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Subsurface activities and decision support systems An analysis of the requirements for a social acceptance-motivated decision support system

Herman W.A. van Os [a,*], Rien Herber [a], Bert Scholtens [b,c]

[a] University of Groningen, Faculty of Mathematics and Natural Sciences, Geo-Energy, PO Box 800, 9700 AV Groningen, Netherlands
[b] University of Groningen, Faculty of Economics and Business, PO Box 800, 9700 AV Groningen, Netherlands
[c] University of Saint Andrews, School of Management, 908, Scotland, UK

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ABSTRACT

In this paper, we present a novel perspective on evaluating subsurface activities by increasing the role of social acceptance in the decision-making process. We use the triangle of social acceptance to structure and analyze the decision-making problem in three classes: social–political, market, and community acceptance. This allows the inclusion of strategic and social concerns, beside economical and environmental aspects in the evaluation of subsurface activities. We analyze the requirements of a decision support system for each class according to three aspects: the requirements originating from the context, the requirements derived from the decision-making process, and the extent to which the decision support system can fulfill these requirements. Furthermore, we identify the mechanisms that shape and govern the interactions between the requirements and limitations that result from the context and decision-making process of subsurface activities. We conclude that the requirements of a decision support system for subsurface activities are very different for each class of social acceptance. In addition, we find that several aspects need to be included in an earlier phase of the decision-making process for subsurface activities.

1. Introduction

Decision makers are often confronted with a high degree of uncertainty when dealing with activities involving the deployment of subsurface resources, such as natural gas production (Ministerie van I&M, 2011). This uncertainty complicates the decision-making process, which is already affected by a number of recent trends. First, the increasing level of utilization of the subsurface by a growing variety of activities, such as shale gas production and the underground storage of CO_2, increases the chance of interference between subsurface activities (Weyer, 2013). Secondly, the distribution of costs and benefits, as defined in the discourse of environmental justice, is often perceived by several stakeholders as unfair (Franks, 2009; Schlosberg and Carruthers, 2010). Third, society is becoming more concerned with the risks and socio-physical changes involved, such as an increase in safety risks or changes in land use associated with subsurface activities, which in many cases result in protests, delays, or project termination (Franks, 2009).

Recent experience in the Netherlands shows that the increasing utilization of the subsurface, the perceived distribution of cost and benefits, as well as increasing attention to risks and socio-physical changes have had a negative influence on the quality and effectiveness of the decision-making process for subsurface activities (van Os et al., 2014a). Consequently, a thorough assessment of social acceptance might help to improve decision making. We will therefore investigate the requirements for a decision support system in order to improve the current decision-making process. Hence, the challenge is to investigate whether policies, permit procedures, and associated instruments such as a decision support system (DSS) can be redefined. Furthermore, instead of focusing on siting issues of undesired activities ("not in my back yard"), it is important to maintain a broad perspective when analyzing policies or formulating a DSS (Wolsink, 2010). Therefore, following Koornneef et al. (2008), we argue that the decision-making process and subsequent DSS for the permit procedure for a subsurface activity have to be expanded by including strategic and social concerns, that is, competing alternatives and views from host community members. Furthermore, in relation to strategic concerns, the DSS should be able to provide insight about the impact of a strategic decision and the means to identify potential mitigating actions (Vicente and Partidário, 2006). However, how to incorporate all these aspects in a single DSS is still unclear (Koornneef et al., 2008). In this article, we propose a

* Corresponding author.
E-mail addresses: H.W.A.van.Os@rug.nl (H.W.A. van Os), Rien.Herber@rug.nl (R. Herber), l.j.r.scholtens@rug.nl (B. Scholtens).

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method which includes these aspects in order to determine which methods are best suited for the task.

Following Geels (2004) and van Os et al. (2014b), our analysis focuses on the uncertainties and risks that affect decision-making process, the stakeholders and the rules and institutions that govern the perception and actions of the stakeholders. On the basis of these three elements we will determine the requirements of a DSS for subsurface activities. In addition, following the recommendation of Dyer et al. (1992), we include the characteristics and preferences of stakeholders in our analysis of the requirements of a DSS. To the best of our knowledge, this kind of analysis has never been done before for subsurface activities. Several studies have addressed the different aspects affecting the design of a DSS (Al-Harbi, 2001; Dyer et al., 1992). However, in these studies the requirements and choices were analyzed in isolation, without including interactions between the context, the decision-making process, and stakeholder characteristics. A previous study by van Os et al. (2014b) concludes that the interaction of these aspects substantially affects the requirements of a DSS. Therefore, we believe that our analysis framework presented in this article will increase our knowledge of these interactions and allow us to formulate a DSS for subsurface activities from a social acceptance perspective. Furthermore, to the best of our knowledge, this is the first attempt to incorporate strategic and social concerns, besides economic and environmental concerns, in a single DSS for subsurface activities.

