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Abstract

While studies in project management increasingly recognize the need for effective external stakeholder management, there is a paucity of investigations that apply analytical methods. Drawing on the fields of project management, stakeholder engagement and social acceptance, we propose Q methodology as a powerful tool for proactive risk mitigation in project management. In our case study of a shale gas drilling pilot project in the Netherlands, we carried out Q methodology research to arrive at stakeholders' perspectives. The results illuminate the perspectives of stakeholders in large-scale projects riddled by uncertainty. We argue that Q methodology is a significant and innovative risk management strategy for large-scale technological projects.

Keywords

stakeholder engagement; Q methodology; proactive risk mitigation; shale gas

1. Introduction

Stakeholder discontent can put large-scale projects at risk. Developments of energy infrastructures such as the siting of wind parks or transmission grids, have at times met with so much public opposition that projects have not only been stalled but also cancelled. Without social or external stakeholder support, it can be impossible to manage and deliver successfully large-scale technology projects. Large projects are not always warmly welcomed by all stakeholders thus demonstrating that there are multiple perspectives on the desirability, feasibility or conditions of a particular project. This is what Hisschemöller and Hoppe refer to as an 'unstructured issue' (Hisschemöller & Hoppe, 2001), also labelled 'wicked' (Rittel & Webber, 1973): a problem for which there is disagreement on the norms and values at stake as well as on the relevant facts. We maintain that managers of large technology projects regularly face unstructured issues that place projects at risk of failure. We bring together lessons learned from studies on public acceptance and public engagement in large technical projects with those in project management. We propose Q methodology as a method to contribute to proactive management practices to reduce risks from stakeholder opposition.

In recent project management literature, the importance of stakeholder management has received increased attention and is recognized as a success factor for projects (Achterkamp & Vos, 2008) (Aaltonen, 2011; Heravi, Coffey, & Trigunarsyah, 2015; Mok, Shen, & Yang, 2015; Olander & Landin, 2005; Tang & Shen; Yang, Shen, Ho, Drew, & Xue, 2011). Successful infrastructure project management includes external stakeholder management. Current methodologies for stakeholder analysis, however, lack reliable methods to gather and analyse relevant data and hence require further development (Jepsen & Eskerod, 2009; Mok et al., 2015).

Studies on public engagement in the fields of environmental policy and planning, and science and technology studies can contribute to external stakeholder management. The cross-fertilization of

studies in project management with those in public engagement resonates with efforts to improve professional project management by learning from other disciplines (Söderlund, 2011; Turner, 2010; Winter, Smith, Morris, & Cicmil, 2006). In our empirical case study, we explore individuals and organizations that became external stakeholders when they perceived risks and burdens associated with an energy infrastructure project—shale gas exploration-- planned in their vicinity. Individuals, some of whom formed groups to organise their roles as external stakeholders, municipalities, local organisations such as SMEs, companies or NGOs such as environmental groups joined together in their opposition ultimately leading to a moratorium on shale exploration in the Netherlands. The opposition that began in a local context erupted into a national debate. Ultimately, all shale gas exploration nationwide was halted.

From environmental policy and planning scholarship, three findings are of particular significance for project management. One, early-stage involvement of external stakeholders is an important condition for garnering social support (Rogers-Hayden & Pidgeon, 2007). Two, the ways in which external stakeholders are informed about and permitted to engage in technology development largely determine their reactions (Ellis, Barry, & Robinson, 2007; Walker et al., 2011). Not only the characteristics of the technology or project, such as the perceived costs and benefits, are important for success but also the decision-making process and its fairness and transparency (Correlje, Cuppen, Dignum, Pesch, & Taebi, 2014). Three, project managers often inaccurately perceive external stakeholders, such as 'the public' or citizens, as being ill-informed, irrational, emotional (Roeser, 2011; Wynne, 2001) or suffering from a 'NIMBY-syndrome.' This leads to unproductive dialogues (Burningham, Barnett, & Thrush, 2006; Haggett, 2011; Wolsink, 2000). Taken together, these three findings lead us to recommend that external stakeholder management should be based on a process approach that involves stakeholders in the earliest possible stage of project development . Furthermore, a successful process approach should avoid (implicit) assumptions about the opinions of those external stakeholders.

We argue that the Q methodology can be employed in a process approach to reveal stakeholder perspectives. Acting upon stakeholders perspectives seriously can support project management risk mitigation strategies thus leading to more resilience in large-scale technical projects. Originally developed for psychological research (Stephenson, 1935), Q methodology is gaining growing recognition and application in policy and planning investigations (Cuppen, Breukers, Hisschemöller, & Bergsma, 2010); (Ellis et al., 2007; Setiawan & Cuppen, 2013; Van Eeten, 2001; Wolsink & Breukers, 2009). Q's merit lies in the possibility for structured, assumption-free analysis of perspectives.

Drawing on the literature on public engagement, we argue that specific analytical methods can support external stakeholder management and the development of risk mitigation strategies. We describe both the controversial shale gas exploration project in the Netherlands and our empirical analysis of stakeholder perspectives derived from a Q methodology study. From this analysis, we illustrate how understanding stakeholder perspectives can be critical for successful external stakeholder management. When these perspectives are understood and taken seriously early in the planning stages, project management is more likely to avoid risks due to societal opposition to large-scale technology projects.

