.1: Codebook

Codes	Interpretation
Ambiguities in collaboration	Contracts do not use fully closed formulation, meaning they leave room for interpretation. This can have both positive and negative effects on collaborative innovation as it gives freedom to use contracts in a way that benefits idea generation and acceptation. On the other hand it provides little to no guidance for this innovation, leaving the initiative with individuals.
Bad budgeting	Contractors are often accused of bad budgeting, meaning that they sign up for a tender with proposals which are extremely tightly budgeted in order to serve their competitive advantage in winning that tender. However this means that there is little margin for errors, unforeseen circumstances, and most importantly in this research, innovation
Barriers	Things that are viewed as a barrier to innovation or concepts which are related to barriers for innovation.
Beaurocracy	This code mentions situations in which beaurocracy is involved in the innovative process. Beaurocracy here meaning paperwork and permission requests which are (perceived as) unnecessary to the core innovative process.
Benefit distribution	Most innovations serve some kind of benefit, either monetary or in terms of reduced delays etc. because of the complex distribution of responsibilities and the matter of compliance among contractors which ProRail has to assure, the distribution of these benefits over the innovating parties is not always as equal as one would expect. This can severely impede the innovative motivation.
Changing contacts	In some rare cases contracts are altered during the contract period. In other cases contracts may change significantly between contract periods, forcing the contractors tendering for these contracts to shift gears more than they would like.
Compliance	In order to preserve a level playing field among all tendering partners, ProRail has to assure compliance, meaning that they do not give any party a strategic advantage for future tenders. This often can be perceived as a barrier for information exchange and therefore a barrier to innovation.
Continuity	Continuity in this context refers to the consistency in both the work and in the people within the collaborative teams. The first mostly concerns the insecurity some contractors experience in the availability of work for their organisation in light of the competitive nature of the market. On the other hand it concerns the continuity within collaborative teams, especially within ProRail the throughput of personnel is large, which makes collaboration difficult
CO-operation vs competition	In spite of the competitive nature of the field of contractors, competitors in some cases can find ways to collaboratively work towards innovation. In these situations the competition can go hand-in-hand with co-operation.
Financial difficulties	One of the downsides of working with industrial partners is that they may experience financial struggles. Where a public party rarely has to worry about their finances as they are (practically) incapable of going bankrupt, industrial organisations have to worry about their bottom line very much, which in some cases can lead to less available resources for innovation.
Idea acceptation	One of the aspects of Innovative capacity and a result of innovation readiness is the openness to new ideas. An organisation needs to be capable and ready to accept new ideas, even if they will not actually result in new processes or implementation, they should be open to accepting these new ideas in the first place to be regarded as a partner which possesses Innovation Readiness
Idea generation	The other aspect of Innovation readiness is the capability to generate ideas. This includes not only the conceptualisation of the idea itself but also the act of sharing that idea, thereby opening up the opportunity for collaborative innovation
Incentives	To stimulate innovation one could consider to impart certain incentives, like monetary discounts or rewards. On the other hand one could also implement negative incentives (i.e. fines in situations where the desired behaviour is not displayed.
Interpretation of rules	Because not all rules and regulations are clearly defined in closed-form formulation, many rules are subject to interpretation. This interpretation can differ between individuals or between organisations and when collaborating parties have different interpretation of these rules this can hinder collaborative innovative efforts.
Knowledge / information acceptance	Knowledge sharing is deconstructed into knowledge acceptance and knowledge donating. Knowledge acceptance, much in the same vein as Idea acceptance is the openness to accept and use knowledge when it is offered to you. This does not include the actual processing and targeted use of the knowledge.
Knowledge / information sharing	Knowledge donating is the act of presenting knowledge or information of a useful nature to the other party. This point focuses mostly on the willingness to share knowledge, not just for the sake of personal/organisational gain but also for the sake of creating benefits for all parties involved on both sides of the knowledge transfer.
Lack of trust	In collaboration, both parties have to have a certain level of trust. This allows for the certainty the both parties will share in the benefits and risks of the undertaking in an equal measure
Lack of understanding	For proper collaboration, parties need to participate in clear communication. Clear communication means that everyone involved understands one another. Parties do not always have to agree with each other but understanding why you disagree is more productive than "blind" disagreement.
Markets / Capetalisation	One of the cornerstones of the collaboration between ProRail and its industrial partners is the capetalisation of the market of work available. Industrial partners have to compete with one another to gain fruitful employment by ProRail. This system has many benefits and downsides when it comes to innovative capacity.
Non-innovative focus	Innovative focus is part of an organisation's culture and is reflected by the systems they use to collaborate. If certain behaviours or convictions of employees of an organisation can be labelled as conservative or contra-innovative, this can point towards a non-innovative focus by that organisation or individual
Opportunities	Even when innovation is not necessarily actively practiced, one may still be able to pinpoint opportunities for innovation. This capability can be seen as a precursor to Innovative behaviours.
Ownership	To influence a process one needs to feel that they are (part) owner of that process. Similarly, to innovate in a collaboration, both parties niet to feel ownership over that collaboration. Moreover they need to experience the ownership of both parties on their respective sides for a fruitful collaborative and innovative effort to take place.
Personal contacts	As a result of the interpretive nature of the contracts between contractors and ProRail, individual interpretations are highly influential in the possibilities for innovation in the collaboration. Therefore it is necessary (or may at least feel that way) to know the right people within the other organisation. While this collaborative mechanic may be hard to eliminate completely, in order for a sustainable and stable collaboration to take place, it needs to be reduced to a minimum
Responsibility	Similar to ownership, both parties of a collaborative effort have to experience a responsible attitude towards that collaboration from both sides of the isle.
Risk	Risk is an inherent factor in innovation, innovative initiatives always are paired with some risks.
Risk aversion	The averseness of a party to risk is called risk aversion. Being very risk-averse is here assumed to be correlated with being less innovative.

