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DESIGN GAMES FOR SIMULATING DESIGN COMMUNICATION

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ABSTRACT
During collaborative design, actors create shared understanding through design communication. The paper shows that design communication in a multidisciplinary team consists of the following elements: (1) Actors from different disciplines use different jargon, (2) Actors from different disciplines use different methods to represent the design, (3) Actors from different disciplines use different levels of abstraction
The paper presents two experimental settings that simulate the collaborative design process. The first setting is the Delta Design game that was developed by Bucciarelli. The second is the Kantjil design game that we developed in order to incorporate soft and elusive aspects of design communication.
The results of the study show that in Kantjil the arrangement of the pieces on the play board is only a representation of the design they are making, while the respondents in Delta Design saw the arrangement of the pieces on the play board is seen as the main aim. In Kantjil the respondents also used the play board as a way to coordinate their different jargon, while this was also not present in Delta Design. Finally, we will show that during Kantjil actors communicate in different levels of abstraction, while this is not the case in Delta Design. Based on these results we conclude that the Kantjil game more accurately represents design communication.

Key words: Design communication, design game, collaborative design

1. INTRODUCTION
During collaborative design, actors have to create shared understanding about the design they are making as well as the design process they have to fulfill. Since a product design team consists of actors from different disciplines, the process of the creation of shared understanding is difficult [1], [2]. For example, designing a bicycle the mechanical engineer primary thinks about the forces within the frame. The ergonomic considers the comfort of the bicycle, while the marketeer is primarily concerned with the salability of the bike. However, together they have to design the bike, which fits all their individual requirements. In order to do this, they have to communicate with each other about the design they are making. This communication is difficult because they all have different mental models about the design and they communicate about different issues, using different design languages (jargon) [3].
Kleinsmann [2] did research on the factors that influence the creation of shared understanding during collaborative design in industry. Kleinsmann found that practitioners have difficulties with the transformation of their knowledge into a format that it is understandable and useful for an actor from a different discipline. Also the different jargon that the actors used while communicating about their part of the design problem caused barriers for the creation of shared understanding between actors from different disciplines.
Both in industry and in practice several tools are developed in order to overcome these barriers. The use of personas [4] and scenarios (e.g. [5]) are considered powerful tools for making explicit the elusive and tacit design knowledge of the different actors. Storytelling plays an important role in the functioning of these tools within the design process [6]. Such shared concrete stories of people, settings and activities, can provide a bridge across the disciplinary boundaries of the team members.
During decision-making, as well as during concept generation, team members can actively refer to these rich stories, which stimulates a shared understanding of the design task at hand.

Even though personas and scenarios have become acknowledged design tools in the current design theatre, their functioning has not been validated. The assumption that they lead to shared understanding, even though plausible, needs to be further examined.

In order to test what tools are most effective for enabling the creation of shared understanding, we need an experimental setting that simulates a design communication process. In this paper we will present two experimental settings that simulate the collaborative design process. The first setting is the Delta Design game that was developed by Bucciarelli [7]. The second is the Kantjil design game that we developed by using elements of the Delta Design game.
The aim of this paper is to compare these two games in order to investigate which design game best simulates design communication in a collaborative design project. Our assumption is that the Kantjil design game simulates design communication better, because we explicitly incorporated the elusive characteristics of design communication in the game. What these characteristics are is described in the next section.

2. DESIGN COMMUNICATION

During collaborative design actors communicate about planning and monitoring, their progress and about the design content [8]. Since this paper is about improving actors creating shared understanding about the design content, the focus lays on communication about the design content. Chiu [9] called this type of communication *design communication*, a term which is adopted in this paper. Design communication is often jargon laden and is therefore difficult to understand for outsiders. It is different from speaking a foreign language, since the actors are familiar with the words. Even so, the meaning of the same words may differ when used by actors from different disciplines. An example of a word with many meanings is the word concept. Figure 1 shows what actors from different disciplines see as the meaning of the word concept. These representations of the word concept differ greatly. During design communication, these differences have consequences for tuning processes between the actors, for appointments about which tasks they have to do, for the view actors have of the status of the project etc, etc.
Since design communication is about an object that does not exist yet, it is about representing possible future realities. Representing reality inherently means that reality is abstracted. Whether drawings represent a spatial configuration, a static topology, or the dynamics of a flow process, they are symbolizing only the essential features of whatever they try to convey. Actors from different disciplines need different forms of abstraction in order to transfer their domain knowledge properly [1], [10]. The correct reading of drawings requires both knowledge of the *jargon* that the drawer uses as well and an *understanding of the context and the moment in use*.
During collaborative design, actors negotiate about the design content. In order to create shared understanding, the actors have to *translate* both their jargon and their representations into a form that all disciplines understand. This requires actors having knowledge of each others' tasks and jargon.
Summarized, design communication in a multidisciplinary team consists of the following elements:

- Actors from different disciplines use different jargon
- Actors from different disciplines use different methods to represent the design
- Actors from different disciplines use different levels of abstraction

Then, success of the design communication in a multidisciplinary team will be largely influenced by the way in which the multidisciplinary team is able to bridge their differences, in other words, to develop shared understanding. In any case, these three elements of design communication need to be clearly present in the communication in a design simulation game.