2. Project Management in Transition

In both project management research and practice, we recognize two trends. One, the early project phases (front-end development) are seen as increasingly crucial in determining the chance of successful project implementation in contrast to earlier emphasis on project execution phase (Artto, Lehtonen, & Saranen, 2001; Bosch-Rekveldt, 2011; Flyvbjerg, Bruzelius, & Rothengatter, 2003; Morris, 1994; Morris, Crawford, Hodgson, Shepherd, & Thomas, 2006; Thamhain & Wilemon, 1975). Particularly in early phases, much effort is made to, for example, define project goals, build the team, assess the risks and align stakeholders. In fact, a shift in focus from the management of project execution towards broader

management of projects has taken place (Bryde, 2003; Fangel, 1993; Morris, 1994). In the late 1980s, project management was extended to project initiation and finalization, leading to the current emphasis on the wider social context in which projects are undertaken (Laslo, 2010; Stretton, 2006), acknowledging the increasing complexity in projects and related challenges (Williams, 2002; Williams, Klakegg, Andersen, & Magnussen, 2012).

Two, the project management approach itself has been transformed. Some argue that currently, traditional project management simply does not work because the dynamic context in which projects take place requires continuous adjustments (J.A. de Bruijn & ten Heuvelhof, 2007; J.A. de Bruijn, ten Heuvelhof, & in 't Veld, 2002). Rather than applying a pure "predict-and-control" management strategy, a process management strategy of "prepare-and-commit" is advocated, or some combination of these two (Koppenjan, Veeneman, Van der Voort, Ten Heuvelhof, & Leijten, 2011). The mechanistic "predict-and-control" approach stems from traditional project management based on, for example, narrow task definition, hierarchical steering (top-down), inflexibility toward change, and limited, or standardised, information exchange. The more organic "prepare-and-commit" approach encompasses, for instance, broad task definition to encourage cooperation, network steering (bottom-up), facilitation of changes as needed, and open, unstructured information exchange.

These two trends broaden project management practice and create space for public engagement. Inclusion of external stakeholders early in the project helps avoid unforeseen problems later (Achterkamp & Vos, 2008; Olander & Landin, 2005). Because outdated top-down "predict and control" project management is unlikely to receive support, stakeholder involvement should be incorporated as a process within "prepare and commit" project management. However, few studies have addressed external stakeholders. Heravi et al. investigated the level of involvement of four stakeholder groups (owner/developer, construction/project management, designer, contractor) throughout the project lifecycle and concluded that improved decision-making strategies are required to

improve the stakeholder involvement in all project stages (Heravi et al., 2015). They show that particularly owners/developers are not engaged in systematic identification of relevant external stakeholders and suggest broadening research towards the level of involvement of the social environment and other project parties (suppliers etc.). In their study on "playing with complexity", Hertogh and Westerveld propose dynamic management to improve stakeholder management (Hertogh & Westerveld, 2010). This consists of a dynamic balancing of control and interaction, dependent on the type of complexity present in the project. Interaction is a theme that also appears regularly in public engagement literature.

3. Stakeholder engagement

Although a technology project may be considered by its developer as a fairly structured task with clear objectives and procedures for achieving those objectives (the *engineer's and planner's fallacy* (O'Hare, Bacow, & Sanderson, 1983) cited in (Wolsink, 2000)), in practice it may not be straightforward. Above we framed technology projects as unstructured issues (Hisschemöller & Hoppe, 2001) suggesting that these projects involve various internal and external stakeholders who define the project differently, e.g. it's desirability, feasibility or conditions. For instance, the shale gas pilot project that we here involves values including security of energy supply, profitability, safety, sustainability, and fairness. Stakeholders disagreed on the relative importance of these values and therefore on which values should guide the decision-making and planning, and on whether the project would enhance these values at all. These value conflicts are inherently connected to the uncertainties involved in a project like this.

The engineer's and planner's fallacy leads to two typical misconceptions of public opposition. First, that public opposition is a *knowledge* problem: if external stakeholders (citizens) know the right facts, understand the (often collective) benefits of the project, and understand risks avoidance, they will support the project. This is known as the 'deficit model' of public understanding of science and

technology (Durant, 1999; Irwin & Wynne, 1996). Attempts to 'solve' this knowledge problem typically involve further risk minimization sometimes to the point of implausibility, emphasis on risk communication, and commissioning more research to convince external stakeholders of e.g. the project safety. Often these attempts fail, as more research usually leads to more, rather than fewer, uncertainties, and as they neglect the normative dimensions involved in technology projects. The second typical misconception of public opposition is that it is an *interest* problem. The most salient translation of this is the NIMBY- Not In My Back Yard – explanation, sometimes labelled a 'syndrome., NIMBY describes opposition as self-interest (in an aesthetic, quiet, and/or safe neighborhood) that prevails over public interests ('the common good', i.e. clean and secure energy supply) (Bell, Gray, & Haggett, 2005; Wolsink, 2006). Attempts to 'solve' this NIMBY interest problem involve rebalancing personal and collective interests, e.g. by offering compensation for the imposed risks or burdens. They often fail and NIMBY has been proven an invalid and inaccurate construct (Burningham et al., 2006; Haggett, 2011; Wolsink, 2000). Furthermore, compensation may be perceived as bribery (see e.g. (Hannis & Rawles, 2013; Ter Mors, Terwel, & Daamen, 2012)).

