Constructing delta realities;
Joint Fact Finding challenges in Serious Game Design

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Abstract

This paper addresses the challenges of Joint Fact Finding (JFF) in spatial planning and design. JFF is an important component of a deliberative planning practice: The construction of (problematic) realities is fundamental for the formulation of challenges and solutions. Information is often contested in complex planning processes due to different interests, values and perspectives. Carefully designed interaction procedures are needed to negotiate the relevance and validity of information sources.

Particularly promising procedures for this are Serious Games: Facilitating joint reality construction through immersive simulations, they are appealing ways to engage not only knowledge-oriented researchers, but also practice-oriented stakeholders and professionals. Their concreteness speaks to spatial planning and design as crafts. Still, the development of such games is not without its challenges and trade-offs. As procedures for reality construction, they cannot escape the power-laden nature of knowledge.

We present a case study on developing a spatial design-oriented game, and analyze it in the tradition of the sociology of translations, aided by literature on serious game development. As indicated, Serious Games could function as JFF procedures in spatial planning and design. Moreover, their architecture can be considered a 'boundary object' providing actors an environment that accommodates information sharing, learning and joint reality construction. In this way the game facilitates the building of capacity to generate and integrate knowledge for spatial planning and design.

In our project on integrative planning in delta areas, the game architecture accommodated researchers and practitioners in governance, spatial design and geo-information. Striving for interdisciplinary synergies, the game architecture was to be accordingly polyvalent. Its main innovative features would be its generative and integrative capacity, i.e. its capacity to both co-produce and integrate a diversity of information sources and to co-develop/generate spatial designs on this basis. *How can joint fact finding in spatial planning and design be organized through a serious game in such a way that it develops integrative and generative capacity, and which challenges and trade-offs are faced in realizing this goal?* In this paper we describe and discuss the practical shaping of these two capacities, and the attendant trade-offs.

Tracking the ontogenesis of a game design, we describe a struggle over appropriate JFF procedures. As proposed procedures for interactive reality construction, the successive

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prototypes and game elements reflect meta-visions on the area under study – as a physical formation to shape, a system to represent and display, or an actor constellation to engage. This analysis allows us to distinguish alternative game architectures, with different appropriateness to JFF and other planning-related purposes. Beyond these procedural-methodological insights on JFF in game development, the observed variety of delta realities is also telling for the complexity of these areas: They are not only intersections of marine and fluvial dynamics, but also of multiple reality constructions.

1 Introduction

Delta areas can be considered complex adaptive socio-ecological systems as these areas are characterized by both morphologic and hydrologic dynamics, and social complexity as many actors (governments, non-governmental organizations, private organizations, etc.) at different scales (local, regional, national) have interdependent relationships (Van Leeuwen & Van Buuren, 2013). The Dutch Southwest delta, formed by the Rhine, Meuse and Scheldt rivers meeting with the North Sea, is a case in point: It is faced by serious flood risks due to climate change and soil subsidence, is vulnerable to ecological decline, and also involves challenging issues of agriculture, industrial and harbor development, and restructuration of the energy sector (Meyer, 2005). These challenges are in practice often faced in fragmented action: every actor (government, citizen, NGO, or private organization) has its own main perceptions and ambitions and approaches in analyzing issues and finding solutions. Although delta areas can be conceptualized as complex interrelated systems, in practice many institutional barriers exist towards really approaching and managing these areas as interdependent wholes (Teisman et al, 2009).

The very multitude of initiatives is frequently lamented as a source of fragmentation and indecisiveness. As we have substantiated in more detail earlier, this fragmentation is constituted by the involved actors' different system understandings, i.e. their different framings of problems and solutions and their different ideas about relevant scales, policy sectors and planning horizons. Accordingly, the planning challenge for the area can be characterized as a cluster of 'synchronization' challenges – alignments between sometimes competing delta realities (van Meerkerk et al., 2013, Edelenbos et al., 2013, Pel et al., 2013, van Buuren et al., 2013).

Considered as challenges of synchronization between diverging system understandings and alternative decompositions of the delta (Ulrich, 1983, Luhmann, 1995, Cilliers, 2005, Carpenter et al., 2009, Smith & Stirling, 2010), the present planning tasks are seen to revolve around the construction of delta realities. For example, the often advocated restoration of ecological values is inextricably linked to the questions of what the delta system comprises, what can be considered its 'natural state', and how its system state is affected by various forms of production-oriented land-uses. In other words, if planning and governance are to do justice to delta complexity, they will have to be supported by adequate Joint Fact Finding (JFF) procedures to mediate between the different interests, values and system understandings. In literature JFF is considered a procedure to generate data, information and knowledge and to integrate information sources to common assumptions and informed

opinions (Ehrmann and Stinson, 1999; Van Buuren en Edelenbos, 2004). Carefully designed interaction procedures are needed to discuss and deliberate the relevance and validity of information sources (Edelenbos et al, 2011).