C

Coded quotes

Code 1	Code 2	Code 3	Code 4	Code 5	Interview Nr	Organisation	Quote
Ambiguities in collaboration					1	ProRail	Daar zitten natuurlijk ook uitdagingen in, dingen die we niet benoemd hebben, situaties die niet beschreven zijn en waar je dus met elkaar voor moet zorgen dat er een oplossing komt
Ambiguities in collaboration					2	Contractor	daar is het PGO contract ook ingewikkeld in. Daar hebben ze het over optimalisaties, modificaties, verbetervoorstellen etc. Het is allemaal een beetje hetzelfde maar niet duidelijk. Je merkt ook dat degene aan de andere kant van het contract ook niet goed weet hoe het moet worden geïnterpreteerd
Ambiguities in collaboration	Barriers	Beaurocracy	Changing contacts	Personal contacts	2	Contractor	Waarbij het aan de ProRail kant wel moeilijk is om besluiten te nemen, ik merk dat het door zo'n log apparaat heen moet dat, al hebben we goede ideeën; dan moet Procurement er weer wat van vinden, of dan vindt de contractspecialist er weer wat van. Dus ook daar weer heb je in de backoffice ook de wisseling van de wacht. Daardoor denk je soms dat "als we het links aanbieden gaat het wel langs start maar rechts niet". En dat maakt het moeizaam
Ambiguities in collaboration	Responsibility				2	Contractor	het contract kan je op verschillende manieren lezen, dus het is net hoe je wil dat je het leest. En als je het de één vraagt denkt die dat het 'zus' zit terwijl de ander het 'zo' ziet. En dat is echt wel een hekel punt, daardoor lopen er nu ook kort gedingen. Het makkelijkst reageren op een voorstel is dat het juridisch niet mag. Daar kan men zich heel makkelijk achter verschuilen en op die manier kan je als aannemer niks meer.
Ambiguities in collaboration					4	BranchOrg	eisen stelt en normen stelt en heel erg op het budget zit terwijl ze gewoon een kwalitatief goed product willen leveren en helderheid vragen die niet wordt geleverd.
Ambiguities in collaboration					4	BranchOrg	Of je moet je afvragen of je je vraag misschien verkeerd stelt en nog een kritisch overdenken wat je nou precies vraag
Ambiguities in collaboration	Speed				5	ProRail	je ziet dat de duur van een contract maar 5 jaar is. Je mag daarin pas na twee jaar wijzigingen (innovaties) doorvoeren of aanbieden
Ambiguities in collaboration	Changing contacts				5	ProRail	Als wij als ProRail in staat zouden zijn om over een langere termijn een productieplan samen te stellen [langer dan 4 jaar] en dat de aannemer daar vooraf ook rekening mee kan houden
Ambiguities in collaboration	Barriers	Ownership			5	ProRail	En dat zijn vaak ook gedeelde assets, je kunt bijvoorbeeld een viaduct hebben waarbij de structurele delen misschien in ons beheer zijn maar dat de onderdoorgangen dan weer voor de gemeente zijn. Dat maakt sommige innovaties die je misschien zou willen lastig omdat je met meerdere partijen te maken hebt. Het moet technisch kunnen maar het moet dan ook conform andere richtlijnen. Dus ja ook andere instanties kunnen regelgeving hebben die vernieuwingen of innovaties in de weg zitten
Bad budgeting	Markets / Capetalisation				1	ProRail	je merkt regelmatig dat een aannemer onvoldoende goed begroot heeft wat ze zouden moeten doen om een bepaalde prestatie te halen
Bad budgeting	Financial difficulties				1	ProRail	een aannemer kan dan heel hard zeggen dat ik een goed punt heb, maar dat zij daar niet op begroot hebben en dus niet tot uitvoeren over gaan
Bad budgeting	Benefit distribution	Responsibility			1	ProRail	Maar op het moment dat dit je enige broodwinning is en ProRail gaat niks veranderen aan hun gunningsmodel dan gaan die aannemers toch op lagere bedragen inschrijven terwijl ze dat niet goed waar kunnen maken
Bad budgeting	Financial difficulties				2	Contractor	En dan nog zitten die contracten best wel financieel onder druk
Bad budgeting	Financial difficulties	Markets / Capetalisation			3	Contractor	Ja het komt door marktwerking. Daardoor wil je als aannemer ook een bepaald marktvolume houden. Je hebt nou eenmaal een bepaald niveau van vaste lasten die moet blijven draaien. Daar hoort werk bij. Dan ga je dus als je je marktaandeel ziet kelderen soms verkeerde keuzes maken. Te ambitieuze aanbiedingen bijvoorbeeld.
Bad budgeting	Financial difficulties	Markets / Capetalisation			3	Contractor	het gaat om marges, schrale aanbestedingen, vechten om je marktaandeel te behouden. Dus dan wil je ook zo veel mogelijk je eigen voordeel voor jezelf houden.
Bad budgeting	Benefit distribution				4	BranchOrg	Want jij geeft aan dat de aannemer ook gedreven is op die laagste prijs en die geeft dus vaak argumenten tegen het innoveren omdat ze het geld er niet voor hebben of niet aan kunnen verdienen.
Bad budgeting	Barriers				5	ProRail	Ik heb ook wel eens een voorstel gehad dat heel mooi technisch omschreven was, maar daar zat wat betreft kosten niks bij. Dus dan moet ik ook zeggen dat ik technisch wel akkoord ben maar dan moet ik eerst een offerte zien van wat het gaat kosten en wie wat voor zijn rekening neemt zodat ik kan kijken of ik het intern kan verantwoorden. Dus soms ben je het technisch gezien ergens wel eens over maar het moet financieel ook kloppen.