For project management, a project should be approached as an 'unstructured issue' with scientific and normative uncertainties and disagreements rather than a structured one without them. Literature on public engagement suggests that this requires, first, early-stage involvement (Reed, 2008; Rowe & Frewer, 2000). Typically, if external stakeholders are involved in a project , it is during the implementation phase rather than the preparation phase (Reed, 2008) when value-based choices are made thus limiting participation to narrow, predefined topics. Yet involving external stakeholders in debate on underlying assumptions, values and agenda setting not only is important for the credibility of the project organisation (Rowe & Frewer, 2000) but also provides an opportunity to develop more socially desirable technologies and projects. Debates may reveal new ideas and better solutions to problems (also referred to as 'constructive conflict' (Cuppen, 2012a)). Second, approaching a project as

an ‘unstructured’ issue requires a process that promotes the interaction and exchange between stakeholders with different values, knowledge and interests to understand better the normative dimensions of a project, and ways to manage diverging values, interests and risks. This is referred to as ‘learning’ or ‘problem-structuring’ (Hisschemöller & Hoppe, 2001). Learning requires an open exploration of diverging views and can be hampered by misconceptions of external stakeholders as ill-informed or self-interested NIMBYs. Presumptions of project organisations about external stakeholders have been shown to shape the responses of those external stakeholders (Cuppen, Brunsting, Pesch, & Feenstra, 2015; Walker et al., 2011). For instance, if a project organisation expects the public to be ill-informed and risk-averse, project managers focus on providing technical facts and reassuring words about. If external stakeholders are concerned about procedural issues (e.g. fairness and transparency), or the distribution of costs and benefits, more facts will not resolve their concerns. As a result, external stakeholders may feel unheard, their concerns may be reinforced, and the opposition may be fuelled. Thus, approaching a project as an ‘unstructured’ issue means that external stakeholder management entails a process of dialogue that involves external stakeholders in an early stage of the project, does not assume to know their views, values and interests, but empirically investigates them. Public engagement and project management studies pay substantial attention to the process of interaction in stakeholder engagement but there is a gap in understanding the preceding stage that identifies stakeholders and their positions empirically (Cuppen et al., 2010). We explore here how the Q methodology for revealing stakeholder perspectives in a bottom-up fashion, can be used in a process approach to improve external stakeholder management with oour case study on a shale gas pilot project in the Netherlands.

4. An empirical illustration: a shale gas exploration project in the Netherlands

The Netherlands has been a major gas producing and consuming country since the middle of the twentieth century. Given the depletion of large gas fields, the exploitation of shale gas has the potential to contribute to the continuity of production. The first initiative to explore Dutch shale was taken by the British company Cuadrilla Resources in 2008 in collaboration with the Dutch state-owned EBN BV. Cuadrilla submitted to the national Ministry of Economic Affairs applications for exploratory drilling permits. Once granted by the state, the municipalities of Boxtel and Haaren in the province of North Brabant agreed by the end of 2010 to grant exploration permits for specific locations (Dignum, Correljé, Cuppen, Pesch, & Taebi, Forthcoming; Remmerswaal, 2013). Permits were awarded and exploration in Boxtel was planned to begin in the second half of 2011. However, when the municipalities informed their citizens about these developments, the spectrum of interested stakeholders in the project expanded. Residents, companies, and NGOs expressed concern about safety. The Rabobank housed its new data centre near the project site in Boxtel and was concerned about potential damage from vibrations and the ground subsiding. Brabant Water, responsible for the purification of ground water and distribution of drinking water, feared contamination of the water table from the fracking process. The Rabobank together with local residents initiated a lawsuit to have the permits in Boxtel retracted and won. The level of public and media attention to potential damaging effects of shale gas exploration increased considerably. Opposition not only escalated, but moved from local to provincial and national arenas and included environmental organizations and political parties (Cuppen, Pesch, Remmerswaal, & Dignum, 2014). As many residents attempted to declare their municipalities 'shale gas free,' all levels of government became involved in the debates. Ultimately, the state imposed a moratorium on exploratory drilling in October 2011 and required further research into possible risks to the environment, groundwater, and public health and safety. The public opposition to shale gas exploration

in the Netherlands continues. For example, a Parliamentary vote December 2014 extended the existing moratorium on shale exploitation until the end of the current cabinet term (approximately two years). As recently as 3 June 2015, a motion was passed in which 226 municipalities in the Netherlands officially declared their areas 'shale gas free' (Boxtel, 2015).

We focus on the early period of heightened concern, public opposition, and considerable social unrest described above. This heated debate surprised internal stakeholders by its intensity. External stakeholders proved politically powerful, halting shale exploration and changing the future of shale exploitation completely. Q research project empirically investigated the diversity of both internal and external stakeholders' perspectives on the shale gas exploration project in Boxtel and Haaren.

5. Q methodology to reveal stakeholder perspectives

Q methodology is a structured, both qualitative and quantitative, method to identify the variety of perspectives in a certain group or population. The merit of Q methodology is that it allows for an open, bottom-up exploration of perspectives, rather than one based on pre-defined categories as in quantitative survey research. The number and nature of perspectives are not predefined but emerge from the data. It thus makes possible the identification of marginal viewpoints that are easily overlooked in quantitative survey research but may be critical in understanding and facilitating productive public engagement. Q methodology involves a set of individual interviews during which a number of purposively sampled respondents (the 'P set') individually sort a set of statements (the 'Q sample'). The labelling of 'P *set'* and 'Q *sample'* indicates that Q methodology works with a reversed data matrix: the statements are a 'sample' of the 'population' of possible statements on the topic, and the respondents are the 'variables' that are grouped in meaningful clusters based on their evaluations of the statements. It consists of five steps: 1) definition of the concourse and selection of statements, 2) selection of respondents, 3) Q interview, 4) Q analysis 5) Interpretation of perspectives.

Definition of the concourse and selection of statements

In this first step statements are collected that reflect the 'concourse', i.e. "the flow of communicability surrounding [the topic under study]" (Brown, 1993, p.94). Statements should reflect "ordinary conversation, commentary and discourse of everyday life" (Brown, 1993, p.94) and can be collected from interviews, reports, blogs or websites et cetera. In this study, the concourse pertains to the 'communicability' surrounding the shale gas exploration project in Boxtel/Haaren and its potential effects on stakeholders. Statements were taken from media sources including newspapers and websites, and internal reports from EBN and Cuadrilla. This resulted in a longlist of over 60 statements. In a next step, this longlist was reduced to a smaller and manageable set that reflected the range of ideas and points of view. The statements were grouped inductively to reduce the set of statements. This resulted in statements categories: Project, Energy (necessity of natural gas from shale and potential alternatives), Economy, Local Impact, Risk, Regulatory System, Trust. After removing overlapping and redundant statements, a set of 49 statements remained (the Q sample, see Appendix).