In our research project on integrative planning in the Dutch Southwest delta), researchers in GIS, spatial design and public administration have sought to fulfill the role of independent mediators in JFF. Considering that JFF should facilitate both knowledge integration and generative capacity, we have turned to serious gaming. Arguably, such immersive environments are particularly well suited to engage practice-oriented stakeholders in JFF (van Bilsen et al., 2010), as serious games introduce concrete pay-offs, room for experimentation, and the need for active negotiation. Moreover, they promise to channel stakeholders' 'moves' towards outcomes. The game provides stakeholders an environment that accommodates information sharing, learning and joint reality construction. In this way the game facilitates the building of capacity to integrate knowledge for generating spatial planning and design.

On the basis of the above considerations and after consultations with its panel of stakeholders, the IPDD board arrived at a memorandum of understanding on the serious game to be played. Yet as the game organizers found soon enough however, it proved far from easy to translate this general agreement into a consistent, operative and appealing game architecture. A host of minor and major challenges came up, the general difficulty being the tensions and trade-offs between integrative JFF on the one hand, and the ambition towards generative capacity on the other. In this paper we elaborate and discuss the practical shaping of these properties and the trade-offs involved: In most instructive ways, the game architecture changed shapes between reflective (and possibly insufficiently 'generative') JFF procedure on the one hand, and expert-fed design on the other. These tensions and challenges in game design seem to reflect the more general problem of devising neutral deliberative procedures (Rozema & Pel, under review). Selecting the area to be simulated, the players to participate, the goals to work towards and the information sources to insert, the game organizers engage in meta-construction of delta realities. Issues are thus framed (Stirling, 2008), assumptions are made about the 'games real actors play' (Scharpf, 1997), and the communication between players is actively shaped rather than fully freed from values and power structures (Kelly, 1994, Tewdwr-Jones & Allmendinger, 1998). Whilst acknowledging that these challenges to communicative rationality apply to any JFF procedure or planning practice, they do raise reflective questions about the purposively immersive JFF arrangement of serious games. We therefore use the case study to answer the following research question, which we consider relevant beyond the immediate interest in game design:

How can joint fact finding in spatial planning and design be organized through a serious game in such a way that it develops integrative and generative capacity, and which challenges and trade-offs are faced in realizing this goal?

Having introduced the challenges of constructing delta realities, this paper proceeds as follows. First, we discuss some literature on Joint Fact Finding and position ourselves in this debate (**section 2**). Subsequently, we expose how the process between memorandum of understanding and final game architecture can be analyzed as an attempt to arrive at a

'boundary object'. Using insights from game design and the sociology of translation, this process is described as a negotiation between GIS experts, public administration researchers, spatial designers and the targeted players themselves **(section 3)**. Next, we briefly describe three striking clusters of challenges in this design process, pertaining to digitization, provision of research inputs, and engagement of players **(section 4)**. We conclude by assessing how the final game architecture reflects the expectations of its various 'translators', also considering how the variety of discarded prototypes could inform further articulations of delta realities **(section 5)**.

2 The serious game as a procedure of Joint Fact Finding

Joint Fact Finding is commonly understood as a process in which actors with different (organizational) backgrounds, interests and perspectives together gather and develop information to facilitate decision-making. In the view of JFF, meaningful knowledge can only be created on the basis of *a process of joint knowledge production*. In this process separate coalitions of scientists and policy-makers and other stakeholders with differing viewpoints and interests work together in order to develop data and information, analyse facts and forecasts, develop common assumptions and informed opinions, and, finally, use the information they have developed to reach decisions (Van Buuren and Edelenbos, 2004).

In its origin, it is targeted to remedy adversarial science (Ehrmann & Stinson, 1999) and to prevent or deal with 'dialogues of the deaf' (van Eeten, 1999), and to transform diatribe into constructive dialogue (Karl et al., 2007). JFF reaches towards a science-policy nexus that avoids evidence-based policy derailing into policy-based evidence. Acknowledging that knowledge claims in contested planning processes tend to be hard-fought and invested with interests and emotions, the difficult task for JFF is to provide the conditions for learning processes nevertheless (Laws & Forester, 2007, 342). As indicated by Karl et al. (2007, 25), JFF rests on three key assumptions. First, scientists are to be continuously involved in the process of issue framing, assisting stakeholders in their identification of relevant questions and ways to address the uncertainties involved. Second, scientific and technical investigations are to be organized that work towards prescriptions for planning. Third, scientific analyses should be linked to a commitment to adaptive management, as sustained responsiveness to uncertainty.

These key assumptions imply that the term JFF should not be taken too literally. Other than an epistemological exercise of mere fact-finding, it is understood better as a way of connecting epistemological problems to 'performative' problems, i.e. the challenge of learning about and co-working with others (Laws & Forester, 2007, 349) meaning that information and knowledge have to be integrated (or coordinated) to become common ground for planning and design. Even when rooted in divergent system *understandings*, these challenges ultimately pertain to stakeholders' ambitions to articulate, elaborate and implement their visions and spatial concepts. In other words, any JFF procedure would not only have to generate system understandings, but also would have to contain sufficient integrative capacity, in which developed information and understanding boils down in shared and common understanding

and information for planning and design - understood as crafts rather than sciences (Bertolini et al., 2012).

