

Response to “Call for R&D&I Rendezvous” - **Work in progress**

(Extended abstract of minimum 10 000 characters).

Innovation in Transdisciplinary and Heterogeneous Collaborations: Exploring new ways of Organizing Environment-friendly Energy Research

*Tone Merethe Berg Aasen**, *Oscar Amundsen** (contact person), *Mona Mølnevik*** and
*Grethe Tangen***

* NTNU Social Research, 7491 Trondheim-Norway

Email contact: oscar.amundsen@samfunn.ntnu.no

**SINTEF Energy Research, 7465 Trondheim-Norway

Purpose of paper

This paper explores the relevance of the ideas of ‘Mode 2 knowledge production’, originally introduced by Gibbons et al. (1994), as an approach to investigate ongoing collaboration processes for knowledge development and the emergence of innovation. It is argued that this work offers a useful supplement to the ideas of Open innovation suggested by Chesbrough (2003) in the context of current interest, which is international collaboration between many partners within the framework of research and innovation (R&I) consortia. Application of the attributes of ‘Mode 1’ and ‘Mode 2’ knowledge production, in particular the emphasis on transdisciplinarity, heterogeneity, reflexivity and context, is seen as a potential help to broaden the understanding of how new knowledge and innovation evolves and diffuses in R&I consortia for those charged with the responsibility of coordinating and managing such complex forms of co-operation. Two ongoing multipartner R&I consortia working to develop and realize innovative solutions within the field of environment-friendly energy are used as examples to explore this claim.

Relevance of paper

The challenges of climate changes and the need for alternative energy forms are by nature of global concern, making strict demands on coordination and collaboration for innovation across national, cultural and professional borders. Accordingly, the topic pursued in this paper links both with the subtheme and with the overall conference theme.

Introduction

"The world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable — environmentally, economically, socially. But that can — and must — be altered; there's still time to change the road we're on" (IEA, 2008:37).

The Intergovernmental Panel on Climate Change (IPCC) states that the observed increase in global average temperatures since the mid-20th century is very likely due to the increased anthropogenic green house gas concentrations (Climate change, 2007). This assumption has led to substantial efforts world-wide to develop expertise and promote innovation through a focus on long-term research in selected areas of environment-friendly energy, CO₂ management and energy efficiency improvement. In Norway, public co-funding can be obtained if the strategic research and innovation (R&I) initiatives represent long-term and binding collaborations among universities, research communities and industrial partners. The examples used in this paper are from two consortia, focusing on Carbon Capture and Storage (CCS), and on reduced energy use in industry, respectively. Each consortium is composed of just over 20 partners from several countries. The authors represent two of the partners in both initiatives; one research institute holds the role as facilitator of processes for team building and innovation in the two consortia (NTNU Social Research), and the other research institute is the host institution, responsible for managing and coordinating consortia processes (SINTEF Energy Research).

The multi-partner consortia we explore as our cases can be seen as examples of a trend towards increasing complexity, size and contextual demands of R&I projects. Different dimensions can be used to describe the situation of the specific examples we use: One is the combination of specialized disciplinary and applied interdisciplinary research, intended to lead to new knowledge and innovation. Another dimension, characteristic for climate related

research, is the demands advanced by national authorities ‘on behalf of society’ that the climate crisis must be solved, presenting a substantial challenge to industrial, political and individual will and ability to adapt. The present extraordinary injection of public funding, combined with the general growing sense of urgency that the climate crisis must be met, set the related research projects in a rather different position than both previous climate related projects and R&I projects in other fields. It is relevant to ask how this new context influences the knowledge processes within the research projects. The question guiding our research is: *How can multidisciplinary, multiorganizational processes for knowledge production and innovation in R&I consortia be described, explored and explained?*

Theoretical background

Schumpeter (1942) claimed that the purpose of innovation is strategic advantage, obtained by doing things in new ways in economic life. Although his ideas are very much alive today, the view on how to interpret and represent processes for innovation has changed over the years (Rothwell, 1994). In the 1970s recession and intensified competition led to increased attention among business managers and researchers towards the value of risk management, networking, best practice, and user driven innovation. Current ideas of innovation as stepwise processes starting with research and ending with market introduction of new technology were gradually replaced by interactive innovation ‘ls, built on system dynamic thinking and on ideas about system integration and network collaborations (ibid.). Furthermore, development towards increasingly more complicated and interdependent technologies and processes led to additional demand for cooperation across organizational, geographical and professional boundaries, and a view emerged that innovation no longer could be seen as processes taking place within the boundaries of a single company (Caloghirou et al., 2004). A now widespread idea is therefore that innovation develops within an innovation system (Werker, 2001), embracing a complex set of relations between actors in various companies, universities and public research institutes. In the wake of these developments, the notion of ‘open innovation’ was introduced by Chesbrough (2003), involving a particular focus on collaborative structures and on the subject of intellectual property rights. His idea is that organizations can and should explore external knowledge sources as a supplement to employers’ competence in all parts of their innovation processes. The suggested benefits of this approach are increased innovation

in selected areas, fewer bad investments and extended markets and market channels for new products (ibid.). An underlying assumption in the open innovation thinking appears to be that the knowledge needed for any purpose is available in an open market, and may, at some price, be exploited by any company. An interesting debate related to this, is whether a strategy of open innovation implies that companies can reduce own knowledge processes, or not (Herstad et al., 2008).