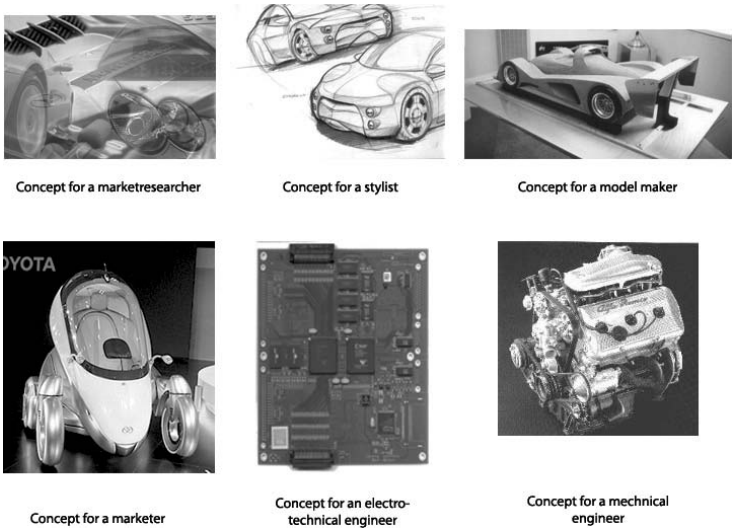

Figure 1. Different meanings of the word concept

3. TWO DESIGN GAMES

This section presents two design games that simulate collaborative design. The first game is the Delta Design game developed by Bucciarelli [7]. The second game is the Kantjil design game that we developed based on our experiences with -and inspired by- the Delta Design game.

3.1 The Delta Design Game

In the Delta Design game, the participants have to design a building for the Deltans, who live on the planet Deltoid Plane (Delta P). Delta P is a planet with only two dimensions. In Delta P there are other laws of nature than on Earth. The Delta Design game must be played with four participants. Each participant receives a unique team role that represents a discipline. Each discipline comes with the accompanying knowledge. The four disciplines are: (1) the Architect, (2) the Structural Engineer, (3) the Thermal Engineer, (4) the Project Leader.

The Architect has to build a building that is pleasant to live in for the inhabitants of Delta P. The Structural Engineer is responsible for the construction of the building. The Thermal Engineer is responsible for the climate of the Building. The Project Leader has to plan and monitor the design process and he has to take the costs of the building into account. In order to be able to fulfill these tasks, all participants have to learn the rules of their own discipline before the game starts.

Since all disciplines only know a part of the entire design task the four disciplines have to collaborate in order to fulfill their design task. Collaboration is hampered by the fact that the criteria of the four disciplines are contradictory on some aspects. This makes it necessary for the participants to negotiate.

Figure 2 shows students playing the Delta Design game. The grid on the playing board shows the two dimensions of Delta P. The triangles on the picture are the building blocks of the building. The triangles can either be red or blue. The red triangles are warm and the Deltans think that they are ugly. The blue triangles are cold and the Deltans like them. The two triangles with the dots are anchor points of the building. The Structural Engineer uses these for calculating the strength of the construction of the building.

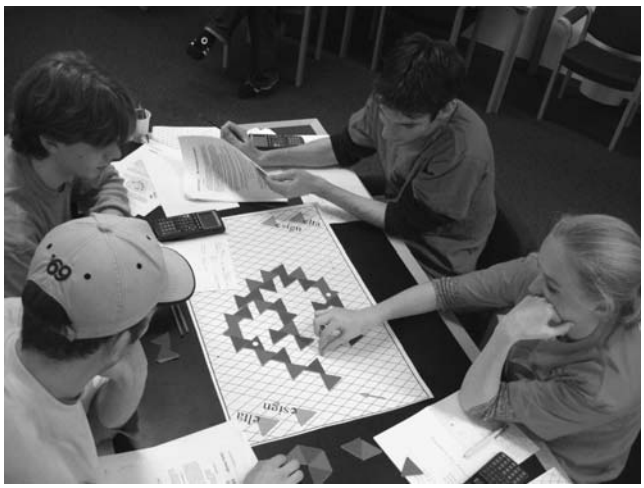

Figure 2. Students playing the Delta Design Game

Reflection on Delta Design game:

