van Leeuwen, J.P., Hermans, K., Quanjer, A.J., Jylhä, A., Nijman, H. 2018. "Using Virtual Reality to Increase Civic Participation in Designing Public Spaces." In: *Proceedings of the European Conference on Digital Government*, Santiago de Compostela, Spain, Oct. 2018.

Using Virtual Reality to Increase Civic Participation in Designing Public Spaces

Jos P. van Leeuwen[1], Klaske Hermans[2], Arnold Jan Quanjer[1], Antti Jylhä[1], and Hanke Nijman[2,3]
[1]The Hague University of Applied Sciences, The Hague, The Netherlands
[2]Municipality of The Hague, The Netherlands
[3]Twynstra & Gudde, Utrecht, The Netherlands
j.p.vleeuwen@hhs.nl
klaske.hermans@denhaag.nl
a.j.r.b.quanjer@hhs.nl
a.t.jylha@hhs.nl
hni@tg.nl

Abstract: Municipalities increasingly seek to include citizens in decision-making processes regarding local issues, such as urban planning. This paper presents a case study on using Virtual Reality (VR) in a process of civic participation in the redesign of a public park. The municipality included citizens in intensive co-design activities to create three designs for the park and engaged the neighbourhood community in co-decision, in the form of a ballot. Through the civic participatory process, we studied the effectiveness of using VR technology to engage the community in participating in the co-decision process. The three designs were presented using highly realistic 360˚ visualisations and the effects on engagement were compared between various devices: VR headsets, smartphones, tablets, and computers. Viewing the designs in 2D paper plans was also included in the comparison. The study included over 1300 respondents that participated in the ballot. A statistical analysis of the collected data shows that participants viewing the 360˚ rendered images with VR technology expressed a significantly higher engagement in the co-decision process than those using their computer at home or viewing 2D paper plans. The paper describes the complete participatory design process and the impact of the e-governance used on the target group as well as on the actors organizing the e-governance process. We discuss how the use of new technology and active presence of a voting-support team inspired citizens to participate in the co-creation process and how the investment in this procedure helped the local authorities to generate support for the plans and strengthen its relationship with the community. The use of realistic visualisations that can be easily assessed by citizens through user-friendly technology, enabled a large and diverse audience to participate. This resulted in greater visibility of municipal efforts to enhance the living environment of citizens and is therefore an important step in increased civic engagement in municipal policy-making and implementation.

Keywords: Participatory design, civic technology, virtual reality, co-creation.

1. Introduction

In a participatory society, authorities share responsibilities with citizens and civil communities in many domains, such as health care, safety, social security, and in the organisation and layout of public spaces. This paper studies an activity to revamp a neighbourhood park in one of the districts of The Hague. The director of the district responded to the persistent flow of complaints from residents regarding the park and a lack of communal sense. With the intention of improving the infrastructure for public participation (Björgvinsson et al. 2010; le Dantec & DiSalvo 2013; Karasti 2014) in the neighbourhood, a process was devised that provided expert support for citizen-workgroups in co-design sessions and involved the entire neighbourhood in a public ballot, using Virtual Reality. Residents were invited to partake in a workgroup to co-design three variants for the park, that were then subject to voting by all inhabitants of the neighbourhood. Virtual Reality technology was used to present the three designs to the public, during the voting period of three weeks. Reaching out in a six-month participation process involving several forms of e-governance requires a lot of organizational activity. To accomplish this, a broad range of actors were involved by the district authority; several civil servants with different roles. For them, organizing such a broad participation process was relatively new. In conjunction with this project of civic participation, research was conducted with three research questions:

1. Does using VR technology affect the residents' engagement with the decision-making process regarding the park?
2. Do users of VR technology have a cognitive benefit, compared to users that viewed the visualisations of the park using other means?