Selection of respondents

The 'P set' is created in the second step. Diversity, as opposed to representativeness in survey research, is the selection criterion for respondents. As a consequence of the reversed data matrix, the number of respondents is smaller than in regular survey research (McKeown & Thomas, 1988). This study included 19 respondents--both internal and external stakeholders. This diversity enabled us compare perspectives of internal and external stakeholders. Of the eight internal stakeholder respondents, four worked for EBN BV and played roles in the shale exploration project and in corporate processes. One representative from Cuadrilla, the Ministry of Economic Affairs, an involved engineering firm, and an involved exploration & production service company comprised the other four. External stakeholders were identified in the media, contacted, and asked to suggest someone relevant to interview. With the criterion of diversity in mind, respondents were explicitly asked to recommend someone who did not

share their views. The external stakeholders represent different organizations and groups: one representative from the State Supervision of Mines and one from the Province Noord-Brabant, two representatives of the local municipalities involved, two from an academia/knowledge institute, one from the provincial water company, one provincial environmental NGO, one local anti-shale gas NGO and two home owners. The 19 participants can be categorised as Industry (7), Research/Knowledge institutes (2), and Government (5), Companies (2), Community (2) and NGO's (1) see Table 1.[1]

Internal stakeholders (8)	**External stakeholders (11)**
Government participant (4)	State Supervision of Mines (1)
Operator (license holder) (1)	Provincial Council (Christian democrats spokesperson) (1)
Ministry of Economic Affairs (1)	Local municipalities (2)
Engineering firm (1)	University of Technology (1)
Exploration & production service company (1)	Technology research institute (1)
	Water company (1)
	Provincial Environmental NGO (1)
	Local anti-shale gas NGO (1)
	Homeowners (2)

Table 1 The P set: 8 internal and 11 external stakeholders participating in the Q interviews

Q interview

In the Q interview, respondents rank statements according to a normally distributed 9-point scale. This scale represents significance or salience (Brown, 1980, p. 198), in this case most disagree (-4 column) to most agree (+4 column). The middle of the distribution (0) represents a neutral opinion or statements regarded as irrelevant. The distribution is forced, which means that the number of statements per column is prescribed. The number of statements per column were as follows: the +/- 4 columns: 2

[1] Some respondents requested anonymity; for this reason not all names of organisations are mentioned explicitly.

statements; +/-3 columns: 4 statements; +/- 2 columns: 6 statements; +/-1 columns: 8 statements; 0 column: 9 statements. The idea of this forced distribution is that respondents prioritize the statements, and thus evaluate the statements in relation to one another rather than individually. Respondents placed statements with which they strongly disagree (-4,-3) or agreed (+3, +4) in the extremes of this distribution.

Face-to-face Q interviews were conducted in June and July 2011. The Q distribution was printed on a sheet of paper, and the statements printed on cards. One interview was held with help of software program FlashQ (Braehler & Hackert, 2007), because a face-to-face interview could not be scheduled. Respondents sorted the 49 statements on a distribution from *most agree* to *most disagree*. They were asked to elaborate upon the statements in the extreme columns. This information was used for qualitative interpretation of the factors.

Q-analysis

With factor analysis, the Q sorts are clustered by similarity, i.e. groups of respondents who sorted the statements in a similar way are clustered. For each cluster, or factor, a typical Q sort can be for qualitative interpretation of the statistical factor. The statements in the two outer columns left and right (four in total) are used to interpret the factor. In addition, statements that distinguish one factor from another, even though it is not in the outer columns, are used for interpretation. Furthermore, the qualitative data from the interviews is used to interpret the factors. Extraction of factors and selection of their number is an interpretative and iterative endeavour. The analyst goes back and forth between the quantitative and statistical data to the qualitative data to find a coherent and meaningful clustering of Q sorts.

All 19 Q-sorts were entered in the computer software PQMethod, which is dedicated software for Q analysis (PQMETHOD, 2002). Principle Component Analysis (PCA) was used for factor extraction and Varimax for factor rotation. Six factors emerged from these analyses, interpreted as six perspectives.

6. Results: six stakeholder perspectives elucidated

1: Natural gas necessary for the energy transition

This perspective perceives natural gas as an indispensable component of our energy system. Due to its low carbon footprint compared to coal, gas is seen as a transition fuel towards cleaner alternatives. Shale gas simply equals natural gas in this perspective. Furthermore, shale gas is considered advantageous for the general economic welfare of The Netherlands. Extensive familiarity with the technology excludes future technological problems. Risks can be controlled and its visual impact limited. Overall, nothing should stop the exploration and production of natural gas production from shale in The Netherlands. Respondents from EBN, Cuadrilla, the Ministry of Economic Affairs and the research technology institute load significantly positive on this perspective. Table 2 shows the statements with the highest positive and negative scores for this perspective and some relevant quotes from the interviews.