Bad budgeting					5	ProRail	En dat de aannemers zich dan heel laag inschrijven voor zo'n aanbesteding betekend dat zij ook dat risico bewust nemen. En dat moeten ze niet iedere keer op de opdrachtgever afschuiven. Ik weet heel goed hoe het daar binnen gaat, you win some you lose some, en zorg dat je organisatie goed voor elkaar is. Door het minimaal aan te bieden ga je je organisatie uitkleden en krijg je dus meer ellende dan je misschien zou willen
Barriers	Beaurocracy				1	ProRail	Dus op het moment dat een aannemer een goed idee heeft dan moet ik altijd in juridische discussie gaan om te laten beoordelen wat de baten zijn die een aannemer gaat krijgen en wat het voor ons als ProRail opleverd met als conclusie welk gedeelte we dan eventueel mee kunnen betalen, en dan moet er
Barriers	Beaurocracy	Idea acceptation			1	ProRail	dus zou je kunnen zeggen dat ProRail, minder dan je zou willen, in staat is om nieuwe ideeën te accepteren? Dat die capaciteit eigenlijk te laag is. A: ja we
Barriers	Financial difficulties				1	ProRail	Maar nu tegenwoordig zie je dat als een aannemer minder geld te besteden heeft gaan ze zich richten op de onderhoudsactiviteiten waar ze zelf het meest
Barriers	Financial difficulties	Idea generation			1	ProRail	Maar goede ideeën over wat een goed product zou zijn om een bepaald probleem op te lossen, dat komt er eigenlijk nooit van omdat we altijd aan het praten zijn over wat er in het hier en nu niet goed genoeg gaat.
Barriers	Idea acceptation	Risk aversion			2	Contractor	Daar was iedereen het ook over eens. Maar dat is er uiteindelijk niet doorheen gekomen want de mensen van het seinwezen bij ProRail hebben een bepaald risico niet durven nemen.
Barriers	Benefit distribution				2	Contractor	Maar als er dan geïnnoveerd wordt moet je ook de ruimte geven om dat te doen en dan moet je niet de baten volledig aan één kant laten vallen.
Barriers	Beaurocracy	Idea acceptation			2	Contractor	En wij willen misschien in sommige opzichten wel liever gisteren beginnen dan vandaag en dat gaat natuurlijk ook niet altijd want je moet bepaalde
Barriers	Beaurocracy				3	Contractor	je kunt nog zo veel goede ideeën hebben, maar om die er door te krijgen, dat kost zo ongelofelijk veel energie dat het bijna geen zin meer heeft. Iets nieuws introduceren, voordat je daar toestemming voor heb
Barriers	Knowledge / Information sharing		Markets / Capetalisation		3	Contractor	Als wij iets heel slims hebben waarmee we de onderhoudskosten kunnen reduceren, dan is dat voor ProRail sowieso interessant, maar de huidige vorm
Barriers	CO-operation vs competition				3	Contractor	Mischien wel een klein beetje, maar dat is voor ProRail wel heel moeilijk. Ik ben nu bezig met 'RailRestore', het onderhouden van spoorstaven met waterstralen, en daar wil ProRail ook in de innovatie meehelpen. Alleen de vraag is dan in welke vorm, dat vinden ze heel moeilijk.
Barriers	Knowledge / Information sharing		Markets / Capetalisation		3	Contractor	maar als ik als aannemer een nieuw lampje ontwikkel wat mij een enorm voordeel geeft in mijn storingsprofiel. Dan is dat mijn ontwikkeling. En dan wil ik dat ook meenemen in mijn volgende tender. Dus je wilt je concurrentievoordeel zoveel mogelijk in stand proberen te houden. Dat is dus bijna bittere
Barriers	Beaurocracy				3	Contractor	ProRail geeft ons de kaart waarbinnen wij moeten acteren. De kaders worden bepaald op basis van Europese wetgeving en ProRail is kader-stellend
Barriers	Beaurocracy	Lack of understanding	Speed		4	BranchOrg	Blijkbaar hebben we daar heel veel papier en tijd voor nodig maar we vragen ons allemaal af of dat nou wel nodig is. We hebben veel meer een mechanisme nodig waarbij we al veel vroeger in het proces met elkaar inzichtelijk krijgen wat de wensen en dilemma's zijn. Zodat je veel eerder die gesprekken voert zonder al het papier en gemail over en weer, dat werkt niet zo efficiënt.
Barriers	Lack of understanding				4	BranchOrg	ga nou eerst eens met elkaar zitten en als je dan constateert dat er een probleem is geef dan wederzijds inzicht in het dilemma waar je voor staat
Barriers	Financial difficulties	Idea generation	Risk		4	BranchOrg	Dus bedachten we dat we juist innovatie nodig hebben om binnen de mogelijkheden die we hebben het maximale resultaat te behalen. En toen hebben we dus ook wel een innovatie pot gecreëerd, waarbij je dus zegt dat je aan de ene kant nog steeds het project op tijd en binnen budget af wilt hebben maar
Barriers	Benefit distribution	Markets / Capetalisation		Non-innovative focus	4	BranchOrg	En je hebt me nu nog geen één keer het woord 'aanbesteden' of 'concurrentie' horen noemen, want dat krijg je hierover snel als weerwoord terug. En daar
Barriers	Beaurocracy	Markets / Capetalisation			5	ProRail	En aan de andere kant zitten we wel altijd met Procurement dat vertelt wat wel mag en wat niet, en we kunnen/mogen niet altijd alles. De wens is er soms
Barriers	Markets / Capetalisation				6	Contractor	De marktwerking in onderhoudsland maakt gezamenlijke innovatie best wel eens moeilijk. Want ik ga natuurlijk mijn goede ideeën niet bij mijn conculega aannemers op tafel leggen. En dat is gelijk wel in de historie van deze samenwerking typerend, er gebeurt best wel een hoop, en mensen wisselen wel wat
Barriers	Compliance				6	Contractor	Dus die compliance zit daar wel ook echt weer in de weg. En bij ProRail zie je dat mensen daar ook wel een beetje bang voor zijn en het dan misschien sneller afschuiven. Dat vinden ze toch eng.