The Delta Design game was originally intended by Bucciarelli to show primarily mechanical engineers that engineering is a social process, rather than a rational problem solving process. Therefore, Bucciarelli more or less deliberately introduced hard figures and equations in the different roles. Even the architect works with equations to identify whether Deltans find a solution esthetically pleasing. Reflecting on our experiences with playing and using the Delta Design game in various design courses, we came to the following observations regarding the applicability of the Delta Design game as a game to simulate multidisciplinary design communication:

- The Delta P game is successful in starting the participants out within their roles without being able to draw on previous experiences. Delta P is such a strange world that all participants start without any content knowledge or analogous previous experiences that they can draw from. At the same time this is a limitation: all participants are laypersons in their roles on Delta P. The game does not say anything about how proficient actors engage in design communication.

- The disciplinary requirements in the Delta Design game are very explicit, and quantitatively operationalized. This leaves little space for interpretation and dealing with the complexity and ambiguity that is typical of design activity.

- Many requirements in design activity the requirements are not as clear-cut as in the Delta Design game: issues like aesthetics, ethics and desires cannot easily be put into numeric requirements (as in the Delta Design game). The process of developing a shared understanding of these vague demands is an essential part of design communication.

- Communication is primarily focusing on negotiating: finding a balance between disciplinary requirements. This means that finding a solution in a way is a mathematical exercise in finding an optimum in which all requirements are met to a certain extent. In conceptual design activity, the focus is more on setting and exploring new directions, often with a lack of explicit requirements to be met: The actors have to operate using levels of reasoning that are more advanced than the current state of knowledge would allow for [11].

These observations lead to the development for a new design simulation game which could overcome the limitations of the Delta Design game, while maintaining its' strengths. In short, such a design game needs to adhere to the following criteria:

- Participants cannot apply earlier content knowledge in their role in the design game.
- Participants approach the design task in different ways: Using different jargon, different ways of representation, and different levels of abstraction.
- Qualitative and elusive factors are important elements of the design task.

3.2 The Kantjil Design Game

In developing a new game, we used the Delta Design Game as a starting point. However, the end product only remotely resembles Bucciarelli's game. The principal ways in which we attempted to meet the criteria mentioned above are: 1) The representation space (the game board and pieces) are made less consistent: Different sizes and shapes of pieces are available. Pieces do not fit the dimensional grid on the board. And, different roles use different dimensional units. 2) The roles are infused with qualitative considerations that cannot be expressed in numbers. The goal of this game is to build an ideal society on an island on another planet. This society can be built with tan gram pieces in different colors (A tan gram consists of 7 pieces, which fit together to form a shape of some sort. The seven pieces are: two small triangles, one medium size triangle, 2 large size triangles, one square and one parallelogram. The game consisted of multiple tan grams that could be used together.). Each color represents a different material. Yellow is stone and is meant for buildings and houses. Blue represents water and green is nature or agriculture. This design game also has four team roles. The design team of the island is made up of four experts:

(1) The Energy Expert, who has to make sure that the inhabitants have enough energy. Energy must be gained by making rivers or by making a dam in a big lake. The Energy Expert needs to meet hard criteria. With the use of formulas, he can exactly calculate if he met his targets.

(2) The Culture Expert has to guarantee that the inhabitants of the island feel comfortable. He must take care of the soft criteria of happiness. (For example, the inhabitants like recreation parks, big cities and cultivated plants.) In addition to these soft criteria, he also has to take care of the total amount of inhabitants. The Culture expert has tables in which he can find the possible amount of inhabitants in certain situations.

(3) The Health Expert is in charge of keeping the inhabitants healthy. Clean water can keep the inhabitants healthy. Farmlands pollute the water. Therefore, the Health Expert should find a balance between farmland and water (this means a balance between the blue and green tan gram pieces). He knows the optimal proportions between the two. Another important aspect for health is the size of a city. Cities that are too large will cause illness. Therefore, the Health Expert also has to take care of the proportions between cities and nature.

(4) The Landscape Architect has to create a good atmosphere. He is responsible for the design of the island. Before the game starts, he must first prepare a design that is based on mood boards that are provided. There is a tension between a nice atmosphere and the number of inhabitants who can be on a certain piece of land.

As in the Delta Design game the criteria that the different actors have to meet contradict with one another. In addition, in the new game the approaches of the different experts also differ. For example, the Landscape Architect makes drawings of concepts of islands, while the Energy expert calculates if he meets his criteria.