These thoughts on JFF, specifically regarding the generative and integrative capacity, are important points of departure for preparing, designing and implementing the serious game in our research project. The game architecture must lead to the development and integration of knowledge and to developing common assumptions and informed opinions for generating planning and design. In this way we view the game as boundary object. We elaborate this view in the next section.

3 Serious Game architecture as a boundary object

As briefly introduced, serious games are procedures for JFF that could serve both the ambitions towards knowledge integration and those towards generative capacity. Serious games distinguish themselves from entertainment games in that they serve a non-entertainment purpose (Michael & Chen, 2006). They allow players to experience situations that are rare, technically unrealistic, dangerous, or too costly for experimentation in vivo (Corti, 2006). Arguably, these immersive environments are particularly well suited to engage practice-oriented stakeholders in JFF: Games have a long history and are being directed at serious purposes for a long time. In ancient times, people acted out scenarios of catching wildlife to practice their hunting skills, and in medieval times chess was played as strategic preparation for periods of war. Since the 1970s, serious gaming has become one of the prime ways to enhance learning on complex organizational situations (Cookall & Arai, 1995; Duke & Geurts, 2004; Greenblat & Duke, 1981). In present times, serious games are applied in a broad spectrum of application areas; education, military, national security, healthcare, public policy, science and corporate training. Beside these applications in a diversity of disciplines, they often involve interdisciplinary crossovers.

Reviewing the evolution of gaming for policymaking, Mayer (2009) instructively exposes a genealogy of serious games and related policy-supporting practices (e.g.. system dynamics, agent-based models, cellular automata, decision support systems, geographical information systems). Early games were rooted in operational research and military simulations, typically reflecting the control-oriented cybernetics of the time. These serious games, as well as the comprehensive planning support systems, came under a cloud during the seventies however: In the face of the complexity of networked policy-making, the bounded nature of rationalities and the wickedness of many societal challenges, their seriousness became decreasingly clear to intended users. With regard to the related techniques of planning support systems (PSS), Te Brömmelstroet (2010) has observed a similar disenchantment with their aspirations to comprehensiveness, followed by their reinvention as vehicles for communicative planning. According to Mayer (2009), serious games practices can be seen to have co-evolved with the policy-science interfaces they are applied in, and typically reflect prevailing views on the complexity of public policy making (842). In line with contemporary views on this, his review concludes with the assertion that serious games crucially allow to integrate technical-physical complexity with social-political complexity (852). This specifies that especially *integrated* serious games can be considered promising for JFF.

Such integrated representation of complexity remains easier said than done however. One difficulty is that technical-physical complexity typically requires 'hard' tools (simulations, models, decision support systems) and social-political complexity rather requires 'soft' tools (participation, process management). Moreover, the latter dimension of complexity is notoriously elusive to measurement and representation (Mayer, 2009, 846). Still, notwithstanding this difficulty to represent complexity adequately, Mayer's review also brings out the particular versatility of serious games, i.e. the possibility to tailor their architecture to particular purposes (Mayer, 2009, 829). This versatility brings to the fore that the functions to be fulfilled by a serious game (e.g. JFF and knowledge integration, or its capacity to generate concrete spatial designs) are a matter of architecture and choice. In Decision Support Systems (DSS) for example, as close relatives to serious games, human interaction is limited to ex ante configurations of the model. This suits their primary purpose of generating substantive knowledge inputs for decision-making or analysis. By contrast, in the more playful serious games the process may be more important than its outcomes, in the light of ambitions towards learning, reflection and JFF for instance.

The versatility in game design is unavoidably bounded by requirements of consistency, however. In this respect Harteveld (2011) has developed a design philosophy in which he defined three equally important actor 'worlds' that any serious game should accommodate. His so-called Triadic Game Design puts forward a design space involving three equally important worlds: Reality, Meaning and Play:

- **Reality:** A game needs to be related to the domain and subject for which the game is developed. Even when abstracting from it, serious games are to maintain a relation with the real world that they ultimately affect. Reality is represented (see Mayer, 2009), for example through the system understandings of and relations between stakeholders.
- **Meaning:** A game needs to be relevant beyond the game itself. This design dimension pertains to the underlying purposes the game needs to achieve, the strategy and concrete operations towards this, and the ways in which outcomes are communicated.
- **Play:** A game needs to have elements that render it attractive to play. The seriousness of a game being constituted by the dimensions of Reality and Meaning, it is impossible to create a game without considering its appeal and seductiveness to its intended players. This involves the criteria of engagement, immersion, and fun.

Whilst emphasizing the importance of a consistent architecture, this guide to game design highlights the need to involve different 'worlds' of actors and their expectations regarding the game. As various tensions can arise within and between these worlds, designers have to make trade-offs and balances to arrive at a game architecture consistent with its purposes. In essence, this 'triadic' approach portrays game design as the development of a 'boundary object' (Star & Griesemer, 1989). These objects are needed in contexts characterized by heterogeneous actors, whose different worldviews and interests cannot easily be brought into consensus. As emphasized in the 'sociology of translation' (Callon & Law, 1982, Callon, 1986, Bijker & Law, 1992, Latour, 2005), any object (such as a serious game) possesses a certain 'interpretive flexibility', i.e. it can be interpreted and appropriated through actors'

different ‘translations’ of it. In the present case, the memorandum of understanding on the game was translated both as an integrative JFF procedure and as a generative ‘design atelier’, for example. The challenge was to arrive at an arrangement that meets the requirements of a multitude of divergent ambitions and interests, without being torn apart by its various translators. *“Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of several parties using them, yet robust enough to maintain a common identity across sites.”* (Star & Griesemer, 1989, 393).