3. What is the impact of organizing this digital participation process on the organizing actors in the local government?

2. Related work

In the past few decades, the way the government relates to the citizens in terms of accountability has evolved considerably, from mere political legitimacy of the decisions accounted for by the elected representatives in classical Public Administration, towards output-focused accountability (New Public Management, NPM). More actors entered the governance arena, and around the turn of the century Network Governance (NG) had matured, whereby horizontal accountability of the process towards the partners prevailed. Currently, a model of governance evolves in which Societal Resilience is essential in defining the actions and accountability of government towards the citizens (Van der Steen et al. 2014). This means that the government has to account for its output and procedures to outspoken citizens as to organize itself differently and let the outcome be defined by the public. Van der Steen et al. (2015) observe that these governance models co-exist and complement each other, depending on the contingency of the task involved.

According to interpretative hermeneutics, practices can be considered part of discourses. A discourse is a coherent assembly of interrelated and interdependent outings in speech and practical behaviour (Hajer 2002). The above-mentioned governance models can be seen as separate discourses. In our case, discourse analysis complements our analysis of the impact of e-governance with an interpretation of the impact of *organizing* e-governance.

In this study, e-governance was a practice used to facilitate a civic participation process, as part of a discourse of societally resilient governance. Creighton (2015) defines participation as "the process by which public concerns, needs, and values are incorporated into governmental and corporate decision-making". Arnstein (1969), already in the 1960's, introduced the concept of a citizen participation ladder. This ladder defines eight progressive ways to involve citizens in governance. From the bottom up, the rungs in the ladder are: manipulation, therapy, informing, consultation, placation, partnership, delegated power, and citizen control. This way, the process of participation, rather than the output, is the incentive of accountability. Arnstein (1969) mentioned that participation may result in stronger commitment to related changes.

Visual communication is considered an effective means of communication in participatory design processes. Data visualisations can break down barriers in public engagement and help collectively make and communicate decisions (Williams 2016). The use of 3D visualisations in urban design processes has long targeted professionals, such as architects, urban planners, and landscape designers (de Vries et al. 2001; van Leeuwen & Timmermans 2006). The past decade has seen an increased use of VR for public participation in urban planning processes (Al-Kodmany 1999; Al-Kodmany 2001; Wissen Hayek 2011; Howard & Gaborit 2007).

The availability of VR technology on modern smartphones has taken VR out of the lab and made it available for large-scale participatory design. The quality of the current technology allows the public to have a sufficiently realistic experience (Maffei et al. 2016; Kuliga et al. 2015) of design proposals. Recent research (Gill & Lange 2015) shows that visualisations help to communicate urban designs and improve citizens' ability to understand and respond to planning issues. Our work will further contribute to using VR in civic participation processes.

3. The participation process

The neighbourhood manager of Mariahoeve, The Hague, working for the City Council, initiated a participatory design process for the revamp of a park, inviting residents to work with her and the city's landscape architect: a middle-out approach (Fredericks et al. 2016) that aimed to meet both the high standards of the city's urban planners and the residents' needs and wishes for the park. The participation process included four stages in which residents could participate, each accounting for different levels of the city's participation ladder (Gemeenteraad Den Haag 2012) inspired by Arnstein's (1969) ladder:

- Call for participation – *consultation*
  All neighbourhood residents were invited to give suggestions for the park and to partake in a co-design workgroup.
- Co-creation workgroup – *co-production*
  The workgroup collaborated in multiple co-design sessions with experts from the municipality. A 3D-modelling environment was used (Figure 1 and Figure 2).

- Public ballot – *co-decision*
  The three variant designs were submitted to a VR-supported ballot by all neighbourhood residents.
- Final design – *co-production*
  The city’s landscape architect and the workgroup co-produced the final detailed design, based on the winning variant.