Agree (+4)	25: Natural gas is a clean alternative to coal for the production of electricity.
	5: The locations where natural gas extraction from shale takes place has a small geographic footprint and their visual impact can easily be limited.
Agree (+3)	3: Continuous energy production from renewable energy sources without the use of natural gas is impossible.
	12: Damage to property as a direct effect from drilling should be compensated.
	2: There must be full transparency about the composition of the 'fracking' chemicals
	43: The entire Dutch population benefits from natural gas production from shale.
Disagree (-4)	16: The State Supervision of Mines has dubious motives due to its affiliation with the Ministry of Economics, Agriculture and Innovation
	14: If diplomatic efforts do not result in agreement obstructing the project physically is justified
Disagree (-3)	45: Injection of chemicals during drilling for natural gas from shale is a hazard for ground- and drinking water quality.
	33: The Boxtel/Haaren area is too densely populated for natural gas production from shale
	49: Because there is uncertainty about the "carbon footprint" of natural gas production from shale, further research is necessary before the project is allowed to start
	32: Natural gas production from shale disrupts the local ecosystem of Boxtel/Haaren
Relevant quotes from the interviews	"Natural gas is not the cleanest alternative for coal in electricity generation however in comparison to coal it is much cleaner. Until we are completely sustainable, this is the best alternative" "The way wells are constructed and finished makes sure that groundwater layers are sealed with pipes and cement. This is no different from other natural gas wells. On land, there have already been constructed thousands like this. A lot of attention is given to protect the groundwater. This well will not be different from natural gas extraction from other rocks."

Table 2: Statements and quotes perspective 1

2: Shale gas fosters Dutch competitiveness

This perspective perceives shale gas production positively because the benefits to the Dutch competitiveness and economy outweigh the local impact of large-scale production. The business case for shale gas has a temporary character however, because it is a finite resource. It will therefore not solve the Dutch future energy problems. Similarly, natural gas is not considered a long-term alternative to coal for electricity production. This perspective emphasizes the need for independent research on shale gas production policy, mainly to guarantee the safety of shale gas production. The respondent from the Christian Democrat Party (CDA) who was the party spokesperson on the subject in the committee of Ecology and Enforcement loads significantly on this perspective. Table 3 shows the statements with the highest positive and negative scores for this perspective and some relevant quotes from the interviews.

Agree (+4)	11: Independent research should form the basis of policy for natural gas production from shale
	43: The entire Dutch population benefits from natural gas production from shale
Agree (+3)	13: If natural gas production from shale serves the common good the project should continue, on the condition that it is safe
	15: The impact of exploration drilling may be limited but the impact of large-scale production of natural gas from shale is unforeseeable
	46: Lagging behind with natural gas production from shale lowers the Dutch competitiveness
	47: Also with exploration drilling an environmental impact assessment should be performed
Disagree (-4)	35: Accidents and pollution during natural gas production from shale in the United States are reason enough to banish the technology
	24: Natural gas production from shale will solve future energy problems in The Netherlands
Disagree (-3)	25: Natural gas is a clean alternative for coal for the production of electricity
	33: The Boxtel/Haaren area is too densely populated for natural gas production from shale
	16: The State Supervision of Mines has dubious motives due to its affiliation with the Ministry of Economics, Agriculture and Innovation
	28: The citizen has no power to oppose decisions of the state
Relevant quotes from the interviews	"The Dutch situation in terms of legislation and subsurface is different than in the US. Besides, technology and science are constantly moving... Also lessons can be learned from the US. A 1:1 extrapolation from the situation in the US to The Netherlands resulting in a complete prohibition would be absurd" "Politicians must depend on research by specialists. Like always policy decisions will not satisfy all and arguments will be used selectively. Therefore it is important that research is absolutely independent."

Table 3: Statements and quotes perspective 2

3: Trust in technology and regulation

Confidence in the regulatory system and the technology are dominant in this perspective. The technology is perceived as mature and the supervision of the drilling and fracking process competent thus safe. From this perspective, processes can and should be done "in the correct way"; e.g. the composition of fracking chemicals should be made transparent and property damage caused by shale gas production should be compensated. This perspective considers independent research necessary to create social support for shale gas production. Two respondents load significantly on this perspective: the representative of the State Supervision of Mines and one of the municipal representatives. Table 4 shows the statements with the highest positive and negative scores and some relevant quotes from the interviews.

Agree (+4)	12: Damage to property as a direct effect from drilling should be compensated
	11: Independent research should form the basis of policy for natural gas production from shale
Agree (+3)	1: In The Netherlands, the use of chemicals in soil is properly regulated, which practically makes it impossible for groundwater pollution to occur
	2: There must be full transparency about the composition of the 'fracking' chemicals
	13: If natural gas production from shale serves the common good the project should continue, on the condition that it is safe
	44: The regulations for drilling in the United States are very lenient compared to The Netherlands. This explains the problems faced there.
Disagree (-4)	16: The State Supervision of Mines has dubious motives due to its affiliation with the Ministry of Economics, Agriculture and Innovation
	8: Technology for natural gas production from shale is not mature enough, safety cannot be guaranteed
Disagree (-3)	29: Protests against projects of natural gas extraction from shale are hypocrite when people use natural gas themselves
	4: It is unclear what local benefits could come out of the project
	35: Accidents and pollution during natural gas production from shale in the United States are reason enough to banish the technology
	33: The Boxtel/Haaren area is too densely populated for natural gas production from shale
Relevant quotes from the interviews	"Independent research, we have called upon this and this is my view. I am convinced that the activities will be performed responsibly, however I have to deal with a great societal unrest and we take this seriously. You can take this away only with independent research, societal acceptance is necessary" "There are several laws in The Netherlands which regulate the use of chemicals. This holds for onshore and offshore. Also the use of 'fracking' chemicals is directed well and monitored. For every chemical there must be a permit. These are watertight laws, when people abide by them then it works out well"

Table 4: Statements and quotes perspective 3

4: Local environmental risks uncontrolled

According to this perspective, the exploitation of natural gas from shale involves activities that are not properly regulated or supervised, and are prone to failure with potentially disastrous environmental consequences for its direct surroundings. Even safe exploitation of natural gas from shale will create unacceptable local consequences. Stricter regulation of shale gas exploration and production, including transparency about the composition of fracking chemicals, and an environmental impact assessment (EIA) for exploration activities (currently an EIA is only needed for production) are crucial. If drilling causes damage to property, it should be compensated. This perspective is shared by respondents from the water company, the provincial environmental NGO, the local anti-shale gas NGO, and a local homeowner. Table 5 shows the statements with the highest positive and negative scores for this perspective and some relevant quotes from the interviews.