Code 1	Code 2	Code 3	Code 4	Code 5	Interview Nr	Organisation	Quote
Barriers	Compliance	Idea generation	Knowledge / Information sharing	Markets / Capetalisation	6	Contractor	ja zeker. Daar zitten twee redenen achter. Bij ons komt dat door de concurrentiepositie en bij ProRail komt dat door compliance. ProRail wil altijd alle
Barriers	Knowledge / Information sharing		Markets / Capetalisation		6	Contractor	maar ik denk dat je daar heel snel tegen de markt-issues aanloopt. Dus dat de aannemers graag de kennis van ProRail horen maar dat er niet veel bereidheid is om dat ook de andere kant op te delen. Dus als je het echt wilt stimuleren moet je haast het PGO model reviseren. Dat zit nu echt in de weg.
Barriers	Benefit distribution	Compliance	Lack of understanding	Markets / Capetalisation	6	Contractor	maar dat is iets wat wij gewoon nieit vrijgeven in zo'n prestatiecontract wat we nu hebben, dus dan zou daar iets uit moeten worden gehaald. Dus over het
Barriers	Compliance				6	Contractor	Ik zou heel graag samen met ProRail onderzoek doen, maar dat vind ProRail natuurlijk weer lastig want dan moeten ze de rest er ook bij betrekken en dan wordt t weer te groot en log om van de grond te krijgen
Barriers	Beaurocracy	Compliance			6	Contractor	Vooral als je bij procurement gaat kijken waar dus veel aandacht moet worden besteed aan die level playing field dan zijn er heel veel rode vlaggetjes
Barriers	Beaurocracy	Idea acceptation			1	ProRail	dus zou je kunnen zeggen dat ProRail, minder dan je zou willen, in staat is om nieuwe ideeën te accepteren? Dat die capaciteit eigenlijk te laag is. A: ja we zijn vaak te bureaucratisch daarin, er is altijd wel een reden om het niet te doen. Iedereen mag
Beaurocracy	Idea generation	Responsibility			1	ProRail	Het genereren van ideeën? Dat komt vaak vanuit de markt, want daar is de markt voor, maar komen die ook wel eens vanuit ProRail? Of ook te weinig? A: Wij hebben daar helemaal niks voor ingericht. Het is bijzonder vreemd dat IK degene ben die het contract uitvoert, dat ik allerlei dingen zie die mogelijk zijn, en dat er niemand is die ontvankelijk is binnen ProRail voor ons om met die dingen naartoe te stappen
Beaurocracy					2	Contractor	Als je bijvoorbeeld een innovatie voor het seinwezen wil doorvoeren hoor je "maar dat staat niet in het voorschrift, dan moet dat aangepast worden". Als je eenmaal in dat traject zit dan kan je eigenlijk beter stoppen. En dat maakt het heel moeizaam om iets door te voeren.
Beaurocracy	Changing contacts	Idea acceptation	Ownership		2	Contractor	En dan moet er dus eigenlijk op directieniveau gesprekken worden gevoerd waarin wordt gekeken naar wat we dan wel kunnen doen. Maar inmiddels is voor bepaalde relais de standtijd dus al weer voorbij waar je die beslissing dus al voor had kunnen nemen maar nu hebben wij inmiddels al weer nieuwe
Beaurocracy					2	Contractor	daar krijg je bij wijzen van spreken een brief voor terug. Daar zit ik helemaal niet op te wachten, dan zit weer een contractspecialist een brief te schrijven,
Beaurocracy	Ownership	Responsibility			2	Contractor	Op het moment dat je het mandaat legt bij het tracé-team, want die zijn verantwoordelijk voor hun eigen contract en die beschikbaarheid, dan is de kans
Beaurocracy	Benefit distribution	Ownership			2	Contractor	Het gaat voorname om het juridische en dan voornamelijk om het verdelen van het voordeel. Ik merk dat als het lokale kleine dingen betreft, dan komt er wel een besluit, dat wordt dan ook lokaal besloten. Maar als het grote zaken zijn dan blijft het vaak hangen
Beaurocracy	Non-innovative focus				2	Contractor	Dus ze zijn niet tevreden als ze het probleem gemanaged is op papier, dus financieel gezien is het geborgd, maar buiten in het spoor is het niet geregeld. En dat is voor de monteurs e.d. super onbevredigend want zij moeten in de nacht wel weer naar die storing.
Beaurocracy					2	Contractor	Op het moment werkt het zo dat bij elke voorgestelde verbetering het profiel moet worden aangepast. Omdat je je hebt ingeschreven met een bepaald
Beaurocracy	Speed				3	Contractor	kijk want als je iets nieuws bedenkt dan moet je al heel snel naar een andere functie op het hoofdkantoor. Dan moet er weer ergens toestemming voor
Beaurocracy					3	Contractor	Maar dan kom je heel snel bij de contracten en welke energie daar hangt. Als je over een contract in de rechtbank moet spreken dan is de energie al snel niet meer heel goed voor innovaties
Beaurocracy					3	Contractor	ja het contractboekje zit in de weg
Beaurocracy	Benefit distribution				3	Contractor	Als we samen willen investeren in dingen en elkaar verder willen helpen dan moeten we het boekje aan de kant leggen. Het boekje is een middel en moet geen doel op zich worden. Als het contract het doel wordt wordt het heel moeilijk om leuk samen te werken en nieuwe dingen te doen.
Beaurocracy					3	Contractor	in plaats van heel zwart-wit alles bekijken en met het boekje zwaaien.
Beaurocracy					3	Contractor	Als je gaat afwijken van regelgeving dan moet je dat dus wel regelen met de regelgevin
Beaurocracy					4	BranchOrg	en daar hebben we blijkbaar heel veel tijd en overleggen en soms papier voor nodig voordat we er achter komen wat we nou eigenlijk bedoelen.
Beaurocracy	Speed				5	ProRail	Want tegen de tijd dat zo'n voorstel door het proces van ProRail heen is ben je al weer bijna aan het einde van het contract
Beaurocracy	Benefit distribution				5	ProRail	En dan zit je dus weer spaak met het contractuele, met procurement. Want je mag innovaties (modificaties) doen waarbij we als ProRail moeten aangeven of die blijvend of tijdelijk zijn. Dus moet je dat aan het eind van het contract als aannemer weer terug herstellen in originele staat of niet. Want wat
Beaurocracy	Compliance	Knowledge / Information sharing		Opportunities	5	ProRail	Of de innovatie makkelijker wordt als je meer gaat delen weet ik niet. De regels aangaande wat wij mogen staan wel gewoon vast. Als die regels misschien
Beaurocracy					5	ProRail	maar die regels heb je wel elke keer in je nek hijgen.
Benefit distribution					1	ProRail	Dus ik denk wanneer zou het wel een goed moment zijn om risico's te nemen op zo'n manier dat daar nieuwe innovatieve ideeën uit ontstaan. Als een aannemer in een gebied nieuw komt wil hij zo lang mogelijk profijt hebben van een genomen risico. En als je kijkt naar die contracten, die duren 5 jaar, en
Benefit distribution	Responsibility				2	Contractor	maar ook dingen goed te leggen bij ProRail. Dus dat als bepaalde reservedelen er niet zijn, dat je er niet van bent op moment dat het zich voordoet. Dat laatste daar zitten we op dit moment heel erg in, in dat traject. Ja, er wordt heel veel verantwoordelijkheid neergelegd bij de aannemer en minimaal bij ProRail. Ik weet dat de werkelijkheid is natuurlijk iets anders, het verschilt ook wel eens per contract. Maar het contract is wel zo geschreven dat je eigenlijk altijd de pisang bent [als aannemer]
Benefit distribution	Idea acceptation				2	Contractor	Als het lange termijn is of voordeel voor niet alleen ProRail maar ook de aannemer hebben, dan is het wel tracé-manager afhankelijk of diegene zijn/haar
Benefit distribution					2	Contractor	En nu is het eigenlijk teruggekomen richting ons als een boemerang máár, dan moeten wij wel volledig de baten teruggeven.
Benefit distribution	Financial difficulties				2	Contractor	maar dat de financiële impact dan dus groot is en dan wordt het op een onwenselijke manier ingericht m.b.t. de baten.
Benefit distribution	Idea acceptation				2	Contractor	Maar toch zeggen ze "neehoor, als jullie dat willen moet je dat doen" en in ons contract (want dat hebben we voor 10 jaar) dan had je dat op dag 1 moeten
Benefit distribution	Financial difficulties	Incentives			2	Contractor	Kijk, de incentive vanuit de storingen is enorm, een storing kost al snel 6 á 7 duizend euro. Maar dat houd dus ook in dat bij trein ontregelende storingen enorme boetes moeten worden betaald. Bijvoorbeeld bij zelfdoding, dat is inmiddels gelukkig uit de nieuwe contracten gehaald, maar daar verdient ProRail dus eigenlijk aan. Daar is het contract natuurlijk niet voor bedoeld. En we hebben er allemaal wel voor getekend maar veel keuze hebben wij daarin
Benefit distribution					2	Contractor	Dus je moet daar de opbrengst goed verdelen.
Benefit distribution	Risk				2	Contractor	je moet elkaar zaken gunnen en dat is natuurlijk ook wederkerig. Het is iet alleen halen, halen, halen. Van ons mag ook iets verwacht worden. Maar je moet niet aan de ene kant alles afroomt wat er af te romen valt en alle risico's bij ons neerlegt, en aan de andere kant geen ruimte biedt om ons ook wat te laten
Benefit distribution					3	Contractor	Het is een kwestie van geven-en-nemen. Een aannemer moet een klein beetje geld verdienen en ProRail moet gewoon goede infra hebben, geen gedoe hebben met veiligheid en duurzaamheid. Het is dus wel belangrijk om te geven-en-nemen en samen te werken.
Benefit distribution	Incentives	Responsibility	Risk		3	Contractor	Als je kijkt naar de PGO contracten en naar wat er in zit aan risico's, malussen, en naar wat je er potentieel aan kan verdienen dan is dat helemaal uit balans. Als ProRail ons alle malussen oplegt die ze willen opleggen dan is [contractor] gewoon falliet
Benefit distribution	Speed				3	Contractor	Als jij een PGO contract hebt van 5 jaar, dan betekend dat dat je in jaar 1 en 2 nog iets kunt doen, en in jaar 3 tot 5 ga je naar het einde. Dus dan ga je al een beetje afschalen en afsluiten. Dus de contractduur staat ook heel veel innovatie in de weg denk ik.
Benefit distribution					3	Contractor	Toen werd er ook teveel geld verdiend door de aannemers. Maar het is momenteel een beetje teveel de andere kant op geslagen.