As later specified by one of the authors that coined the concept, a boundary objects is not just a material thing, but rather is something that people act toward and *work with* (Star, 2010, 603). Boundary ‘objects’ are working arrangements or organizational infrastructures. As such they are not situated at boundaries, but are rather connection areas between various parties that cannot reach full consensus (e.g. the multidisciplinary IPDD researchers and their stakeholders). As working arrangements, boundary objects are particularly dynamic objects: Revolving around them are intricate translation processes in which various actors ‘tack back and forth’ between the boundary object as a vaguely defined shared space on the one hand (e.g. the memorandum of understanding on the serious game), and more concrete elaborations that serve their particular actor-worlds (605). In this process translators will try to standardize particular elements, they will be facing residual categories, and these in turn may incite translators to establish additional boundary objects. As a consequence of these dynamics, it is better to think of boundary objects in terms of fragile properties of working arrangements, which are subject to decline and development (615) – the construction of a game architecture is thus a challenge of arriving at, maintaining and developing further an interaction space that serves translators’ ambitions and requirements.

Figure 1 (next page) displays how the case is analyzed as a process of developing a boundary object. This involves six groups of translators, each seeking to mould the game architecture to fit with their requirements and expectations:

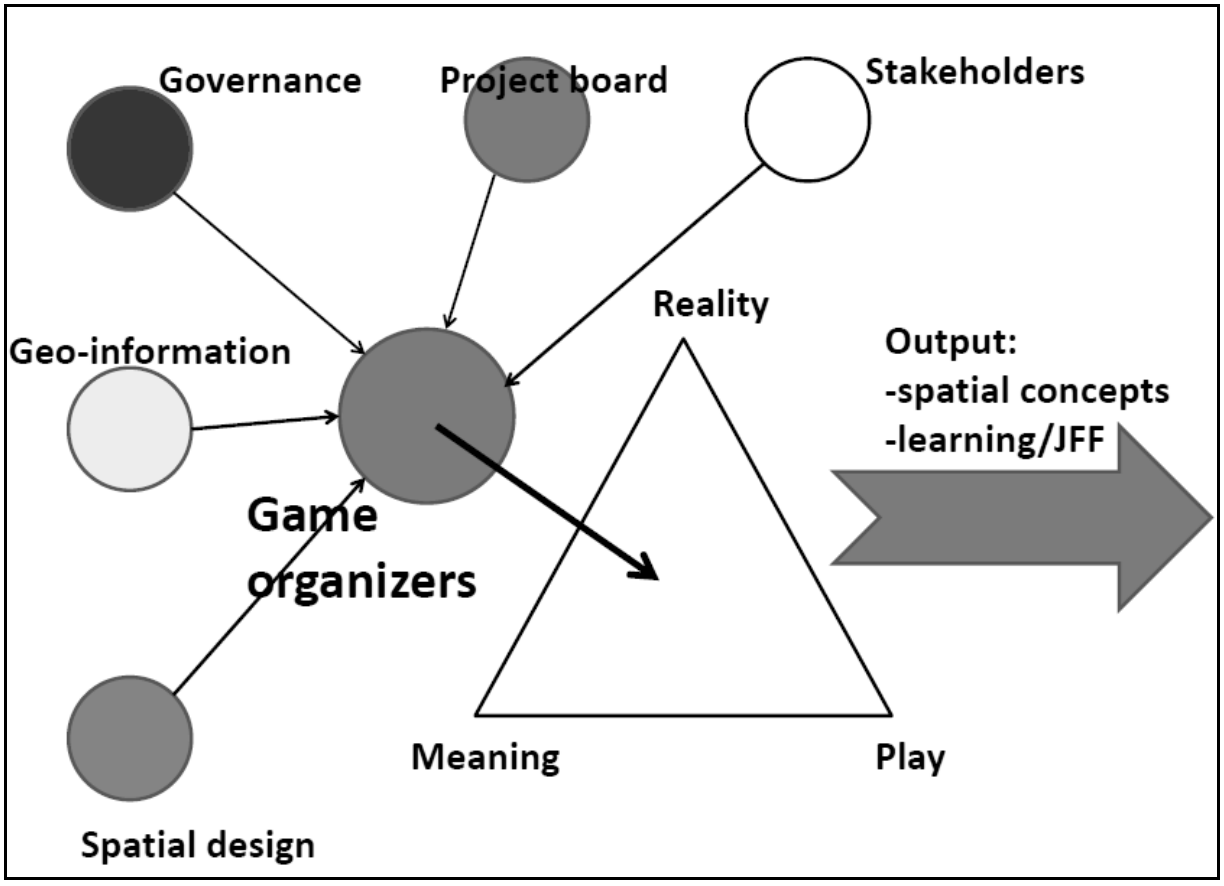
1. **Governance researchers.** For them, the game was primarily to stimulate JFF and synchronization between diverging system understandings, by simulating the delta’s complex actor constellation.
2. **Geo-information researchers and professionals.** For them, the game was primarily to test how various GIS-applications could aid JFF, and represent its spatial complexity.
3. **Spatial designers.** For them, the game was primarily useful as an advanced design atelier, and was meant to test, refine and generate spatial designs.
4. **The project board**, composed from representatives of the first three groups. The board ensured that the game would fit in with the overall goal of developing a methodic for integrative planning and design of delta areas. As prime responsible for the societal relevance of the overall project, they also maintained the contacts with the project’s panel of stakeholders
5. **The stakeholders.** For them it was important for the game to aid them in the articulation, coordination and realization of their plans for the delta.