Figure 3 shows a design team playing the design game. The picture shows that the participants are actively discussing their design. On the table is the playing board, on which the participants are building the island with the use of the tan gram pieces in the three different colors. The drawings of the Landscape Architect are also shown in this picture.

Figure 3. Students playing the Kantjil Design Game

In the next section we will assess whether introducing the various elements in the game to stimulate indeed lead to a better simulation of design activity. This leads to the following research question: *In what ways does (or does not) the Kantjil design game simulate design communication more accurately Delta Design?* We will attempt to answer this question by analyzing the protocols of design simulations applying the two design games.

4. RESEARCH METHOD

In order to test which design game simulates design communication better we set up an experiment, in which participants played the two design games. Each game was played twice (first Delta Design was played twice and after that Kantjil was played twice). The design teams were called Delta Design 1, Delta Design 2, Kantjil 1 and Kantjil 2.The duration of each game was approximately one and a half hour.

The respondents that played the games were students at Delft University of Technology. These respondents were chosen because of their engineering background. Having an engineering background is necessary, because they had to be familiar with the kind of role they had to play, as well, as thee type of task that they had to fulfill. Being a design student was the only selection criterion that we used for recruiting the respondents.

Before the games started, the respondents were taught the role that they had to play during the game. (Of course they were not provided any insights of the other team roles!) Additionally, the respondents got a design brief about the design project they had to carry out. No further instructions were given. While playing the game the respondents were allowed to ask questions that concerned obscurities in their design task or the design brief. However, it was impossible for them to ask questions that were related to aspects related to the solving the design problem, like for example contradicting requirements. The respondents were videotaped while they were playing the design games.

The first step of data analysis was the transcription of the verbal protocols of the design communication that the respondents had while playing the game. The second step of data analysis was making an overview of the design processes of the four design teams. We did this in order to show if the design processes of the two games were comparable.

The third step of data analysis was coding the verbal protocols according to the method of *reflective practice* as developed by Valkenburg [12]. The reflective practice is a continuous process of four activities that alternate continuously. These four activities are framing, naming, moving and reflecting. *Framing* guides the design process. Frames enclose the solution space of both the design content and to the design process. *Naming* is the activity in which actors make things that need attention explicit. During naming a designer makes a choice of the things that matter. Actors in a design team are *moving* if they execute activities, such as generating ideas, exploring problems or looking at the consequences of design decisions, undertaken by the design team. Moves often contribute to reframing the design problem. There are two types of moves. First, moves inside frames, which are guided, and second, moves outside frames that seem to lack a goal. The last activity is *reflection*. Reflection is the activity during which actors turn their thoughts toward what they are doing or what has been done, but on a macroscopic level. Additionally, reflection is the activity during which actors question where their actions are taking them within the design task. Actors use reflections as guidance of both project progress and project quality. Reflections can lead to reframing the problem or to new moves. Figure 4 shows the graphical system that Valkenburg developed in order to describe team communication. The frames are represented as the gray rectangles. The names are ellipses, the moves are triangles, and circles represent the reflections.

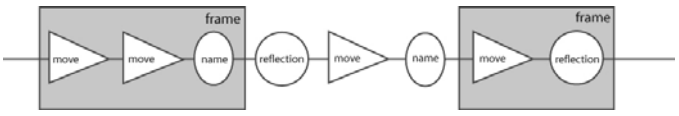

Figure 4. Design as a reflective practice

Since Valkenburgs method is developed and validated for analyzing the content of design communication, it is useful for the purpose of this study. One researcher coded all four protocols and a second researcher checked this coding. Both coders were familiar with the coding system as developed by Valkenburg. In case of a disagreement between the coders, they discussed their statements in order to come to a final coding of that part of the protocol.
The final step of data analysis was an analysis of the coded protocols.

5. RESULTS

This section presents the results of this study. We will fist present the design processes that occurred during the design games. After that the design communication is analyzed.
By analyzing the protocols of the four design teams we could distinguish the following design process:

1. *Explanation of the different team roles:* Every team member explains his/her role to the design team. Both goals and criteria are explained to each other.
2. *Exploring the different team roles:* During this phase, the participants discuss the contradicting requirements that their different team roles contain.
3. *Setting the design criteria:* After exploring the design criteria, the design teams all tried to make a list with criteria, which is the starting point for the development of the concept. None of the design teams finished their list. They started laying out a concept before.
4. *Developing concept(s) on the play board:* While setting the design criteria, the design teams start 'building' their first concept on the play board. The start point is often an important criterion of one of the participants, or the awareness that they have to make progress in order to finish the design task in time. Only team 'Delta Design 1' developed two concepts and explicitly chose one of them.
5. *Evaluating the concept:* During all four design games there was a moment that there was laid out a complete concept. This initial concept was discussed and evaluated according to the criteria set for the different team roles. During this step the weaknesses of the concept appeared.
6. *Optimizing the concept:* During this step the team members move the different pieces on the play board in order to optimize the concept.
7. *Evaluating the end result*: In the last process step, the actors most of the time 'count' the different types of pieces on the play board by taking into account how the pieces are situated and related to each other.

