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Communicating risk through a DSS: A coastal risk centred empirical analysis

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ABSTRACT

Risk communication has recently evolved from the design of unidirectional (from scientists to the public) information flow toward a more integrative deliberative procedures (involving scientists, policymakers, stakeholders and the general public) aimed at reconciling diverging social constructs of risk. Furthermore, risk communication is seen now as an activity that is transverse to the risk governance process as a whole. Risk communication is therefore part of the preassessment, appraisal, characterization/evaluation and management phases of risk governance. At the same time the development of risk management Decision Support Systems are increasingly geared at facilitating decision making while taking into account and streamlining all the phases of the risk governance process. These recent trends lead to a redefinition of the role of risk communication in the context of the development of DSS.

This paper explores these issues by analysing how risk communication can be integrated into THESEUS's DSS. A first step of this analysis consists of applying grounded theory to analyse stakeholders' perception in three of THESEUS's application settings. We then compare this theorization to the grounded theorization of the foundational model of THESEUS's DSS. The result of this comparison points to diverging, yet not incompatible, paradigmatic views on the nature of coastal risks. These divergences are further analysed through semi-structured interviews with key informants involved in the development of the DSS.

Building on these results we develop a communication scheme that should allow a progressive convergence of paradigmatic views occurring through the use of the DSS; we are thus proposing that the DSS in itself be a locus where risk communication as a deliberative practice occurs. In order to achieve this we propose that the cognitive pathways followed by DSS users be proactively designed and involves integrative exchanges between designers, users and policy makers.

1. Introduction

This paper proposes an empirically grounded and innovative approach to the use of Decision Support Systems (DSS) as locus of knowledge mobilization integrating diverging social representations. It uses as a case study the analysis of the development of a DSS within the THESEUS project (Zanuttigh, 2011; Zanuttigh et al., 2014-this volume). This DSS has the goal of contributing to the reduction of coastal risks.

Managing coastal risks entails decision-making processes that call for the involvement of a high diversity of stakeholders. This diversity leads to three potential challenges:

(1). Heuristic diversity: high diversity of experience with the coastal system and associated risk, leading to a variety of understanding of the way the coastal system functions;
(2). Issue diversity in material terms: differing prioritization as to what should be protected, as to what deserves attention;
(3). Issue diversity in normative terms: differing moral statements as to how values may be threatened by the risk or by the risk governance/mitigation options that are envisioned.

The issue of conflicting norms leading to diversity in representations has been addressed quite thoroughly in various settings following the seminal work of Douglas and Wildavsky (1982). A recent avatar may be found in Kahan et al. (2012) where the authors show that science numeracy and literacy does not explain diverging perceptions on climate change while groups values does explain this "tragedy of the perception commons". The authors, in their conclusion, summarize what is seen as the current role of risk communication: "communicators should endeavour to create a deliberative climate in which accepting the best available science does not threaten any group's values."

The issue of diverging heuristics leading to different understandings as to the causal linkages leading to the description of the risk has been explored in a variety of settings (Renn, 2008). Yet coastal systems are often identified as archetypes of "complex system" characterized by

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their non-deterministic nature, emerging properties, multiple scales, extremely porous boundaries (Berkes, 2003; Costanza et al., 1993; Ostrom, 2009). There is therefore a genuine possibility that the understanding of causal relationships within coastal systems be complexified by paradigmatic tensions. Coastal risk may be construed as part of a deterministic, simple system, or as part of a non-deterministic complex system. In this paper we argue that a DSS may be a locus where diverging worldviews are integrated in order to accompany risk governance. In order to achieve such integration we analyse how vulnerability and resilience, as risk governance discourses, constitute the bedrock of the deterministic/non-deterministic paradigmatic tensions. We then propose to formally include these considerations into the design to the DSS cognitive pathway.

In this paper, we root this exploration in an empirical analysis centred on the THESEUS project (Zanuttigh, 2011; Zanuttigh et al., 2014-this volume). This project had as objective to examine the application of innovative combined coastal mitigation and adaptation technologies generally aiming at delivering or lower risk coast for human use/development and healthy coastal habitats as sea levels rise and climate changes. Its primary objective was to provide an integrated methodology for planning sustainable defence strategies for the management of coastal erosion and flooding that addresses technical, social, economic and environmental aspects. Conceptually, integration has been achieved within THESEUS by refining the Source Pathway Receptor Consequences (SPRC) model and applying it formally to the coastal system (Narayan et al., 2014). The SPRC model was used to organize the risk assessment, to identify the role within a vulnerability reduction approach of various mitigation options, and define the underlying structure of the THESEUS DSS. One of the project's key outputs is the THESEUS DSS which frames the empirical work that is presented here. This Decision Support System, which is not web based, and has been developed using licence free software, is geared at assisting coastal manager and risk management practitioner, into the choice and design of coastal risk mitigation options (Zanuttigh, 2011; Zanuttigh et al., 2014-this volume). Some of its key design constraints were the need to be usable at a variety of spatial scales (1 to 100 km) and temporal scales (1 to 100 years). A probabilistic multiscenario approach was used in order to take into account projected changes in local climates. Starting from environmental data and scenario, wave transfer function, erosion and flood models, the DSS allows for the establishment of flooding maps and hydraulic vulnerability maps. The data on floods and hydraulic vulnerability is used to assess the economic, social and ecological impacts through associated functions leading to the production of economic, social and ecological vulnerability maps; these maps combined into a single integrated risk assessment map. The THESEUS DSS contains various mitigation options, developed and analysed in the course of the project. The implementation of these mitigation options is modelled, allowing for an analysis of its benefit in terms of risk reduction, under various climate, environmental and socio-economic scenarios (either predefined and user defined).