To analyze the decision-making situation for subsurface activities, we use the triangle of social acceptance (Wüstenhagen et al., 2007), because it allows for a comprehensive analysis of the different driving forces, stakeholders, and their concerns (van Os et al., 2014a). The triangle divides the decision-making situation into three classes: social–political, market, and community acceptance (Fig. 1).

In this triangle, social acceptance is viewed from a broad perspective (van Os et al., 2014a; Wüstenhagen et al., 2007). Furthermore, as indicated in Fig. 1, the acceptance level for each class is determined by the stakeholder's views and concerns. Hence the manner in which trust, procedural justice and empowerment e.g. the perceived fairness of the decision-making process, are addressed in the decision-making process and in the underlying decision support system directly affect the acceptance level (van Os et al., 2014a; Marsden and Markusson, 2011). We want to point out that there may be a problem with unambiguously defining the stakeholders and their concerns and interests. Therefore, we will analyze the role of the stakeholders congruent with each category of social acceptance (van Os et al., 2014a). Furthermore, we want to highlight that our interpretation of the triangle of social acceptance differs from the original interpretation of Wüstenhagen et al. (2007), which focuses on institutional changes necessary for the implementation of renewable. However, following van Os et al. (2014a) and van Os et al. (2014b), we will use the triangle of social acceptance to identify the relationship between the different driving forces affecting subsurface activities and the relevant stakeholders. Furthermore, we use the triangle to identify the interaction between different driving forces and between the different stakeholders. This allows us to structure the decision-making process. Furthermore, we use the insights underlying the triangle of social acceptance, for example role of empowerment, procedural justice and trust building, as criteria for analyzing the requirements for a decision support system for subsurface activities.

In Section 2, we describe the context for subsurface activities for all three classes of social acceptance and we analyze the uncertainties, risks, and interactions between the classes. In Section 3, we describe the requirements and limitations of decision-making processes following from the conditions set by the context. In Section 4, we assess the

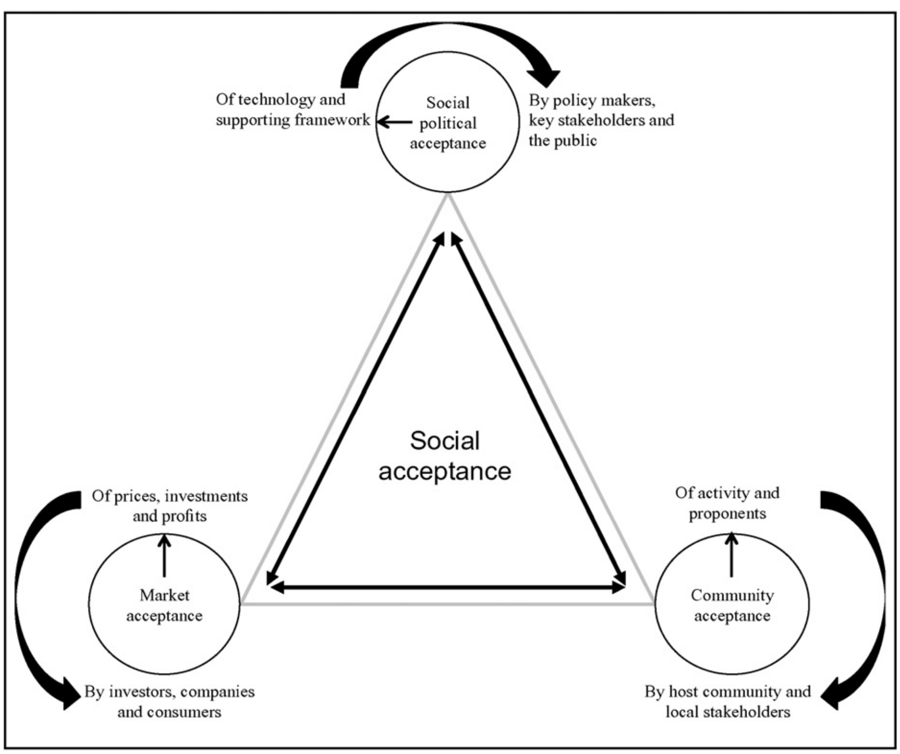

Fig. 1. Triangle of social acceptance (Wüstenhagen et al., 2007). The three classes of social acceptance are depicted as circles. The small arrows indicate the concerns of the class and the curved arrows indicate the relevant stakeholders. The triangle in the middle indicates the interaction between the three classes of social acceptance. In the social–political acceptance class, the main goal of a decision support system is to gain better insight into the contribution of a subsurface activity to the realization of policy goals both now and in the future. These policy goals are usually formulated broadly and at a highly abstract level, such as for energy security and CO_2 emission reduction (Wüstenhagen et al., 2007). In the market acceptance class, the main goal of the decision-support system is to determine the allocation of costs benefits and risks among market participants, which consist of producers as well as consumers. For the community acceptance class, the main element of the decision support system is to facilitate the judgment of the host community concerning the locally endured risks and the social, physical and economic changes resulting from the proposed subsurface activity as well as the reputation of the project owner (van Os et al., 2014b).