The above shows that all four design teams followed a rather similar design process, which forms a proper base for comparing the two different design games.

In order to analyze the communication of the four design teams coded the four protocols according the reflective practice as developed. Figure 5 and 6 are the results of this process. (The last ten minutes of the Delta Design 1 protocol lacked. Therefore, we could not include it in the figure. We know from the video that nothing remarkable happened in the end.) The figures are positioned horizontally, which means that each protocol starts left above and continues on the next line.
By analyzing the four graphic representations of the design processes, it is clear that both Delta Design and Kantjil contain one experiment in which framing is one of the main activities, while the other experiment contains only one frame.
According to Valkenburg [12], frames guide the design process and improve therefore the quality of the design communication. This means that our experiment consists of a good and a weaker example of the execution of the two design games. Both Delta Design 1 and Kantjil 1 are better performed design processes as Delta Design 2 and Kantjil 2. This is not only related to the amount of frames or the duration of the frames. Looking at the names of the frames the two weaker design processes have one frame that is called '*the concep*t'. This means that the design team did not actively create a

metaphor for framing their design activities. This is something that the two good design teams did. They created frames like: '*triangle*', '*multiple triangles*' and '*villages*', '*agriculture*' and '*water*'.
By looking at the names of the frames of both Delta Design 1 and Kantjil 1, uncovered another remarkable aspect. The frames that the Delta Design 1 team developed were all related to the shape of the pieces on the play board. The frames that the Kantjil 1 design team developed were all related to the actual thing that they were designing (e.g. water and villages). This implies that the Kantjil 1 design team was actually designing. They used the play board and the pieces as a representation of their design. The three other design teams were not doing this. The two Delta Design teams did not distinguish between representation form and the actual design task since the descriptions of their roles did not force them to do so. Their roles did not contain soft design criteria. All criteria can be reduced to amounts of pieces, a red/blue distribution and the way that the pieces are arranged compared to each other. In Kantjil this is different. There are many soft criteria added to the game. These soft criteria provide meaning to the pieces on the play board. This is for example shown in the following quote:

Kantjil 1:
Health Expert says: *"Four pieces of agriculture lead to a contagion of the water."*

Below there are four pieces of protocol that show the difference in design communication when the game consists of hard criteria (Delta Design) and when a game consists of soft criteria (Kantjil):

Delta Design 1
Architect: *"… blue is comfortable, so I have to take care that we create as much blue as possible."*

Delta Design 2
Architect: *"So, let's have a look. I think that it is good if the three of us make a concept that is ultimate, concerning red and blue."*

Kantjil 1
Landscape Architect: *"Maybe we have to define the river first in relation to agriculture, because that is very important for the spatial content…."*

Kantjil 2
Landscape Architect: *"We'll provide these people with even more quality of live. Another park. That is possible, isn't it?"*

The question rises why the Kantjil 2 team was not designing like the Kantjil 1 team. The reason for that is that they actively dismissed the soft criteria from their design task. By doing this they reduced their design task to organizing pieces on the play board. The piece of protocol below supports this:

Kantjil 1
The Energy expert: *"But if there are requirements that are not purely mathematical, let's dismiss them"*
Culture expert: *"Yes, I agree on that."*
Health expert: *"A quarter of the tan gram pieces need to be agriculture."*
Energy expert: *"Oh, yes…"*
Health expert: *"That is a hard requirement."*
Energy expert: *"Yes, that is true."*

The Landscape Architect is not participating in this part of the conversation. He is not very keen on meeting his soft requirements. He takes his design of the landscape just half an hour before the end of the session in order to check if he meets his requirements. And just after he did that that he expresses his motivation by saying the following:

Landscape Architect: *"You shouldn't be afraid of scoring low, come on!"*

From this quote it becomes clear that the Landscape Architect is not trying to meet his (soft) criteria, which is a confirmation of the decision of the other team members to dismiss the soft criteria.
Moves represent the activities that the actors are performing. Moves within frames guide the design process. Therefore, they are also interesting to analyze. By analyzing the moves within the frames that

Kantjil 1 created one can see (in Figure 6) that the design team switches between designing and representing the design. The moves within the frame that Kantjil 2 developed only represent the design moves. They did not explicitly discuss their representation activities. By analyzing the moves of Delta Design 1 within the frames, it becomes clear that the design team switches between representing their design and the design brief in order to check if they meet their criteria (see Figure 5). This is also the case in Delta Design 2 (see also Figure 5).