Agree (+4)	2: There must be full transparency about the composition of the 'fracking' chemicals
	8: Technology for natural gas production from shale is not mature enough, safety cannot be guaranteed
Agree (+3)	47: Also with exploration drilling an environmental impact assessment should be performed
	45: Injection of chemicals during drilling for natural gas from shale is a hazard for ground- and drinking water quality
	12: Damage to property as a direct effect from drilling should be compensated
	15: The impact of exploration drilling may be limited but the impact of large-scale production of natural gas from shale is impossible to estimate
Disagree (-4)	1: In The Netherlands, the use of chemicals in soil is properly regulated, which practically makes it impossible for groundwater pollution to occur
	31: The fact that the government grants permits is reason enough to expect that the environment will be protected during the project
Disagree (-3)	14: If diplomatic efforts do not result in agreement obstructing the project physically is justified
	27: Natural gas from shale is the same as natural gas from conventional gas fields
	17: There is uncertainty about the motives of other parties
	36: Drill- or production locations are only acceptable on existing industrial areas
Relevant quotes from the interviews	"Cuadrilla has stated now that there are two chemicals involved in the exploration drilling, this is fine. However, when large scale fracking will take place, will they use the same mix? We are continuously busy with the groundwater quality." "It is a completely new drilling and production method. In The Netherlands this is a new project. It turns out that the law and legislation is not prepared for this." "It is idiocy that an EIA (In Dutch: MER) is not necessary. Looking at the irreversible damage done to the geological structure and possibly on the landscape, large quantities of chemicals enter and partly exit the ground and an acre of beautiful nature is tarmacked and fenced." "(Regarding statement 1) This is not the case, there is virtually no legislation. European legislation is still not ready and outdated."

Table 5: Statements and quotes perspective 4

5: National benefit at local cost

Local socio-geographical values are central to this perspective. Whereas natural gas from shale could create general benefits for the Dutch population, the local visual impact is considered too high. The area is too densely populated for shale gas production and the industrial activities conflict with the rural character of the region. With large-scale exploitation the impact on the surroundings would irrevocably alter the character of the area. To a large extent, the perspective respects national policy frameworks in which local authorities should not have the power to block projects to protect the interests of local citizens. Sharing the incomes of gas production with landowners and local citizens is not considered desirable. This perspective perceives exploration as inseparable from shale gas production. Objections to the project focus on the inevitability of production rather than on (temporary and small-scale) exploration of shale gas. One municipality representative loads on this perspective. Table 6 shows the statements with the highest positive and negative scores for this perspective and some relevant quotes from the interviews.

Agree (+4)	32: The Boxtel/Haaren area is too densely populated for natural gas production from shale
	43: The entire Dutch population benefits from natural gas production from shale
Agree (+3)	9: Drill installations for natural gas extraction conflict with the rural character of the area Boxtel/Haaren
	15: The impact of exploration drilling may be limited but the impact of large-scale production of natural gas from shale is impossible to estimate
	34: The significant investments made in exploration drilling suggest that exploitable natural gas is present in the shale
	41: Individuals who refuse to lease land to project developers will not halt exploration. If one doesn't lease land, their neighbours will
Disagree (-4)	5: The locations where natural gas extraction from shale take place have a small geographic footprint and their visual impact can easily be limited
	2: There must be full transparency about the composition of the 'fracking' chemicals
Disagree (-3)	17: There is uncertainty about the motives of other parties
	14: If diplomatic efforts do not result in agreement obstructing the project physically is justified
	10: Local authorities should have the power to block similar projects to protect the interests of local citizens
	18: A percentage of the income generated by natural gas production from shale should go to landowners and local citizens
Relevant quotes from the interview	"Cuadrilla told us that a single exploration well would mean a single production well but this is not the case. It turned out that an exploration well could lead to ten production wells in a radius from 200 to 2000 meters around the exploration well… This has a tremendous influence on the ecological structure." "We have no formal power to oppose the project… When Cuadrilla asks for a definitive permit and we say no, you cannot have it, will Verhagen (Minister of ELI) come with a zoning plan to continue anyway? I have still not received the answer to this question, after four months. Of course they know the answer; there is a reason for not telling us, probably because it is true."

Table 6: Statements and quotes perspective 5

6: Not under my backyard

This perspective focuses on local private interests. There are serious concerns about safety of operational activities and increased (industrial) traffic. However, even if safety is guaranteed there should be no wells. Although temporary, drill installations are ugly and do not belong in The Netherlands. Exploration activities lower the home values and the affected citizens have no power to influence or oppose them. Two homeowners, in a combined interview, load significantly on this perspective. Table 7 shows the statements with the highest positive and negative scores for this perspective and some relevant quotes from the interviews.