6. **The game organizers,** recruited from the three first groups and the prime responsible for the architecture and implementation of the game. For them, the game was primarily to be consistent, operative, and appealing to the participating stakeholders. As indicated through the arrows in figure 1, the organizers found themselves as central translators amongst the five other groups of translators.

These translators will be observed to transform the game in the design space of Reality, Meaning and Play as indicated by Harteveld (2011). Achievement of the intended outputs, earlier described as integration/JFF and generative capacity, is beyond the scope of this paper. Reconstructing these translations on the basis of participant observations and project documentations, this analytical framework helps elicit the difficulty to maintain a game architecture with both integrative JFF affordance as well as generative capacity.

In order to develop, examine and evaluate the game architecture for serious game, we conducted called action research (Greenwood and Levin, 1998). We (as researchers) acted as participants in the process and as a consequence, we were partly subject of our own research as is common in action research (Elden and Levin, 1991; Greenwood and Levin, 1998).We conducted research by various methods in the project: document analysis, interviews, and participant-observation in experimentation sessions. These are common methods in applying action research (Van Schie et al, 2011).

Figure 1: Serious game design as translation process



4.0 Constructing Delta Realities

As discussed briefly in the previous section, the development of a game architecture that serves its purposes involves a series of sometimes hard choices. In this particular case the hard choices revolved around the difficulty to reconcile the reflective ambitions towards JFF and integration with the rather 'performative' (Laws & Forester, 2007) and instrumentalist ambition towards the generation of spatial designs. This central theme surfaces through the three key challenges that will structure our case analysis: *How to digitize the delta?* **(3.1)** *How to insert and present the researchers' findings to players?* **(3.2)** *How to draft (which) stakeholders for the game?* **(3.3)**. Conclusions and reflections on these issues follow in the concluding section.

4.1 Digitizing the delta

As indicated earlier by Mayer (2009), it is both important and difficult to represent the simulated area in its full complexity. This Reality dimension of game design (Harteveld, 2011) comprises both technical-physical as well as social-political complexity, and especially the latter is elusive to representation. Considering the involvement of many GIS experts, the game organizers had reasons to believe in a relatively smooth digitization of the delta, however. This would allow for a JFF procedure that would seize the ever-increasing possibilities of geographical representation, and present players with a both immersive and realistic delta.

After a hesitant take-off of interdisciplinary collaboration, the GIS partners in the project (academic GIS researchers, consultancy and software development firms) finally found themselves in the position to show their contribution to integrative JFF and the generation of spatial designs. They had various GIS databases available or under construction, had knowledge on appropriate interfaces, and were working on web-based applications to make the information easily available on mobile devices. Particularly promising devices seemed to be the so-called Maptables however: As tables equipped with digital maps, drawing tools, calculation functions and multiple thematic geographical layers, they could invite players to engage in a playful exploration of the delta's complexity. Especially the drawing tools would encourage a creative interaction, enabling players to visualize their ideas. As such, these devices could substantiate why the GIS-partners often referred to themselves with GIDS – the D pertaining to decision support.

Initial demonstrations of these tables evoked a mixture of curiosity and skepticism amongst their project partners, however. Especially the sudden breakdowns curbed the enthusiasm amongst governance researchers and spatial designers. Generally the maptable operators would explain the possible causes of the breakdowns, also indicating the technology to be in constant development. Yet their colleagues tended to be less interested in these 'technicalities', and were hardly assured about the reliability and performance of the equipment. Moreover, the game organizers and the project board were even less inclined towards technical experimentation. Acutely aware of their commitments to stakeholders, they

did not want to be embarrassed by malfunctioning technology – after all, the game was their showcase for relevant, innovative and professionally undertaken delta research.