Code 1	Code 2	Code 3	Code 4	Code 5	Interview Nr	Organisation	Quote
Benefit distribution					3	Contractor	Ja daar hebben we ook samen in geïnvesteerd dus dat ging hartstikke goed.
Benefit distribution	CO-operation vs competition	Ownership			3	Contractor	Dat ging hartstikke goed. Daar heeft ProRail ook maximaal gefaciliteerd in proeven en testen en zelfs (met moeite) financieel een klein beetje bijgedragen. En uiteindelijk is dat een mooie samenwerking geweest.
Benefit distribution	Lack of trust	Lack of understanding			4	BranchOrg	Dat soort dingen moet je eerst met elkaar bespreken zodat iedereen weet wat we nou eigenlijk bedoelen, en als we dat weten kan je vervolgens met elkaar afspraken maken. En dan niet alleen voor dat ene project maar misschien ook voor de toekomst. Maar het snappen van het verdienmodel en het business model dat moet men wel echt begrijpen. Dus soms is het zo dat wat wordt gevraagd misschien wel legitiem is en in eerste opzicht niet zo raar klinkt, maar dat het effect op de ondernemer niet altijd goed wordt doordacht en waar ook geen oog voor is soms
Benefit distribution	CO-operation vs competition	Financial difficulties	Idea generation	Risk	4	BranchOrg	En dan zie je dat de ondernemers dus zelfs ook het initiatief om mee te investeren in die aparte pot. En daarbij dan gezegd hebben dat je beiden meedeelt
Benefit distribution	Continuity	Financial difficulties	Incentives	Markets / Capetalisation	4	BranchOrg	Dat als een opgave niet betaalbaar is, of als je meer/sneller/goedkoper wil dan moet je ook investeren en faciliteren, dus zowel in geld als beleid. Dus je
Benefit distribution					5	ProRail	Dan zit je ook wel eens te denken of het voor de zittende procesaannemer wel loon
Benefit distribution	Changing contacts				5	ProRail	Als het ons als ProRail dan lukt om een productieplan voor die hele termijn in te dienen, dan hebben wij er profijt van want er komen minder wijzigingen,
Benefit distribution					5	ProRail	ant die storingen en afwijkingen kosten gewoon geld. Dus men gaat ook proberen wat kan en wat niet kan. Voor de aannemer blijft dat een kosten-baten verhaal. De aannemer zit er om geld te verdienen. Punt. En het liefst met zo min mogelijk moeite zoveel mogelijk verdienen.
Benefit distribution					5	ProRail	Dus de plussen en minnen moeten wel uit egaliseren.
Benefit distribution	Knowledge / Information sharing				6	Contractor	Dus enerzijds is het het moeten en anderzijds is ook de vraag welk doel de gedeelde kennis dient. Dus als de gedeelde informatie alleen het doel van ProRail dient, dan gaat medewerking natuurlijk heel moeizaam. Maar als het doel gedeeld is tussen partijen, bijvoorbeeld: 'als je deze techniek toepast dan
Benefit distribution	Financial difficulties	Idea acceptation			6	Contractor	Want als het wel in het belang is van ProRail dan wordt er vaak direct een clubje samengesteld en dan komt er budget en dan gaan we aan het werk. Maar ProRail heeft in dat opzicht veel meer financiële middelen dan wij. Wij hebben een vrij uitgekleed contract waar we het in moeten doen. Dus innovatie is heel leuk, maar zolang dat niet binnen dat contract valt of kan, dan komt vanuit hoger management heel snel het bericht dat we dat niet gaan doen. Want wij moeten wel gewoon iedereen z'n salaris kunnen betalen.
Benefit distribution					6	Contractor	Want dan willen wij best helpen maar dan moet ProRail daar ook financieel voor bijdragen en als we daar om vragen dan worden we weer heel snel afgeschilderd als de boeven die altijd maar om geld zitten te zeuren.
Benefit distribution	Idea acceptation				6	Contractor	er zijn heel veel partijen die dat zelf willen doen maar dat kost veel te veel geld om te installeren en beheren en dat haal je er in een contract van 5 jaar niet meer uit dus dan moet je het er weer af gaan halen. Dus wij zeggen altijd tegen ProRail dat ze daar in moeten investeren want die data die daar uit
Changing contacts					2	Contractor	elk jaar hebben we wel een nieuw team van ProRail gekregen,
Changing contacts					2	Contractor	Alleen denk ik dat het te veel varieert. Want voor je het weet hebben we alweer een wisseling van de wacht. Dat maakt het moeizaam maar met de
Changing contacts	Continuity				4	BranchOrg	en daar blijven we vaak tegenaan lopen en daar kan een uitvoeringsorganisatie misschien ook niet zo heel veel aan doen, maar dat is continuïteit. In die top 3 mag continuïteit ook wel toegevoegd worden. En dat heeft te maken ook met de continuïteit van de aanbod van werk. En als dat niet gegeven kan
Compliance					3	Contractor	En compliance binnen ProRail is denk ik ook een beetje doorgeslagen
Compliance					3	Contractor	compliance
Compliance	Lack of understanding	Ownership			4	BranchOrg	Dus je moet je altijd wel afvragen waar je nou welke vraag neer legt. En of je wel met de juiste partij praat, en als je praat met ProRail of RWS dan moet je
Compliance	Idea acceptation	Markets / Capetalisation			6	Contractor	Maar wat je vaak ziet is dat wij een specifieke vraag aan ProRail hebben en dat zij vervolgens terughoudend blijken omdat ze iets niet aan ons kunnen geven omdat ze het in dat geval aan alle aannemers moeten geven, en dat kan wel een remmende factor zijn. Dan willen wij heel graag iets willen of doen,
Continuity	Lack of trust	Personal contacts			4	BranchOrg	dat klopt ja, want je werkt op zich wel lang samen en daar zitten teams op en bij van die hele grote projecten kan je vanuit de ondernemers wel er van uit
Continuity					4	BranchOrg	En dan kom je ook weer terug op die continuïteit, dan zal een onderneming ook eerder geneigd zijn om ook het perspectief er in te zien en dus mee te investeren
CO-operation vs competition					1	ProRail	En m.b.t. die samenwerking met die aannemers hebben we elkaar gewoon heel hard nodig. En dat realiseren we ons niet altijd genoeg.
CO-operation vs competition	Markets / Capetalisation				2	Contractor	Maar ze zijn als de dood dat als we een mooie innovatie bij ons hebben dat de concurrent daar weer wat van vind.
CO-operation vs competition	Ownership				2	Contractor	Maar die vernieuwing moeten we samen pakken, wij hebben als aannemer heel veel kennis van hoe het er buiten bij ligt maar wij zijn onvoldoende in staat om dat te vertalen naar productieplannen. Aan de andere kant heeft ProRail te weinig verstand van wat er buiten eigenlijk vernieuwd moet worden, los van de standaard zaken.
CO-operation vs competition					3	Contractor	hebben we wel met ProRail en de markt volop gedeeld dus dat is toen wel gebeurd. Maar goed, dat is ook een gezamelijke innovatie geweest.
CO-operation vs competition					5	ProRail	Ja het is goed als je samen kijkt naar waar je processen kan verbeteren.
CO-operation vs competition	Opportunities				5	ProRail	Je moet soms ook kijken naar wat de mogelijkheden zijn. Sommige mensen zijn daar wel heel strikt in en anderen toch minder. Als je er samen naar kijkt
CO-operation vs competition					5	ProRail	Ik probeer altijd wel in overleg er uit te komen. Ondanks alle eisen die we hebben kan je best wel een hoop dingen doen. Je moet elkaar alleen even
CO-operation vs competition	Knowledge / Information sharing				6	Contractor	ik zit ook in het CTO (chief technical officers overleg), wat een samenwerking tussen alle aannemers, leveranciers, ingenieursbureaus en ProRail is. Daar kijken we naar hoe we data en kennis kunnen delen, welke stappen interessant zijn voor iedereen om te zetten.
CO-operation vs competition	Lack of understanding				6	Contractor	De samenwerking is beperkt doordat iedereen met z'n eigen belangen zit.
CO-operation vs competition					6	Contractor	Daar zit dus best veel in. En of je dus samen iets aan het oplossen bent of je iets opgelegd krijgt. En dat gaat van beide kanten zo
Financial difficulties					1	ProRail	overlevingsmodus
Financial difficulties	Risk aversion				1	ProRail	risico avers
Financial difficulties					3	Contractor	Die zit veel meer in de ruimte die je contractueel krijgt en in de regelgeving. Net als het eventueel gezamenlijk investeren en de benefits die verdeeld
Financial difficulties					4	BranchOrg	Met name in de Infra hoek zijn natuurlijk nogal kapitaal intensieve ondernemingen. Dus daar is niet altijd ruimte om met lage marges te werken en daarom dus ook niet om te innoveren in nieuwe dingen, dus het moet wel lonen.
Idea acceptation	Idea generation	Knowledge / Information sharing			1	ProRail	Ik denk dat dat zeker zou helpen.
Idea acceptation	Non-innovative focus				4	BranchOrg	dan komen we eindelijk een keer met een alternatief, een oplossing of een innovatie, en dan wordt dat weer afgewezen. Dan denk je als ondernemer ook 'ik heb het weer geprobeerd maar dan doen we het dus niet'. En dan verlies je dus de motivatie om te investeren in dat soort vernieuwingen
Idea acceptation	Ownership	Responsibility	Risk		4	BranchOrg	En dat het risico van het niet slagen van een innovatie of een nieuwe aanpak niet ten koste gaat van het op tijd en binnen budget opleveren van het project. Dus eigenlijk wil je het risico uit dat project halen. Daar moet je eigenlijk niet op afgerekend worden, je kunt wel erkennen dat het risicovol is en