In this paper, we demonstrate that this DSS may, through careful and empirically grounded cognitive pathway design, become a locus to foster a deliberative climate. It is important to stress here that the purpose of such an exercise is not to develop a single unified representation of the costal risk system. Its purpose is not to fill some imagined gap in the understanding by stakeholder of the nature of the coastal risk. The purpose for such an exercise is to allow exchange, mutual learning, and the development of deliberative exchange, through a plurality of perspective, on a complex societal issue.

In order to achieve this we have proceeded first by exploring empirically the three following working hypothesis: (1) Representations of coastal risks are diverging, more precisely the representation of coastal risks of local stakeholders and scientists working on the development of THESEUS's DSS are different; (2) These divergences are rooted in different material and moral value systems; and (3) These divergences are rooted in paradigmatic tensions visible through the relative importance given to intervening within causal chains (deterministic paradigm; vulnerability reduction approach) and the relative importance given to intervening on the system's boundary conditions (non-deterministic approach; resilience enhancement approach). We then analysed the THESEUS proposed DSS structure in terms of cognitive pathway. This allowed one for the development of a cognitive pathway geared at achieving a deliberative climate in which accepting the best available science does not threaten any group's values or worldviews.

In this paper we begin by presenting the methods used for empirical part of the work conducted (Section 2, the present introduction being Section 1). We then proceed by presenting and discussing the results of the empirical work (in Section 3). In Section 4 we develop the proposed cognitive pathway, before concluding (Section 5).

2. Material and methods

2.1. Data description

Three corpuses have been used. A first one consisting of transcribed semi directed interviews with coastal risk stakeholders. A second one consists of scientific reports associated with the development of the DSS. A third one consists of transcribed interviews with scientists involved in the DSS development. This choice of material was made sequentially in the course of the project. After analysing the first corpus, heated exchanges among the THESEUS partners led to the feeling that a comparison of stakeholders' representations and the scientific developments underlying DSS was needed. Following this, we wanted to ascertain how strongly the differences between the two corpuses were associated with the project and its structure (influencing the nature of deliverable in the second corpus) or with the paradigmatic differences that might exist between stakeholders and scientists as individuals.

2.1.1. Stakeholder interview corpus

The "stakeholder interviews" consist of 32 transcribed semi directed interviews with stakeholders in three locations where the THESEUS DSS will be implemented: the Gironde estuary, France (9 interviews), Santander, Spain (12 interviews) and Cesenatico, Italy (11 interviews). The interview framework was built around an aerial photograph of the site, the identification of areas at risk of flooding or erosion, and the discussion of current or envisioned challenge for risk mitigation. The interview framework consisted of three questions that were associated with prompts (see Table 1).

These interviews were chosen as a proxy to local stakeholders' individual and collective representations. The choice of semi directed interviews as an approach to the analysis of representations was made in order to be able to be able to gain an insight into the "experiences, concerns…values, knowledge and ways of thinking, seeing, and acting" (Schostak, 2006) of the interviewee, while keeping a high level of flexibility. The challenges associated with this choice are the near impossibility to represent the results quantitatively and the need to develop robust interpretation procedure.

The average duration of interviews amounted to 50 min (minimum of 17 min, maximum of 73 min). Transcriptions averaged 1812 words (minimum of 882 words, maximum of 3089 words).

The sampling was designed in order to capture a high variety of differing experience in relation with the coastal site under scrutiny. An initial sample of key informants was identified through the scientists' personal networks. Thereafter we relied on advice from the informants themselves, using thus an approach akin to snowball sampling.

Table 2 presents key characteristics of the interviewees' sample.

Such a sampling procedure has the characteristic of not representing the population in statistical terms. Yet statistical representativity is not what we wanted to capture. Our goal was to capture meanings associated with a diversity of experiences. We thus aimed for a diversity of heuristics associated with the coastal risk system. In order to define sample size we conducted saturation analysis. Saturation analysis conducted by