Once most of the hitches in the maptables had been resolved and their operators had learned about project partners' desires and requirements, the game organizers could move from these operational issues to the more strategic ones. Granting the maptables the benefit of the doubt, the question became rather how they could be made instrumental to game objectives. In this regard the spatial designers remained skeptical however: An early try-out had brought out fairly unambiguously that these so-called 'design tables' were hardly conducive to actual design: The pointing devices were insufficiently flexible compared to their usual practice of sketching on paper maps and overlays, and the drawing tools required a complicated navigation of menus. If interactive design and creativity would only be slowed down, they held, it would not be advisable to stick to the machines. By contrast, the governance researchers were professionally less attached to the feel of sketching and designing, and more appreciative of the devices' stimulation of interactive exploration. Being concerned more with the game's function for reflective JFF and knowledge integration than with its generative capacity, they rather had second thoughts about the devices' presentation of information: The systems thinking adopted in the project they found rather poorly reflected in the device's land-use categories, and the calculation functions on suitable land-use and costs appeared as uncanny black boxes that could easily achieve the inverse of JFF. These latter objections were not considered overriding by game organizers and project board however. To them it was primarily important to offer game participants some evidence base and quantification, so as to secure sound and reality-checked spatial design.

These rather strategic issues arising from sometimes deeply-felt professional convictions and modus operandi, it proved not possible to arrive at full consensus. Yet as the partners learned about the technological options available and the possibilities in customization, the organizers managed to develop a better fit between the game's objectives and its instrumentation. Considerable work was done to harmonize datasets with the systems model applied in the project, the risk of overloading the maptables was deflected by outsourcing parts to the web-based 'i-Maps' application, and attempts were made to render the calculation functions suitable for the monitoring and feedback desired. Moreover, by thinking through the overall sequence of game rounds, the organizers could fine-tune a division of labour between high-tech digitization and low-tech design of the delta. For this latter point it is of high symbolic significance that the Maptables were no longer referred to as malfunctioning 'design tables', but rather as providers of additional functions.

This division of labour also indicates that the GIS-applications were not just squeezed to fit with the game objectives. Once overcoming cold feet regarding their usefulness, project partners started exploring more actively how to seize the technological potentials. The navigation functions of zooming and various bird's eye displays became appreciated as ways to engage stakeholders, the game sequence was informed by the division of labour between high-tech and low-tech techniques, and the decision on the appropriate number of players was partly informed by the possibilities of gathering around the tables. The tables rather fulfilling functions as facilitators of visioning and design, JFF was scheduled as a preparatory first

game round. In the process of digitizing the delta, the scope for JFF was thus partly determined by the instruments available.

3.2 Feeding delta construction

Other than is usual for game exercises and JFF, the decision to organize this game did not follow from a client's assignment, but primarily from the ambition of the IPDD researchers to make their findings available and practically relevant to stakeholders – the panel of SWD stakeholders in particular. The rather reflexive ambition towards JFF was thus accompanied by the wish to 'valorize' scientific findings – the researchers were to provide both questions and answers. This double objective in the memorandum of understanding proved not easy to materialize in a consistent game architecture however; the different disciplinary backgrounds of the involved researchers (translator groups 1-3 in figure 1) led to diverging emphases on either JFF or knowledge dissemination.

For the governance researchers the game constituted primarily a simulation space for the delta's complex actor constellation, and for the ensuing challenges of 'synchronizing' between diverse system understandings. Its outcomes of spatial designs and visions would primarily have to emerge from JFF and subsequent elaborations, without being 'contaminated' by the system understandings of the researchers themselves. Moreover, the very process towards those outcomes they appreciated as systemic learning – to be valued no less than the generated spatial designs themselves. By contrast, the spatial designers were skeptical about the possibility of emergent spatial designs. To them this would be a risky bet, considering many stakeholders' difficulties in articulating their visions and in creatively synthesizing ambitions. They had frequently noticed the stakeholders' difficulty of thinking counterfactually – away from the necessities of the present and towards the potentialities of the future. Moreover, they also reminded that several elaborate spatial designs had already been developed, which rather required testing and elaboration than questioning and invention. To them here was no need to go back to square one, which would also crucially disregard the desires towards concrete results on the side of the stakeholder panel.

This basic tension between ambitions towards integrative capacity on the one hand and generative capacity on the other was resolved mainly in favour of the latter. The consultations with stakeholders were one ground for this, another was that the researchers had been working hard to arrive at practically relevant knowledge. The question therefore became how to deploy these quite ready-available game 'modules'. Available or in development were a systems-historical analysis of the delta, an analysis of its actor constellations, an analysis of its possible futures, and an analysis of envisioned or planned interventions in the delta's respective subsystems. Especially the insertion of the latter was passionately pleaded for by the spatial designers, as a way of feeding a sufficiently imaginative and founded delta construction. Even when their worries about insufficient expert feeding were not generally felt as strongly, most project partners appreciated that these dissections of extant plans were ideal inputs to the process: As these 'intervention sets' consisted of series of thematic maps, they could easily be transmitted through the GIS applications (provided that difficulties in geo-referencing could be resolved). Furthermore, the maps were categorized through the systems

model of the project, which would also ensure that the game would be fed with systems thinking. These 'intervention sets' became a cornerstone of the game architecture. Considerable efforts were made to ensure that they could be used in both high-tech and low-tech applications, and the game organizers arrived at the procedure to have players select upon the sets through stickers. This selection procedure met doubts on the side of the governance researchers: The interventions were presented as building blocks to choose from, rather than as prefabricated solutions.