The play board is the common representation form that is given to all team members. Additional to this common representation form, we learned the different team members of Kantjil representing the design differently. By doing this, they can judge if the design on the play board meets their individual requirements. In Delta Design these different representation forms do not exist. All team members can calculate if the design on the play board meets their individual requirements. Adding different representation forms difference leads to the following differences in design communication:

> Kantjil 1:
> Energy Expert: *" …they have coupled the energy production of an artificial lake to units and the energy of a windmill park to the squares on the play board…"*
>
> Healthcare Expert: *"… a quarter of the pieces need to be agriculture."*
>
> Landscape Architect: *"… if we have a laughing river the water floats from the left to the right and if we have a crying river the water floats from the right to the left."*
>
> Culture Expert: *"I don't have an amount to strive for. I know that when there are combinations, for a city, that the amount of inhabitants decreases if there are, for example, a certain amount of green pieces, or water, then you get a penalty, if there are too many…"*

These differences lead to extensive discussions about both the team roles and the design they have to make since it is not immediately clear what the other means. Additional to this, it is not obvious what the contradicting requirements are. This leads in a later stadium to rich negotiation processes. In Delta Design the team roles are more explicit, which makes the both the team roles and the negotiation processes very explicit. Therefore, design communication is in Delta Design is not as rich as in real design communication. The following two examples show the differences is negotiation processes:

> Delta Design 1
> Thermal Engineer: *"No, but is that also important for the modules?"*
> Project Leader: *"Well, blue red, I don't thinks so."*
> Architect: *"Blue red is expensive."*
> Project Leader: *"I think that you should try to avoid that if you have to connect two modules that you have to connect two reds. So if you have two modules then you don't want to connect them on the red side and the red sides of the modules need to be connected to two blue ones. That is the multiplying factor. It is a bit vague."*
> Structural Engineer: *"I try something since I'm looking at the area of the interior that we need."*
>
> Kantjil 1
> Landscape Architect: *"And the lake could also be used as moor place?"*
> Energy Expert: *"And moor. It has to be 5 pieces, well this is 6 pieces."*
> Culture Expert: *"Yes, that was recreation."*
> Health Expert: *"Yes but, is it possible… yes an artificial lake..."*
> Energy Expert: *"But you build a dam here and you have an artificial lake, isn't it?"*
> Health Expert: *"But then…"*
> Culture Expert: *"But if it is still a river?"*
> Health Expert: *"Yes, that is what I mean."*
> Energy Expert: *"If it is still a river? I don't know… Ha!"*
> Landscape Architect: *"Yes, it is closed, so you cannot use this as a moor place."*

This section showed in what ways the Kantjil Design Game simulates design communication better then delta design, which answers the research question set.