Figure 1: One of the three teams discussing their design using 2D plans

Figure 2: A co-design team in action with the landscape architect (left) and the 3D modelling expert (right, sitting at the computer)

3.1 Participatory design process

Responding to the municipality's call for participation, 60 residents attended an informative meeting about the participation process and submitted over 84 written suggestions. A workgroup of 25 residents was formed that, for six months, collaborated with municipal experts to generate designs for the park. The workgroup analysed the public's suggestions, prioritised ideas, studied constraints, and then formed three teams to create three concepts for the park. The three concepts were elaborated by a municipal landscape architect to generate detailed designs that were discussed with each team (Figure 1) and improved using a digital 3D modelling system, Sketchup, that was operated by an expert (Figure 2). This enabled the three teams to comment on and modify the initial designs and instantly visualize their new ideas in the 3D modelling environment.

3.2 Voting procedure

The three designs were visualised in photo-realistic 3D environments, rendered as 360° images from three positions in the park that could be navigated in the style of Google's Street View. The designs were presented to the neighbourhood community and could be viewed in a browser-based application on desktop and mobile devices (Figure 3) and by means of a VR headset offering a stereoscopic, immersive experience. The designs were also presented in 2D plans on paper.

Figure 3: Visualisation of the designs on a computer screen

The circa 13,500 residents of the neighbourhood were invited to view the three variants either by themselves, through their own digital devices such as their laptop, tablet or smartphone, or by using a VR headset or paper plans that were brought into the neighbourhood by a voting-support team. During the ballot period of three weeks, the team was present in thirty sessions of 3-4 hours, at over twenty locations in the neighbourhood, with two VR headsets and paper plans in 2D for residents to use (Figure 4). The team assisted in the voting sessions, by offering residents a choice to view the variants using 2D paper plans or using the VR headset. The team was instructed to guide the viewing of the three variants, by operating the navigation of the VR headset, and by answering questions that residents might have.

After viewing the variants, by themselves or assisted by the team, the residents could vote for their preferred proposal. Voting took place through an online form on the district's official website, where voters could first view the three variants – using their preferred device – and then cast their vote. The voting-support team also carried tablets to allow residents to vote immediately after viewing the designs via the VR headsets or on paper (see Table 1).

Figure 4: Residents using the VR headset (left) and paper plans (right), with the voting-support team

Table 1: Five ways to view the designs and number of votes cast during the ballot period

	Device	N
Unassisted voting	Computer	241
	Table/iPad	71
	Smart-phone	217
Voting assisted by team	Paper only	252
	VR headset	521
	All devices	**1302**

4. Methodology

4.1 Questionnaire during the ballot

The voting procedure offered the opportunity to do quantitative research among all voting citizens, to evaluate the effectiveness of VR technology for this form of civic participation. The online voting form was extended with a short questionnaire that was completed by all voters. Four questions were included that respondents scored on a scale from 0 to 10:

- How certain are you of your choice?
- Could you see the differences between the variants of the park?
- How important is the park for you?
- Will you ask others to vote as well?

The final question, about the voters' willingness to ask others to vote as well, is used to determine the citizens' engagement.

To assess the residents' engagement with the voting process a metric was used that is often applied in marketing research, called the Net Promoter Score (NPS) (Reichheld 2003). To this end, the questionnaire included the question: "Will you ask others to vote as well?" The answer was noted on a scale of 0 to 10. To calculate the NPS, those scoring 9 or higher are considered promoters, whereas those scoring 6 or lower are considered

detractors. The remaining group is considered to have a neutral opinion. The NPS is calculated as the percentage of promoters minus the percentage of detractors:

$$NPS = \frac{(promoters - detractors)}{N}$$

Research indicates that the performance of the NPS is generally as good as that of other customer feedback metrics, such as customer satisfaction metrics and the customer effort score (de Haan et al. 2014; van Doorn et al. 2013).

4.2 Analysis of the organizer's experience

From government perspective, organizing e-governance is a relatively new way to facilitate participation processes. To study the experience and impact of the organizing process, discourse analysis was used (Hajer 2002). Discourses reflecting on the organizing process may add to the plain insights given by the organizers. A governance discourse which focuses on the legitimacy of decisions is part of the Public Administration discourse, whereas steering on results of (semi-)privatized former government services like railways match the discourse of New Public Management. In addition, the Network Governance discourse emphasizes the (transparent) process of cooperation with diverse actors, amongst which government is seen as one stakeholder. In the Societal Resilience discourse, terms and practices include civic participation – bottom-up initiatives in which civil servants play a facilitating role.