Code 1	Code 2	Code 3	Code 4	Code 5	Interview Nr	Organisation	Quote
Idea acceptation	Idea generation	Risk			4	BranchOrg	creëert om het op een andere manier te doen en dat zij ook weten dat ze er niet op worden afgerekend dat dingen mislukken. Je moet er natuurlijk van uit gaan dat het lukt maar dat je niet wordt afrekent op een onverwachte gebeurtenis of onverwachte uitkomsten van een nieuwe aanpak. Want dan zou je dus ook met elkaar duidelijk afspreken dat je samen een experiment gaat uitvoeren. Dat is dan dus part of the deal. Dat is af en toe wel echt best nog een dilemma nu
Idea acceptation	Incentives	Lack of understanding	Ownership		6	Contractor	Er is alleen wel één belangrijk belangenverschil namelijk of het moeten of mogen is. Je hebt natuurlijk vanuit een contract dat een inspecteur kan zeggen dat het niet goed genoeg is en dat diegene ons onder druk gaat zetten om dingen anders te doen. En daar gaan bij ons een beetje de haren van omhoog staan
Idea acceptation	Incentives				6	Contractor	ja, er is heel veel mogelijk zolang de middelen er zijn
Idea generation					1	ProRail	ja absoluut. Het is ook een groot verschil in die zin of je in overlevingsmodus bent of dat je volledig in control bent. En je ziet dat de ene aannemer meer in
Idea generation	Risk				2	Contractor	Nou liep daar het contract wat minder goed. En was dat eigenlijk nog belangrijker, om die kansen en risico's beter te managen, hè, want het doen van
Idea generation	Incentives	Responsibility	Risk		2	Contractor	risicomanagement is misschien wel onderbelicht geweest al die jaren. Ik merk, zeker in het contract waar ik nu zit, dat we het aardig onder controle beginnen te krijgen en daardoor ook met innovaties of verbeteringen kunnen aankomen
Idea generation	Incentives				2	Contractor	Eén grote input is de risico's die we hebben. Niet persé de contractuele risicos (dat is ook input), maar vooral technische risico's. We hebben een groot risico dossier
Idea generation	Incentives				2	Contractor	De ander is het verlagen van onderhoudskosten,
Idea generation					3	Contractor	[silence] Niet dat ik weet. Het komt vooral vanuit leveranciers en aannemers.
Idea generation	Lack of understanding				6	Contractor	Het is sowieso belangrijk om goed te luisteren naar elkaar. Kijken welke uitdagingen er leven en wat je daar mee kan
Incentives	Markets / Capetalisation				2	Contractor	Dus de verdere markt wordt ook wel betrokken bij die initiatieven.
Incentives					3	Contractor	us ik denk dat PGO in de basis wel een goed middel is om de markt te triggeren om nieuwe dingen te doen. Dus in de basis doet ProRail het helemaal niet verkeerd.
Incentives	Risk				4	BranchOrg	En het risico-averse… mensen zijn in principe altijd wel bereid om risico te nemen maar dit helpt wel als incentive aan beide kanten om het toch daadwerkelijk te doen
Incentives	Non-innovative focus				5	ProRail	de aannemer moet ook in kunnen zien dat een modificatie soms gewoon zodanig in hun voordeel is dat zij daar zelf ook in moeten investeren
Incentives	Markets / Capetalisation				5	ProRail	En soms proberen aannemers ook nieuwe technieken of onderhoudsmethodes uit wat de ene keer positief werkt en de andere keer negatie
Incentives					5	ProRail	Nou je hebt je incentives nodig om een klein beetje te blijven sturen dat er wel vooruitgang in het proces zit. Als ze op een gegeven moment te weinig gaan doen en er komen teveel storingen, als daar geen incentives voor zijn
Incentives					5	ProRail	En door de juiste incentives kan je op een gegeven moment ook de aannemer laten betalen en dus te triggeren. Dan kan je ze laten zien dat het met de storing en niet goed gaat en dat er een verhoging van de storingen te zien is, en dan kan je ze vragen hoe ze dat gaan herstellen. Welke innovaties en
Interpretation of rules	Personal contacts				1	ProRail	Maar toch is het ook heel verschillend afhankelijk van welke mensen je tegenover je hebt
Knowledge / Information acceptance		Knowledge / Information sharing			4	BranchOrg	dan heb je die extra informatie dus juist nodig.
Knowledge / Information acceptance		Knowledge / Information sharing		Non-innovative focus	6	Contractor	Wat je wel ziet is dat men direct drie stappen verder wil. Een voorbeeld is dus dat we dan een initiatief behandelen van hoe we meer data kunnen uitwisselen, en het gesprek gaat dan voor 90% over dat éne stukje data waar ik van heb aangegeven dat ik dat niet wil delen. En ProRail gaat daar dan dus
Knowledge / Information sharing		Non-innovative focus			2	Contractor	Daarin moeten we denk ik ook veel meer open kaart met elkaar spelen. Dat wordt niet met intentie achter gehouden maar ik denk dat dat gewoon nooit gebeurde. Dus daar moeten we veel meer interactie over hebben tussen ons en ProRail
Knowledge / Information sharing					3	Contractor	Ik denk dat het wat dat betreft wel in balans is. Over het algemeen delen we in gesprekken wel alles over en weer. Daar zie ik geen belemmering
Knowledge / Information sharing		Lack of trust	Lack of understanding		4	BranchOrg	ja dit vind ik dus typisch zo'n voorbeeld waarbij we dus blijkbaar nog niet met elkaar het gesprek hebben kunnen voeren over wat het dilemma is. Dus dat
Knowledge / Information sharing					4	BranchOrg	Ja, en dan niet project voor project maar veel meer programmatisch
Knowledge / Information sharing					5	ProRail	Ik denk eigenlijk dat we al best veel data en informatie delen
Knowledge / Information sharing		Markets / Capetalisation			6	Contractor	Leveranciers willen bijvoorbeeld heel graag dat ik alle data oplever, en ik wil dat juist helemaal niet, dat is mijn data
Knowledge / Information sharing		Personal contacts			6	Contractor	Dus die grens is niet heel duidelijk nee. Dat is ook een kwestie van meningen, dus dan heeft het ook invloed wie er aan tafel zit en wat diens rol is in het bedrijf e.d.
Knowledge / Information sharing		Personal contacts			6	Contractor	hoe beter de mensen van de aannemers en bijvoorbeeld de systeemmanager van ProRail elkaar kennen hoe meer samenwerking er is. Dus de relatie is wel een belangrijk punt, mensen moeten elkaar wel mogen.
Lack of trust					1	ProRail	weinig vertrouwen
Lack of trust					4	BranchOrg	En als je dan niet een vertrouwensband hebt of een afspraak over hoe je daar dan met elkaar mee om moet gaan dan werkt dat niet bevorderlijk
Lack of trust	Lack of understanding	Speed			4	BranchOrg	dan leidt dat tot frustratie, vertraging en vooral wederzijds onbegrip
Lack of understanding					4	BranchOrg	Alleen heeft men in de samenwerking niet altijd begrip voor dat die top 3 aan beide kanten van de tafel bestaa
Lack of understanding					4	BranchOrg	En elkaar niet elkaars dilemma vertellen en inzicht daarin geven daar is nog wel heel veel winst te behalen want daar zijn we over het algemeen niet zo
Markets / Capetalisation					2	Contractor	Ik weet niet hoe wij daar als bedrijf in zitten, want iets innovatiefs wil je misschien ook wel voor jezelf houden
Markets / Capetalisation					3	Contractor	Dat kan zeker in de weg zitten.
Markets / Capetalisation		Ownership			3	Contractor	bijvoorbeeld. Oostenrijk is wat dat betreft de baas in Europa. Daar zitten de grote machinebouwers en grote leveranciers. Dus het is heel moeilijk om daar
Markets / Capetalisation					4	BranchOrg	Als je het in een aantal woorden moet omschrijven… Mijn ervaring is dat er vanuit de publieke partij een top drie is van zaken die het meest belangrijk zijn:
Non-innovative focus					1	ProRail	Maar je komt op een gegeven moment op een punt dat je met elkaar de degeneratiepatronen van onze assets wil gaan managen. En daar is iets anders voor nodig dan we nu doen. Dus we moeten met PGO naar een volgende fase en dat vraagt andere randvoorwaarden dan we nu invullen. En daar wordt