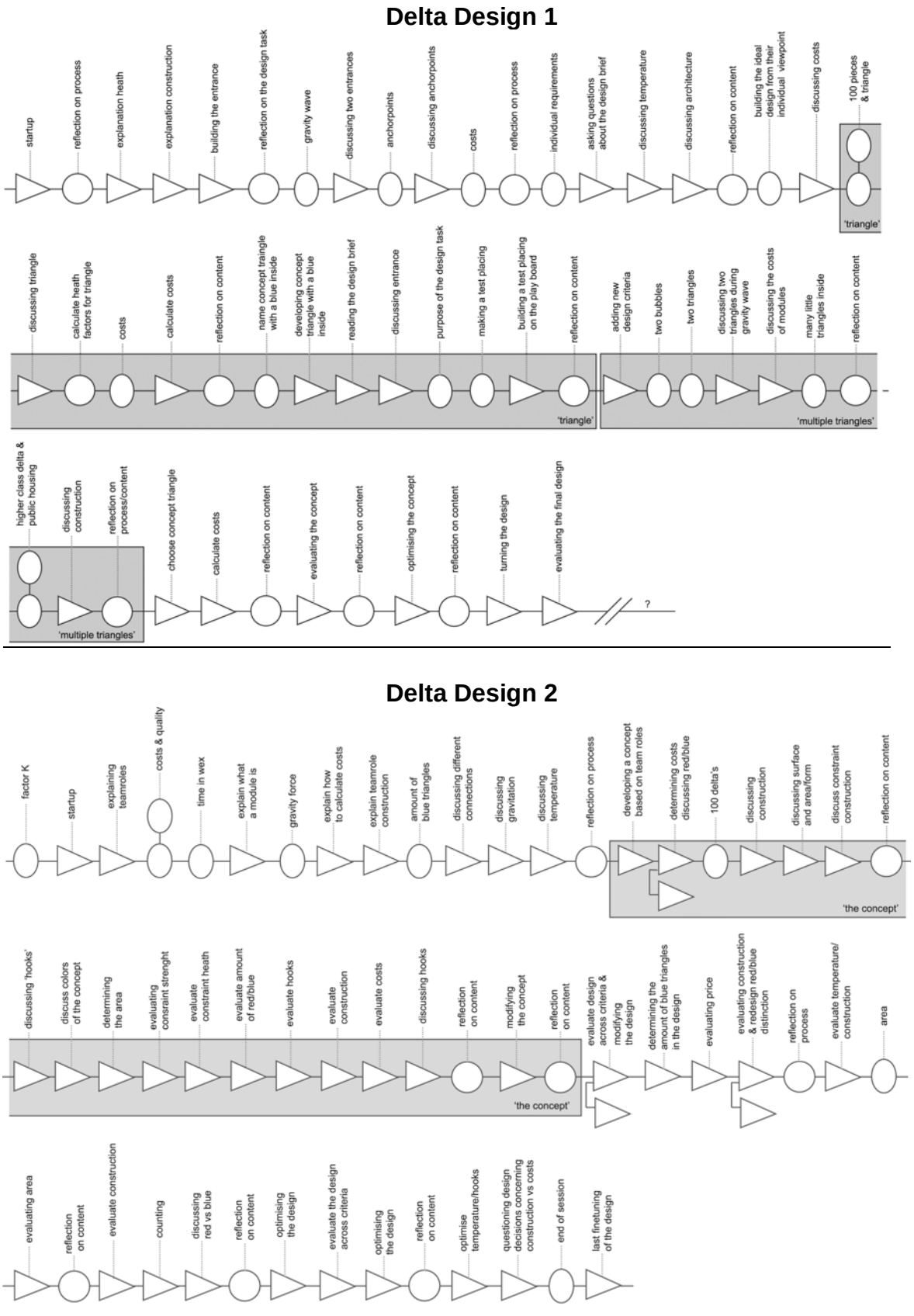

Figure 4. The reflective practice Delta Design 1&2

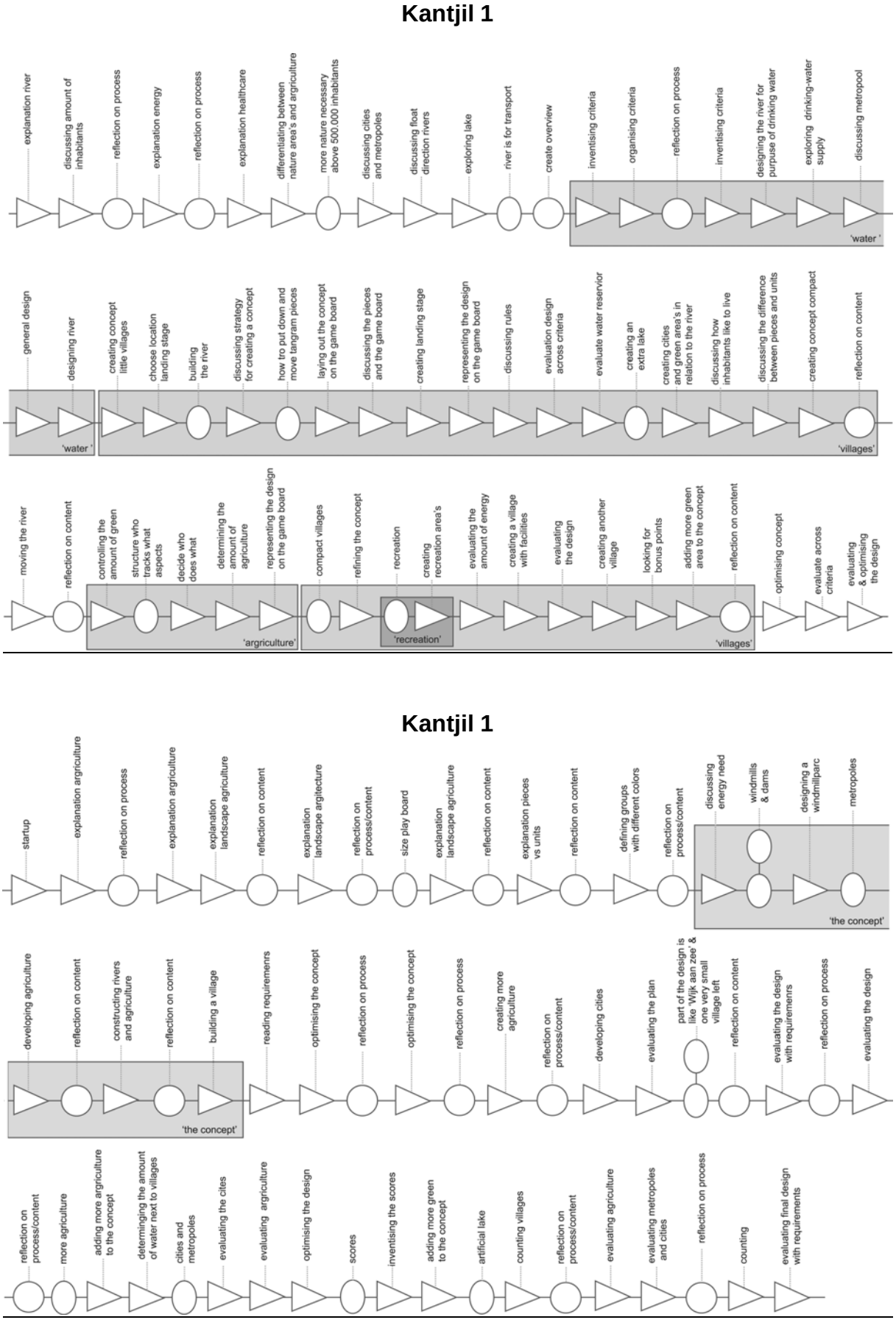

Figure 5. The reflective practice Kantjil 1&2

6. DISCUSSION

This paper presented two design games that simulate a design process. We executed an experiment in order to test if the Kantjil Game simulated design communication better than the Delta Design game. The results of the experiment showed that Kantjil actually provided a more accurate simulation of design communication. However, we do think that there is a lot of space for improvement. In this section, we would first like to discuss some aspects that could refine the simulation of design communication in the Kantjil Design Game, to make Kantjil design game resemble real team design activity even better. Then, we will provide some considerations regarding the ways in which we can apply Kantjil in our studying of tools that enable the creation of shared understanding between team members from different disciplines.

By analyzing the design process that the team members followed during Kantjil, it becomes clear that idea generation is not an explicit phase in this process. Although idea generation is enticing, we decided to skip this part from of the design task, because of the time limitations. In order to achieve this, we let the Landscape Architect develop a concept before the game starts. This concept forms the start point for the game. Concept development is more interesting than idea generation since the ideas of the different disciplines needs to be integrated during concept development. In the literature the concept phase is also described as the most difficult phase for the creation of shared understanding [9]. Another aspect that is lacking in the game is the use of different jargon, which is an important part of design communication. This is an aspect that we need to work on. However, we are a bit reluctant on making the game more complex for the team members. During the design game the participant had to go back to their assignment often. In addition to that, their design communication showed sometimes that they had difficulties to comprehend their entire design task and the accompanying knowledge. By adding jargon, it becomes even more complex. Expanding the amount of time for learning their team role, could solve these problems.