Eight organizing actors were approached to share their qualitative reflections in hindsight. The respondents were selected on the basis of the organizing role they played in the participation process. The roles included chairing the citizen's workgroup (an independent inhabitant), a citizen who facilitated meetings, and the following civil servants: the park manager, two programme managers, the district director, the online communications expert, and the expert for communicating on the process with the neighbourhood residents. In an open questionnaire, they were asked to respond to the following questions:

1) How did you experience this participation process?
2) What was the impact of this process according to you?
3) What did this process imply for your role?

The answers to these questions were analysed and compared to the governance discourses. In addition, observations of the behaviour of these respondents were tracked by one of the authors, who was a participating observer, and then discussed with the other authors.

5. Analysis of results

5.1 Citizen engagement

At the end of the ballot, 1302 valid votes and completed forms were submitted by the residents. The ballot period comprised three weeks but, as was to be expected, the final week showed a reduced participation, particularly in unassisted voting. Therefore, the comparative study discriminated a sample of votes from the first 17 days of the ballot period, from those cast during the final week (see Table 2).

The first objective in this study was to assess the residents' engagement with the voting process. To this end, the Net Promoter Score (NPS) (Reichheld 2003) was used.

The ballot's first two weeks showed an NPS of -22.6 (see Table 2). This matches annual research that reports an average NPS for Dutch municipalities of -23 (Kloosterboer 2014; Piksen & Kruize 2016). Municipalities in The Netherlands have a rather high score, compared to other branches, such as banks (-27) and insurance companies (-38). It should be noted that the NPS in The Netherlands is generally negative (average -30) and cannot be compared to scores in, e.g., the US (van Doorn et al. 2013).

Table 2: Number of votes cast per device and corresponding Net Promoter Scores (NPS)

		First 17 days		Final week		Entire ballot period	
	Device	**N**	**NPS**	**N**	**NPS**	**N**	**NPS**
Unassisted voting	Computer	202	-27.7	39	-30.8	241	-28.2
	Table/iPad	60	-23.3	11	-27.3	71	-23.9
	Smartphone	187	-9.1	30	-23.3	217	-11.1
Voting assisted by team	Paper only	148	-41.2	104	-63.5	252	-50.4
	VR headset	339	-18.9	182	-23.1	521	-20.4
	All devices	**936**	**-22.6**	**366**	**-35.5**	**1302**	**-26.3**

The NPS for residents using Paper only is considerably lower than the NPS for other devices, in particular the Smartphone and the VR headset. As expected, most involved citizens voted early in the process. During the final week, the NPS dropped for all devices, but particularly for voters using Paper only.

A statistical analysis, using an independent samples t-test, confirms the above findings. *During the first 17 days*, voters using Paper only were significantly less willing to ask others to vote as well, compared to users of Smartphones (mean difference: -1.61, BCa 95% CI [-2.55, -.67], p = .000) and users of the VR headset (mean difference: -.99, BCa 95% CI [-1.84, -.15], p = .012). Voters using their own Computer were significantly less willing to recommend than Smartphone users (mean difference: -.992, BCa 95% CI [-1.86, -.12], p = .016).

In the final week of the ballot, the difference between Paper only and VR headset, regarding the willingness to recommend, is even more evident (mean difference: -2.37, BCa 95% CI [-3.54, -1.21], p = .000). This could not be correlated to the self-reported importance of the park for the voters, nor to the period of voting (the first two weeks versus the final week of the ballot).

Residents using their own devices mostly voted during the first two weeks of the ballot: only 18% in this category voted during the final week. The voting-support team, however, was equally successful in the final week in engaging residents in the voting process, recruiting 37% of these voters in that final week.