Code 1	Code 2	Code 3	Code 4	Code 5	Interview Nr	Organisation	Quote
Non-innovative focus					1	ProRail	Want het contract heeft wel heel veel dingen en opties (modificatievoorstellen), hoe kan het nou dat er landelijk niemand binnen ProRail de vraag stelt
Non-innovative focus					1	ProRail	ik denk dat er teveel is dat 'in het nu' opgelost moet worden. We raken er wel over in gesprek, maar als wij het ministerie alleen maar rapporteren over de storingen en niet over de kwalitatieve inhoud, dan ontstaat er aan die kant geen urgentie
Non-innovative focus					1	ProRail	die is bij beiden te laag. Er zijn aannemers die het al decennia hetzelfde doen. Daar zou dus ook veel slimmer om kunnen worden bijgestuurd door te snappen hoe iets degenereert.
Non-innovative focus					3	Contractor	De spoor wereld is wel heel erg conservatie
Non-innovative focus					4	BranchOrg	Maar we zijn heel innovatief met oplossen binnen een project. En wat we niet doen is er met elkaar vervolgens voor zorgen dat die innovaties en die ervaring over meerdere projecten uitsmeren. Het is altijd een one-off innovatie, terwijl we juist heel veel behoefte hebben aan het starten van een programma in meerdere projecten en zo dus de geleerde lessen toepassen op meerdere projecten
Non-innovative focus					4	BranchOrg	Dus je investering gaat zich ook daadwerkelijk uitnutten en belonen. En aan de kant van de uitvoerende partij werkt het ook zo want ik pas het ook toe in verschillende projecten en uiteindelijk is daarvan de slotsom dat dingen sneller of goedkoper gaan of met een betere kwaliteit. Dus dat zou goed zijn, dan profiteer je er allebei van. Maar dat mechanisme zit nog niet in de cultuur omdat we elkaar nog steeds afrekenen op tijd en op geld.
Opportunities					2	Contractor	dat we het dus met z'n allen wel willen
Ownership	Responsibility				1	ProRail	omdat niemand eigenlijk de eigenaarschap hiervan pakt.
Ownership					3	Contractor	ik denk dat ze bang zijn voor de financiële impact. Dat aannemers denken "hé een wijziging, nu kan ik eventjes een factuurtje sturen". Als het gaat om je
Ownership	Responsibility				4	BranchOrg	En inderdaad geeft ProRail in die zin de verantwoordelijkheid teveel af, dan zou je misschien veel meer gebaat zijn bij dingen collectief regelen.
Personal contacts					2	Contractor	Die techneut krijg je dan misschien wel mee, dat hangt overigens nog steeds af van wat het is en wie je dan spreekt.
Personal contacts					2	Contractor	Maar gevoelsmatig is het soms afhankelijk van de persoon waar je mee spreekt of het idee wel of niet wordt ontvangen of tot uiting komt
Personal contacts					2	Contractor	Je kunt er niet tegen in als de contractspecialist het zo ziet. Dus je contact binnen ProRail moet ook met je mee willen werken om het contract zo te zien
Personal contacts					3	Contractor	het is wel team- en mens afhankelijk
Personal contacts					3	Contractor	Hoe een tracémanager in de wedstrijd zit is wel mensenwerk en daar zie je wel verschillen in
Personal contacts					5	ProRail	Ja. Het is wel de toon die de muziek maakt. Het heeft wel invloed hoe je om gaat met de ande
Personal contacts					6	Contractor	Dus dat kan af en toe via 1-op-1 relaties
Responsibility	Risk				1	ProRail	Wat de algemene opvatting is dat als ProRail teveel risico bij haar onderaannemers legt dan zeggen ze dat willen we niet aangaan dat risico. En als je het hebt over fatsoenlijk risicomanagement dan staan we echt nog aan het begin.
Responsibility					5	ProRail	Er is natuurlijk ook een hoop verantwoordelijkheid en geld mee gemoeid
Risk aversion					2	Contractor	ProRail is volgens jou dus vaak meer gebrand op de risico's en minder bereid om die te nemen. Minder dan dat de aannemers dat wellicht zijn.
Risk aversion					2	Contractor	Ze durven daar dus niet hun nek voor uit te steken, met name techneuten niet. Want die willen het liefst triple-safe zijn. Wat helemaal niet verkeerd is of raar maar het is wel een beetje een angsthazencultuur aan die kant
Risk aversion					3	Contractor	Ja zeker.
Speed					2	Contractor	En snelheid is ook belangrijk
Speed					3	Contractor	voordat je uberhaubt iedereen mee hebt en het voor elkaar hebt is je contract al bijna voorbij. Dus dan telt je terugverdientijd bijna niet meer. Iets innoveren moet ons iets opleveren in de zin van het voorkomen van storingen of minder onderhoud en daar help je ProRail mee uiteindelijk. Maar de
Speed					3	Contractor	contractduur
Speed					4	BranchOrg	En zeker als je contract binnen 5 jaar afloopt