Regarding the other possible research inputs it was hard to decide how to insert them. The future scanning was widely considered essential for the simulation of delta complexity and uncertainty, but in try-out sessions they could not be seen to have a great impact on what mainly developed as design exercises. Still the project board emphasized their importance as reality checks, for which it would be desirable to quantify the consequences of future scenarios. Also the results from the actor analysis proved hard to insert: As qualitative data they were relatively difficult to present concisely and in geographical formats, and the governance researchers themselves were reluctant towards over-feeding and directing the players. Eventually their input consisted mainly in the selection and formulation of role descriptions of players, so as to ensure a representation of social-political complexities and interdependencies.

Apart from these in-built information sources, the researchers also sought to feed delta construction more indirectly, through evaluative feedback and through intermezzo's for presentations by researchers. As regards the first, there were quantitative feedbacks on integration (the inclusion of multiple delta subsystems), and on the appropriateness of envisioned land-uses in the light of local conditions. Furthermore there were rather qualitative feedback procedures on governance feasibility and on robustness against future scenarios. The added value of these feedback systems was difficult to assess during try-out sessions, as the participating researchers tended to have internalized them already. As regards the second, doubts remained on the appropriate role of the research presentations. Presentations differed in their substance- or method- orientations, were sometimes found too academic to engage stakeholders, and more generally the question was whether they should disclose information or rather serve as 'appetizers' for animated play. Eventually the game organizers opted for the latter, also considering the importance of guiding the players through a game with a clear storyline.

3.3 Involving delta actors

As mentioned earlier, the 'Reality' dimension of a game requires also a representation of the social-political complexity of the situation simulated. In this case this dimension of complexity had actually been mapped in an analysis of the delta's actor constellation (van Buuren et al, 2013), which could be used as a basis for drafting 'players'. Reasoning from the 'Play' dimension however, it was also crucial for the game organizers to live up to their commitments to the stakeholder panel – their endorsement was a prerequisite for the game to be played at all. The balancing of 'Reality' and 'Play' was one of the challenges in engaging the delta actors – who hadn't really asked for such exercise, to begin with.

Even when the stakeholder panel was not the actual commissioner of the game, this group of game translators had an important role in its shaping. The memorandum of understanding that gave the game organizers the 'go' sign came about only after intensive consultations with stakeholders. One factor to confront by the project board was a looming 'game-fatigue' amongst stakeholders – in recent years they had witnessed a miscellany of initiatives towards serious gaming and similar participative procedures, all asking for participants to have them played. Further considering the general intensiveness of professional life, the stakeholder group wanted convincing evidence that the game would be worthwhile playing. The project board were therefore most cautious about launching the initiative, the failure of which would be costly both in financial and in reputation terms.

Understanding the game to be in search of motivated and somehow representative players, both project board and game organizers tended to represent the views of the stakeholder group in the game design process – a view that easily could be forgotten in the professional skirmishes between the researcher groups. This approach had a pervasive influence on the game, as relevance and attractiveness to players became a prominent consideration in any game-architectural choice. It reinforced the bet on cartographical representations, for example, as condensed and accessible pieces of information. The engagement of players being organized indirectly, i.e. without direct involvement of them in the architectural choices, it proved to raise unexpected challenges however. First, it entailed parallel procedures for the selection of players. Researchers doing actor analysis sought to inform the game on the delta's complex actor constellation and the crucial tensions and challenges therein, and eventually established a list of actor types to be represented. They also had to consider that the Maptable devices could host only a limited number of players. Yet whilst the researchers prepared the drafting of players through these rather content-driven considerations, the ongoing stakeholder consultations constituted the actual selection procedure that somewhat ran ahead of this. As both selection procedures shared the ambition for a diversely composed group of players, their mutual disturbance was limited. Confusion remained on the function of the role descriptions, however – were players to act as themselves, as representatives of their organization, or as representatives of the delta subsystems distinguished by the researchers? The consecutive versions of the game manuals displaying efforts to specify this matter, the actual role-play was difficult to assess, however: Try-outs with the researchers and even with employees from an affiliated research agency could hardly predict the behaviours of the eventual exercise with stakeholders.

Finally, the particular approach to involving the delta actors also raised a second unexpected challenge. As the stakeholder panel arrangement entailed a certain pre-selection of players, the game organization became crucially dependent on their willingness-to-play. For some stakeholders the latter suddenly declined drastically however, as their mutual relations turned sour. Having become wound up in an adversarial 'negotiation situation', these actors were hardly ready for informal game interactions. This unfortunate (and transient) circumstance confronted the organizers with a question somewhat beyond the game architecture itself: However well-crafted, maybe it was not the right time for the game to be held?

5 Conclusion and discussion of findings

The above account of the development of a serious game on envisioning and spatial design of a delta area substantiates why a game architecture can be considered as a 'boundary object' (Star & Griesemer, 1989, Star, 2010). For such knowledge infrastructure to become consistent as well as relevant to diverse users, a host of choices and trade-offs have to be made – whilst in this case, the possibilities of in vivo testing were limited. The case shows why boundary objects should not be mistaken for static 'consensus machines', but are appreciated better as ever-tense arrangements that manage to connect diverse 'translators' despite sometimes incommensurable world views (Star, 2010). The described professional tensions between researchers in governance, spatial design and GI(D)S can be considered exemplary for the latter point: Even when eventually converging onto a game architecture held sufficiently operative and consistent, these translator groups maintained their initial expectations of the game: It was simultaneously a physical formation to shape, a complex system to represent and display, and an actor constellation to simulate and engage.