5.2 Effectiveness of VR technology

The second objective was to assess the effectiveness of the VR technology, compared to other means, in giving residents insight in the decision to be taken. The questionnaire that was added to the ballot included questions that would give insight in voters' confidence about their vote and their confidence about having been able to see the differences between the three variants for the park's design.

Between the votes cast in the ballot (design variant A, B, or C), there are no differences in the voters' confidence about their vote, nor in their confidence about perceiving the differences between the designs. Between the devices used in the ballot, there are no significant differences in voters' confidence about their vote, but users of the VR headset scored significantly higher when asked if they had noticed the differences between the designs, compared to the other digital devices, especially the Computer and the Smartphone. Voters looking at Paper only also felt significantly more confident than voters using the Smartphone, about their ability to see the differences. Rather surprising is the insignificance of the difference between VR headset and Paper only (see Table 3). The assumption that the richness of the VR experience would help voters to develop a better insight in the variants is not supported in the analysis. This suggests that these differences may not relate to the devices used but to the circumstances of using the device: paper and VR headset were used with the voting-assistance team; the other devices were used in unassisted voting. The presence of the team may play a role in the voters' self-reported confidence.

Table 3: Mean differences for the variable 'Differences perceived' in the ballot

(I) Device	(J) Device	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
Paper only	Computer	.568	.251	.157	-.12	1.25
	Tablet/iPad	.764	.354	.198	-.21	1.73
	Smartphone	1.342*	.255	.000	.65	2.04
	VR headset	-.200	.228	.905	-.82	.42
VR headset	Paper only	.200	.228	.905	-.42	.82
	Computer	.768*	.206	.002	.21	1.33
	Tablet/iPad	.964*	.324	.025	.08	1.85
	Smartphone	1.543*	.211	.000	.97	2.12

*. The mean difference is significant at the 0.05 level.

5.3 Impact of the process on the organizing actors

Accountability was twisted around 180 degrees, when looked at from a Public Administration discourse. To meet the desires of the public, the design process was shaped in a direct participatory way, whereby inhabitants delivered input in multiple stages of the process. This way of responding to Societal Resilience contrasted the traditional top-down design process, in which budget would be indicated in advance and which would value expert knowledge above public knowledge. Transparency of the procedures towards the public was valued higher than normally.

As a result, the organizers encountered several hiccups that in hindsight can be explained by differing values on accountability. First, budget allocation to realize the final design is still ongoing. Administrators were not used to listening to the relatively limitless desires of the public; they usually allocate budget within which desires can take limited shape.

Second, transparency in all procedures leads to a constant public desire for updates and having a voice in all decisions, in contrast to top-down Public Administrative discourse. As the district director mentioned, in the Societal Resilience governance discourse boundaries of participation become blurred. It becomes a challenge to balance between internal and external interests, meeting all modes of governance and corresponding discourses.

Third, expertise is valued differently in different discourses. In the case study, experts such as the landscape architect and the online communications specialist had a guiding role rather than their usual content-driven role. Adaptability to this seems personal and involves giving personal account to one's specialist profession.

These three examples show the different modes of accountability demanded by different modes of governance. The internalization of the discourse used influences how easy or difficult the adaptation towards the organizing process of this case was for the actors. Actors fully incorporating the Societal Resilience discourse were comfortable during the whole process. Incidental hiccups appeared with and between actors, who partly practiced traditional top-down Public Administration discourse during the bottom-up participation process.

6. Conclusions

From this study, three conclusions can be drawn: (1) Users of the VR technology with the VR headsets showed significantly higher engagement than those viewing 2D plans on paper or viewing the 360˚ images on a computer screen; (2) sending the voting-support team into the neighbourhood, with the VR headsets, has attracted a large number of residents that otherwise would not have been reached; and (3) digital participation is complex to organise, stimulates a reciprocal decision-making process that potentially facilitates a deliberative democracy, and is less valued by organizing actors with a top-down governance approach.