Agree (+4)	39: Natural gas production from shale in close vicinity lowers the value of homes
	12: Damage to property as a direct effect from drilling should be compensated
Agree (+3)	37: Exploration drillings will cause traffic and this may cause unsafe situations
	32: Natural gas production from shale disrupts the local ecosystem of Boxtel/Haaren
	35: Accidents and pollution during natural gas production from shale in the United States are reason enough to banish the technology
	9: Natural gas production from shale in close vicinity lowers the value of homes
Disagree (-4)	1: In The Netherlands, the use of chemicals in soil is properly regulated, which practically makes it impossible for groundwater pollution to occur
	29: Protests against projects of natural gas extraction from shale are hypocrite when people use natural gas themselves
Disagree (-3)	13: If natural gas production from shale serves the common good the project should continue, on the condition that it is safe
	28: The citizen has no power to oppose decisions of the state
	31: The fact that the government grants permits is reason enough to expect that the environment will be protected during the project
	36: Drill- or production locations are only acceptable on existing industrial areas
Relevant quotes from the interviews	"By default, I don't agree with drilling under my home. Not in my front yard. Drilling an exploration well is just as bad as drilling a definite production well" "Personally I do not find protests hypocritical. I use natural gas, this is true, however shale gas is a completely different form of exploitation than gas and nowadays there are good alternatives in solar and wind energy"

Table 7: Statements and quotes perspective 6

Similarities and differences

From the six perspectives, three are positive (P1, P2 and P3) and three are negative (P4, P5, and P6) about shale gas exploration. The three positive perspectives see shale gas either as a necessary transition fuel (P1), a way to increase the Dutch competitiveness (P2), or mined with technology that is well regulated and can be implemented responsibly (P3). Although P2 and P3 both consider independent research necessary, the reasons differ slightly. While P2 considers research necessary for policymaking, in the sense of 'speaking truth to power' (Wildavsky, 1979), P3 sees a role for independent research to increase social support. The three negative perspectives focus on different local impacts and risks. P4 considers the environmental risks too big and disagrees with P3 that regulation can control these risks. P5 focuses on local socio-geographical visual impacts. This perspective is aware of the collective benefits of shale gas but feels that they are outweighed by the local impact. P6 focuses on private, mainly economic impact such as devaluation of house prices. These three perspectives provide a snapshot of external stakeholder perspectives in an early stage of the local public debate on the shale gas exploration project in Boxtel/Haaren. Interestingly, in a later stage the public debate shifted to a national debate on the use and necessity of shale gas in the Dutch energy transition, involving a wide range of national stakeholders (Cuppen et al., 2014). Local actors incorporated arguments that went beyond local impact, referring for example to the need for a more sustainable energy supply (Dignum et al., Forthcoming).

7. Implications for project management

We maintain that Q methodology can serve as a tool to support proactive risk mitigation in project management. More specifically, Q methodology can be used in a stakeholder management strategy that acknowledges the unstructured nature of large-scale infrastructure projects because it reveals the diversity of values, interests and uncertainties as perceived by different stakeholders. Our results show first that, at the start of the local debate on the shale gas exploration project, no less than six

perspectives existed. Three of these were in favour of the project, and three against. The six perspectives show the heterogeneity rather than the uniformity of stakeholder perspectives. The three negative perspectives, for instance, articulate the diversity of local values that are at stake for particular groups of external stakeholders: environmental values for stakeholders in P4; aesthetic values (i.e. visual impact) for stakeholders in P5; and private economic values (house prices) for stakeholders in P6. Although the negative perspectives were shared by external stakeholders only, both internal and external stakeholders were found amongst the positive perspectives. As such, Q methodology creates a more nuanced picture that goes beyond simplistic divisions between proponents and opponents or simplistic labelling of public opposition as a NIMBY response.

Second, the results show that stakeholder positions are multidimensional. There are *different* issues that play roles for stakeholders maintaining *different* perspectives. Aspects that lead to conflict are, for example, trust in both regulation and other actors (high or low), safety of the technology (high or low), and the perceived fairness of distribution of costs and benefits (unfair according to P5). This means that proponents and opponents cannot be mapped on a continuum from 'pro' to 'con'. Q methodology thus makes possible the articulation of a diversity of risks and values perceived by stakeholders. Further study is necessary to explore exactly how project managers can act upon the values and perspectives uncovered in Q research. However, we are convinced that taking stakeholder values into consideration not only aids proactive risk mitigation but also contributes to the identification of opportunities (Lechler, Edington, & Gao, 2012). The latter is important because knowing what external stakeholders value is a prerequisite for project management to create societal value and mutual benefit. And as Hertogh and Westerveld (2010) have shown, mutual beneficial cooperation is critical to project success.

Q methodology is a tool that must be embedded in a proper process to insure its effectiveness. Once project managers acknowledge that large-scale infrastructure projects are unstructured, they can embark on a process to learn about the relevant values, facts, interests and problem definitions of

various stakeholders. This may sound obvious but the traditional "predict and control" approach is still commonly practiced (Koppenjan et al., 2011) and thus resonates with a management assumption that large-scale infrastructure projects are structured and need 'ruling' management (see 'policy as ruling' (Hisschemöller & Hoppe, 2001)). Awareness of the unstructured nature of large-scale infrastructure projects requires a willingness to reflect upon one's own practice, (implicit) assumptions, values and beliefs. Only when project managers develop reflective capacities can meaningful cooperation or dialogue with external stakeholders be productive. Our recommendations are consistent with suggestions to approach uncertainties and complexities in large projects with redundancy and resilience (Priemus, Bosch-Rekveldt, & Giezen, 2013). When decision making processes in project management are open to 'outside-in' information flows from early stages, external stakeholders can provide relevant, often unexpected, external views. A flexible and adaptive approach creates resilience in the project to react to risks, impacts or responses expressed by (external) stakeholders. Public engagement with energy projects is dynamic, values and perspectives can change over time. Furthermore, stakeholder groups articulating new values may emerge during the process. The local anti-shale gas NGO was, for instance, founded in the initial stage of local unrest after the shale gas exploration project had been announced. Resilience is thus also important for external stakeholder management. In the earliest phase of a large project, it is not necessarily clear who the external stakeholders are. It is crucial to anticipate the emergence of active stakeholders, particularly because they may form a risk for project success if they hold the power to block it (Hillson & Simon, 2007). Thus, analysing stakeholders and their perspectives (with or without Q methodology) should not be a one-time event. While Q methodology can kick-off a process of dialogue and deliberation with external stakeholders, changes in perspectives should be monitored as the project proceeds (on using Q methodology for measuring changed perspectives, (Cuppen, 2012b)). Q methodology cannot directly ascertain external stakeholders in a project. Thus, identifying external stakeholders in early phases of project management remains a challenging yet critical task.