As stated in the introduction, the pivotal tension in this particular boundary object revolved around the dual ambition towards reflective and integrative JFF on the one hand, and the rather 'generative' ambition towards 'performative' (Laws & Forester, 2007) spatial design on the other. Guided by the Meaning, Reality and Play dimensions to game design as distinguished by Harteveld (2011), it can be established what balance has been arrived at eventually, and what challenges can arise from the dual ambition. As regards the first, it can be observed that the Reality and Meaning requirements proved difficult to separate: To some researchers a realistic representation of the delta would foreground its diverse actor constellation, to others such would rather ask for a firm evidence base on its physical processes, land-uses and development patterns for the game to have meaning beyond itself. This intertwinement of design dimensions seems to follow directly from the emphasis on either integrative JFF or generative design – the latter featuring more prominently in the eventual architecture. Furthermore, the Play dimension can be observed to have been shaped predominantly by a subset of involved translators; the triangle of project board, stakeholder panel and game organizers.

Overall it proved to be difficult to set a 'neutral' architecture facilitating both integrative and reflective JFF and the rather 'generative' deployment of this input for developing appealing designs. The game architecture exhibits implicit substantive choices (deliberate dissemination of research findings, insertion of certain expert opinions on spatial design), which can frustrate a process of joint fact finding. The construction of delta realities is taken in directions somewhat beyond the control of the players. Moreover, it is striking how difficult it can be to move from the 'epistemological' dimension of JFF to its 'performative' dimension (Laws & Forester, 2007). The devil is in the details: The specific bet on serious gaming as an immersive and information-feeding arrangement introduced choices and dilemmas that were relatively new to the initiators. Reinforcing the facilitation of reality construction through combinations between low-tech and high-tech tools, the game translators were continuously engaged in meta-reality construction: How to represent the delta in order to make it subject to play in a multi-actor setting in which actors from different (organizational) backgrounds were

participating? In an attempt to summarize the challenges of combining integrative JFF and generative capacity, the following three merit attention:

1. **'Manning the equipment or equipping the warrior?'** This question by te Brömmelstroet (2010) points to a key challenge the game organizers faced. Were the so promising GIS devices to determine the game architecture through their functionalities, or should these functionalities only be used to fulfill predefined goals and requirements on the side of players? The warning against technology-pushed JFF is clear here. Yet the case also demonstrates that exclusive attention to 'equipping the warrior' may well be more time–consuming and laborious than a process of mutual adjustment between technological affordance and strategic objectives. The history of the deployment and adaptation of the 'maptables' exemplifies how becoming acquainted with technological affordances can also guide towards more strategic choices. Intensive discussions on the failing 'design tables' also led translators to reconsider what these devices *could* do well, which in turn led to reconsiderations of the overall game set-up. The many experimentation sessions with the available tools had unexpected pay-offs for overall consistency.
2. **Immersion or ideology?** As indicated by Mayer (2009, 840-842), the use of gaming technologies for serious purposes has the great advantage of creating immersive environments. This very persuasiveness to players is obviously important for the engagement of stakeholders in JFF. Yet as the other side of the coin he indicates the risk of creating overly persuasive and possibly ideological environments, . Indeed, the tensions surrounding 'delta digitization' and 'feeding delta construction' testify how GIS instruments can easily turn into suggestive black boxes rather than mere facilitators. From the perspective of 'epistemological' JFF (Laws & Forester, 2007) such immersive knowledge mediation should meet with suspicions. On the other hand, the often closely related ambition towards 'performative' JFF (and in this case the capacity to generate elaborate spatial plans) tends to require evidence bases to build on, and devices to play with. In this case the latter consideration prevailed, and the risk of blackboxing was counteracted mostly by instructing the game hosts to stimulate reflection amongst players.
3. **Simulating complexity or establishing simplicity?** As exposed by van Bilsen et al. (2010), games can be powerful ways to convey the complexity of decision situations. The emergent properties of complex systems can be built in with the game architecture, through the insertion of feedback mechanisms for example, and complexity can then be experienced rather than learned from theory. On the other hand, Mayer (2009, 848) points out that complexity tends to be hard to convey to policymakers, who are often socialized into linear modes of thinking. In this case the game organizers had all the more reason not to confuse the players with the complexity thinking adopted by the researchers themselves – their drafting for the game was both precarious and essential. In this regard it could be considered how a more direct involvement of stakeholders in game construction could have helped to strike a balance in this dilemma.

Having shown the practical challenges of meta-constructing (problematic) delta realities, this case can also be considered as an example of contemporary visioning in interdisciplinary and transdisciplinary contexts. The architectural choices reflect the existing diversity of basic assumptions about the delta area simulated. As such, this variety of delta realities is also telling for the complexity of these areas: They are not only intersections of marine and fluvial dynamics, but also of multiple reality constructions.

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