Whether due to the use of VR technology, the 360˚ imagery, or the presence of the voting-support team, the municipality succeeded with their approach to involve citizens in the participatory design and voting process. The municipality's effort to set up the voting process and to hire experts to work with residents on creating the 3D models has resulted in the involvement of nearly 10% of the population in the decision-making process – much more than expected, in the experience of the municipal representatives, with traditional means, sending

letters and inviting people to look at 2D drawings of proposals. The use of realistic visualisations that can be easily assessed by citizens, presented through user-friendly technology, enabled a large and diverse audience to participate. This resulted in greater visibility of municipal efforts to enhance the living environment of citizens and is therefore an important step in increased civic engagement in municipal policy-making and implementation.

Sending the voting-assistance team into the neighbourhood, with the VR headsets, has attracted a large number of residents also during the final week of voting, when very few residents still took the initiative to vote by themselves. Observations and experiences of the voting-support team indicate that the sessions with the VR headsets took much longer than those with the paper maps. This may be indicative of a correlation between residents' engagement and the type of interaction voters had with both the medium and the support team. The extra human attention given by the team, a natural part of instructing participants, possibly leads to more engagement. Many voters mentioned the opportunity to try out the VR device to view plans for their own neighbourhood as a reason for their participation – a motivation that the support team quickly picked up to convince passers-by to partake. We hypothesise that investing in novel technology can help attract citizens to participatory design projects.

The use of 3D modelling during the co-design sessions also had a positive impact on the workgroup's engagement. There was a sincere effort by the municipal representatives to listen to citizens' opinions. Citizens, taking a serious interest in the policies that determine their living environment, were willing to learn about legal and budgetary restrictions, thereby engaging in a true participatory process. This raises the hopes for the district director's ideal of handing over the care for the park (at least partially) to the citizens: citizen control, the 'highest' form of participation according to Arnstein (1969).

Regarding the effectiveness of VR for making informed decisions, using the VR headset did not give voters more confidence about their vote, compared to other digital means or compared to paper. However, rather than the nature of the device, the presence of the voting support team did significantly increase voters' confidence about being able to see the differences between the variants of the park.

In terms of organizational capacity, VR technologies were new to all actors involved in organizing the participation process. This implied intensive cooperation. Most actors shared the same discourse on accountability, namely that government should respond to calls of inhabitants in a democratic way. This discourse of Societal Resilience governance was not intrinsically shared by two actors, who practiced discourses of other modes of governance. In Public Administration, the practice of accountability is shaped by formal representative and legislative bodies, unlike full procedural transparency towards the public in Societal Resilience governance. In Network Governance, the process of cooperation matters more than transparency towards the public. These different views on accountability within different discourses explain procedural hiccups during the organization of the e-governance process and indicate the importance of discourse analysis in understanding complex processes of governance.

References

Al-Kodmany, K., 1999. Using visualization techniques for enhancing public participation in planning and design: process, implementation, and evaluation. Landscape and Urban Planning, 45(1), pp.37–45.

Al-Kodmany, K., 2001. Visualization Tools and Methods for Participatory Planning and Design. Journal of Urban Technology, 8(2), pp.1–37.

Arnstein, S.R., 1969. A Ladder of Citizen Participation. Journal of the American Planning Association, 35(4), pp.216–224.

Björgvinsson, E., Ehn, P. & Hillgren, P.-A., 2010. Participatory design and "democratizing innovation." In Proceedings of the Participatory Design Conference - PDC '10. pp. 41–50.

Creighton, J.L., 2005. The public participation handbook: Making Better Decisions Through Citizen Involvement, Hoboken, NJ: John Wiley & Sons, Inc.

le Dantec, C.A. & DiSalvo, C., 2013. Infrastructuring and the formation of publics in participatory design. Social Studies of Science, 43(2), pp.241–264.

van Doorn, J., Leeflang, P.S.H. & Tijs, M., 2013. Satisfaction as a predictor of future performance: A replication. International Journal of Research in Marketing, 30(3), pp.314–318.