D

Informed Consent Form

Informed consent form

Title research: Perspectives on Innovative Capacity in the public-private partnerships in Rail Infrastructure

Responsible researcher: Daniël Sommers

To be filled in by participant

I declare that I have been informed in a clear manner on the nature, method, goal and [if applicable] risks of the research. I know that data and results of the research will only be published anonymously I understand that any videos, photos, questionnaires and audio recordings or edits thereof will only be used for analysis and/or scientific presentations or publications. Only the researchers have access to who said and did what exactly. The data will be presented at all times in a manner that won't be traceable to any of the participants.

I agree voluntarily to the participation of this research. I hereby reserve the right to terminate my participation in this research at any time without giving any reason.

Name participant:……..

Date:…….. Signature participant:…….

To be filled in by researcher

I have given verbal and written explanations on the research. I will answer any remaining questions about the research to the best of my abilities. The participant will not experience any negative effects of terminating the research prematurely.

Name researcher: Daniël Sommers

Date:…… Signature researcher:

E

User-test Survey resulsts

Table E.1: Survey results of the user-test

	Q1: Wat is je eerste reactie op het gespeelde spel?	**Q2: Welke tegenslagen/barrières heb je ervaren in het bereiken van je bestemming?**
Subject 1	erg leuk en interessante reacties van de tegenspelers	beperkte financiële middelen, en de interne toestemming
Subject 2	Leuk, interactief. Goed opgebouwd met realistische scenarios.	Als ProRail zijnde, weinig tegenslagen. Alleen een investering die niet gedeeld werd met de aannnemer.
Subject 3	leuk spel. Herkenbare voor en nadelen die in het echt voorkomen	je bent erg afhankelijk van de dobbelsteen, maar dat maakt een spelletje ook leuk
Subject 4	Leuk, realistische reactie op kanskaarten	negatieve consequenties, weinig extra stapjes

	Q3: Waren er tegenslagen/barrières die nieuw voor je waren? (zo ja, welke?)	**Q4: Welke rol/functie denk je dat je toegewezen hebt gekregen?**
Subject 1	geen	Tracemanager
Subject 2	Opzich zijn alle getoonde scenario's bekend bij me. De enige die misschien niet meteen bij me op zou komen, zou het scenario met europese regelgeving zijn. Bv. een innovatie die door beide stakeholders wordt goedgekeurd maar niet door Europese regelgeving komt.	ProRail
Subject 3	niet echt, leek op PGO sitaties	aannemer
Subject 4	geen	projectmanager aannemer

	Q5: Welke nieuwe vaardigheden, kennis of meningen heb je opgedaan tijdens het spelen van dit spel?	**Q6: Nog tips?**
Subject 1	elkaars wereld beter willen begrijpen	nog meer spelers
Subject 2	Leuk om de verschillende scenarios tussen de verschillende rollen te zien. Je merkt ook meteen de herkenning bij de rollen en de daarbij horende gevolgen. Kan verschillende stakeholders binnen de spoorbranche inzicht geven in beslissingen en de verschillen in gevolgen/impact.	Zelf dobbelen live op het scherm, ipv de mensen online te laten dobbelen.
Subject 3	je vraagt je af of het aantal stappen terug of vooruit proportioneel is bij scenario's. Gaat je contract ten onder als een verbetervoorstel niet doorgaat??	ik zou de stad zwaarder laten meewegen. In het echt gebeuren soms ook nog grote klappers die game changers zijn
Subject 4	de afhankelijkheid van opdrachtgever bij het waarmaken van innovaties	Misschien qua spel om-en-om, zodat je niet na 1 beurt al achterstaat voor je gevoel. Net 1 stapje extra tussen stations.