In this paper, we presented two design teams that executed the Kantjil game. One team was successful and the other design team was weak. The weak design team was less motivated than the successful team. Furthermore, the team roles that contained the soft aspects were not allocated to participants that adopted such type of role naturally. The motivational aspect is hard to influence. In the future we could control for motivation, by asking questions about it after the design game. Allocating team roles should be more controlled in the future. We need to test what team role should be allocated to a certain participant.

Our next research step will be the development of tools that enable the creation of shared understanding. In order to test the tools, we will use the Kantjil Design Game. An aspect that we need to think of is how we implement the tool in the design game. Do we present the tools to the entire team, or do we only provide the project leader with the tool? There are reasons for both options. By providing only the project leader with the tool, a natural situation is created. In industry, project leaders are responsible for an efficient design process and collaboration is one of the aspects. However, by implementing the tool as a part of the design task of the project leader there is a risk that he does not use the tool. Therefore, it might be better to implement the tool in de design process when the creation of shared understanding is hampered. In that case, an observer should decide when he introduces a certain tool to the design team. As a guide for this, the observer could use the barriers for the creation of shared understanding that [2] found in her research. However, this intervention might be interrupting the natural process too drastically.

7. CONCLUSION

We developed a game for simulating design communication. Results show that the game gives space to the softer and elusive aspects of design communication that were not found in earlier design simulation games, such as Delta P . Still some work needs to be done before we can actually execute our next research step: Exploring and validating new tools to stimulate the creation of shared understanding in multidisciplinary team design.

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