Fredericks, J., Caldwell, G.A. & Tomitsch, M., 2016. Middle-out design: collaborative community engagement in urban HCI. In Proceedings of the 28th Australian Conference on Computer-Human Interaction. pp. 200–204.

Gemeenteraad Den Haag. 2012. *Inspraak- en participatieverordening gemeente Den Haag 2012* (The Hague municipal bill on civic participation, in Dutch). Gemeente Den Haag.

Gill, L. & Lange, E., 2015. Getting virtual 3D landscapes out of the lab. Computers, Environment and Urban Systems, 54, pp.356–362.

de Haan, E., Verhoef, P.C. & Wiesel, T., 2014. Customer Feedback Metrics De voorspellende kracht van klanttevredenheid, NPS en andere metrics (in Dutch), Groningen University.

Hajer, M., 2002. Discourse analysis and the study of policy making. European Political Science, 2(1), pp.61-65.

van Houwelingen, P., Boele, A. & Dekker, P., 2014. Burgermacht op eigen kracht? Een brede verkenning van ontwikkelingen in burgerparticipatie (in Dutch), Den Haag: Sociaal en Cultureel Planbureau.

Howard, T.L.J. & Gaborit, N., 2007. Using Virtual Environment Technology to Improve Public Participation in the Urban Planning Process. Journal of Urban Planning and Development, 133(4), pp.233–241.

Hu, Y. et al., 2015. A multistage collaborative 3D GIS to support public participation. International Journal of Digital Earth, 8(3), pp.212–234.

Karasti, H., 2014. Infrastructuring in participatory design. In Proceedings of the Participatory Design Conference - PDC ’14. pp. 141–150.

Kloosterboer, W., 2014. Tien Lessen uit Vijfentwintig Jaar Klanttevredenheidsonderzoek (in Dutch),

Kuliga, S.F. et al., 2015. Virtual reality as an empirical research tool - Exploring user experience in a real building and a corresponding virtual model. Computers, Environment and Urban Systems, 54, pp.363–375.

Kunze, A. et al., 2011. A Conceptual Participatory Design Framework for Urban Planning. In Proceedings of eCAADe 2011: Respecting Fragile Places. Ljubljana, Slovenia, pp. 895–903.

van Leeuwen, J.P. & Timmermans, H.J.P. eds., 2006. Innovations in Design & Decision Support Systems in Architecture and Urban Planning, Dordrecht, NL: Springer.

Maffei, L. et al., 2016. Immersive virtual reality in community planning: Acoustic and visual congruence of simulated vs real world. Sustainable Cities and Society, 27, pp.338–345.

Piksen, G. & Kruize, E., 2016. Customer Experience: Het Belang van de Juiste Voc-Mentaliteit (in Dutch).

van der Steen, M. et al., 2014. Leren door doen: overheidsparticipatie in een energieke samenleving (in Dutch). The Hague: PBL.

van der Steen, M., Scherpenisse, J. & van Twist, M., 2015. Sedimentatie in sturing: Systeem brengen in netwerkend werken door meervoudig organiseren (in Dutch). The Hague: NSOB.

Reichheld, F., 2003. The one number you need to grow. Harvard business review, 81(12), pp.46–55.

de Vries, B., van Leeuwen, J. & Achten, H. eds., 2001. Computer Aided Architectural Design Futures 2001, Dordrecht, NL: Kluwer Academic Publishers.

Williams, S., 2016. Data Visualizations Break Down Knowledge Barriers in Public Engagement. In E. Gordon & P. Mihailidis, eds. Civic Media: Technology, Design, Practice. Cambridge, MA: The MIT Press, pp. 165–197.

Wissen Hayek, U., 2011. Which is the appropriate 3D visualization type for participatory landscape planning workshops? A portfolio of their effectiveness. Environment and Planning B: Urban Analytics and City Science, 38(5), pp.921–939.