We argue that Q methodology is a structured and rigorous method for analysing stakeholder perspectives useful in project management. Because it is lengthy and labour-intensive, the method is not well- suited for small projects. In the large-scale infrastructure case study performed, and in other unstructured large-scale technical projects that face both normative and scientific uncertainties, Q methodology is an innovative tool for proactive risk mitigation.

8. Concluding remarks

External stakeholder management has received increasing attention in project management particularly in sectors where opposition has influenced the success of projects. Our case study of a shale gas exploration project illustrates that Q results shed light on unexpected stakeholder perspectives. Given the risks and uncertainties inherent in large-scale technological projects, we propose the implementation of Q methodology to reveal internal and external stakeholders values that need to be taken seriously throughout the project lifecycle. With an increased understanding and analysis of these values, project managers can both mitigate risk and identify opportunities.

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11. Appendix: List of Q statements

Nr.	Statement	Category
1	In The Netherlands, the use of chemicals in soil is properly regulated thus making it impossible for groundwater pollution to occur	Regulatory system
2	There must be full transparency about the composition of the 'fracking' chemicals	Trust
3	Continuous energy production from renewable energy sources without the use of natural gas is impossible	Energy (supply and alternatives)
4	It is unclear what local benefits could come out of the project	Project specific
5	The locations where natural gas extraction from shale take place have a small geographic footprint and their visual impact can easily be limited	Local impact
6	Natural gas is a transition fuel to a sustainable energy future	Energy (supply and alternatives)
7	Drilling for natural gas from shale is a 24/7 activity, the associated noise disturbs humans and animals	Local impact
8	Technology for natural gas production from shale is not mature enough, safety cannot be guaranteed	Risk
9	Drill installations for natural gas extraction interfere with the rural character of the area Boxtel/Haaren	Local impact
10	Local authorities should have the power to block similar projects to protect the interests of local citizens	Regulatory system
11	Independent research should form the basis of policy for natural gas production from shale	Regulatory system
12	Damage to property as a direct effect from drilling should be compensated	Local impact
13	If natural gas production from shale serves the common good the project should continue, on the condition that it is safe	Local impact
14	If diplomatic efforts do not result in agreement obstructing the project physically is justified	Project specific
15	The impact of exploration drilling may be limited but the impact of large-scale production of natural gas from shale is impossible to estimate	Local impact
16	The State Supervision of Mines has dubious motives due to its affiliation with the Ministry of Economics, Agriculture and Innovation	Trust

17	There is uncertainty about the motives of various parties involved	Trust
18	A percentage of the income generated by natural gas production from shale should go to landowners and local citizens	Economy & politics
19	In this project, national interests weigh heavier than local interests	Project specific
20	Natural gas production from shale is bad for the environment	Energy (supply and alternatives)
21	So far, all problems in the new technologies for with natural gas extraction from shale can be solved	Risk
22	Natural gas production from shale changes geo-political dependencies drastically	Economy & politics
23	Expansion of natural gas production reduces our dependence on the Middle-East	Economy & politics
24	Natural gas production from shale will solve future energy problems in The Netherlands	Energy (supply and alternatives)
25	Natural gas is a clean alternative for the production of electricity	Energy (supply and alternatives)
26	Expansion of natural gas production is a good alternative for the more dangerous nuclear energy	Energy (supply and alternatives)
27	Natural gas from shale is the same as natural gas from conventional gas fields	Energy (supply and alternatives)
28	The citizen has no power to oppose decisions of the state	Trust
29	Protests against projects of natural gas extraction from shale are hypocritical if people use natural gas themselves	Project specific
30	A percentage of the income generated by natural gas production from shale should go to local governments and provinces	Economy & politics
31	The fact that the government grants permits is reason enough to expect that the environment will be protected during the project	Trust
32	Natural gas production from shale disrupts the local ecosystem of Boxtel/Haaren	Local impact
33	The Boxtel/Haaren area is too densely populated for natural gas production from shale	Local impact
34	The significant investments made in exploration drilling suggest that exploitable natural gas is present in the shale	Trust
35	Accidents and pollution during natural gas production from shale in the United States are reason enough to banish the technology	Risk
36	Drill- or production locations are only acceptable in existing industrial areas	Local impact
37	Exploration drillings will increase traffic and this may cause unsafe situations	Local impact
38	Natural gas production from shale is important in reaching the Dutch status as "gas roundabout" of Europe	Economy & politics
39	Natural gas production from shale lowers the value of homes nearby	Local impact
40	There can be local benefits from natural gas production from shale	Local impact
41	Individuals who refuse to lease land to project developers will not halt exploration. If one doesn't lease land, their neighbours will	Project specific
42	Investments in natural gas production from shale will withhold money from the development of renewable energy sources such as solar and wind energy	Energy (supply and alternatives)
43	The entire Dutch population benefits from natural gas production from shale	Economy & politics
44	The regulations for drilling in the United States are very lenient compared to The Netherlands. This explains the problems faced there.	Regulatory system

45	Injection of chemicals during drilling for natural gas from shale is a hazard for ground- and drinking water quality	Risk
46	Lagging behind with natural gas production from shale lowers the Dutch competitiveness	Economy & politics
47	An environmental impact assessment for exploration drilling should be performed	Regulatory system
48	Natural gas production from shale will not be used as a substitute for coal but as an expansion of the use of fossil fuels	Energy (supply and alternatives)
49	Because there is uncertainty about the "carbon footprint" of natural gas production from shale, further research is necessary before the project is allowed to start	Energy (supply and alternatives)