During the 1990's, a somewhat different strand of research emerged, based on an increasing recognition that the science system is getting more oriented towards strategic goals and the production of relevant knowledge (Gibbons et al., 1994; Nowotny et al., 2001; Hessels and van Lente, 2008). The concept of 'Mode 2' knowledge production was introduced by Gibbons et al. (1994) to denote "*knowledge produced in the context of application, by so-called transdisciplinary collaborations*" (Hessels and van Lente, 2008:740). In 'Mode 2', the distinction between basic and applied research is no longer relevant. The overall objective of research is to respond to perceived needs for new applications, involving the necessity of taking into account the different requirements, values and demands of collaborating partners. 'Mode 2' knowledge production can therefore be understood as being more complex than a traditional 'Mode 1' knowledge production. While 'Mode 1' knowledge is seen to be the result mainly of work in scientific institutions, 'Mode 2' knowledge is shaped by broad specters of intellectual, social, and also commercial needs. The basic claims related to the 'Mode 1' and 'Mode 2' knowledge development concepts can be summarized in the following table (ibid):

Table1

Mode 1	Mode 2
Academic context	Context of application
Disciplinary	Transdisciplinary
Homogeneity	Heterogeneity
Autonomy	Reflexivity / social accountability
Traditional quality control (peer review)	Novel quality control

Our intention in this paper is to use the claims of the 'Mode 1' and 'Mode 2' concepts

as an approach to describe and analyze the knowledge development processes in multipartner R&I consortia, exemplified by two cases, which are placed in the context of environmental friendly technology development and innovation. At present, the collaborations are at an early stage, and technologies are immature. The consortia are, however, financed for a minimum of five years, enabling us to study the collaboration and coordination processes over time. Examples of questions already emerging are whether researchers and business managers in general become increasingly reflexive, in the sense that their focus is on the potential environmental effects of emerging knowledge and technologies. The concept of reflexivity points at a distinct characteristic of the 'Mode 2' knowledge production, which is the researchers' awareness of the potential societal consequences of their research, and the implication of this for their choice of research objectives, methods and approaches. Another issue is to what extent researchers consider the innovation potential of their results and how this affects their priorities. Furthermore, the paper seeks to explore whether the consortia, or particular groupings within the consortia, develop into genuine transdisciplinary collaborations, and how the characteristics of such groups affect knowledge development and innovation.

The research gap addressed

Although research on the management of collaborative innovation efforts is extensive, focus is generally on performance seen from the perspective of individual companies or research institutes. This is also true of the Open innovation concept (Chesbrough, 2003; Chesbrough et al., 2006). However, it has been argued that the increasing demands on formalized formation of heterogeneous, multi-partner R&I groups have led to a change of science systems into more interactive and 'socially distributed' systems (Hessels and van Lente, 2008). To the best of our knowledge, the dynamics of such transdisciplinary collaborations and the managerial challenges in terms of innovation have not been explored.

Being among the consortium partners, the combined role of a NTNU Social Research as a facilitator and researcher of innovation processes in the consortia is yet unusual. A main task is to support and coordinate processes for centre building and to promote innovation, and at the same time to explore the experience gained from an innovation process perspective.

This gives a unique opportunity to learn about important aspects of heterogenous consortium collaborations for innovation as they evolve.

Approach and analysis

As indicated, the reported work started in 2009. The focus is on the early phase of collaboration where processes of cooperation and coordination within two heterogeneous groups of partners are still in the melting pot. Ideas from recent research on new knowledge production are investigated (Hessels and van Lente, 2008), and combined with insights from research on Open innovation (Chesbrough, 2003). The experience from the consortia efforts will be explored from 'within' the development processes (Shotter, 2006), through the adoption of a complex responsive processes perspective (Stacey, 2001). The complexity perspective is about temporal participation in local communicative interaction and the approach we adopt is that of *emergent participative exploration* (Christensen, 2005; Aasen, 2009).

Findings

The reported findings should be seen as preliminary. However, the concept of 'Mode 2' knowledge production appears as a valuable tool to explore ongoing knowledge processes in temporary, multipartner R&I consortia. The results indicate that the relevance of the characteristics suggested being representative of 'Mode 1' and 'Mode 2' knowledge production differs between and within the two consortia studied. It should be emphasized that 'Mode 1' knowledge production is not viewed as a perspective of the past. Rather, the concepts of 'Mode 1' and 'Mode 2' knowledge production are interpreted as concurrent processes, which can be observed in various combinations in the two consortia.

Although useful, the limitation of the 'Mode 1' and 'Mode 2' knowledge production perspective is the lack of focus on the individual actors and their motivation for contributing to knowledge production and innovation. The ideas of Open innovation (Chesbrough, 2003), on the other hand, are developed from the perspective of single companies in need of an extended store of knowledge, and as such, appears highly relevant to our work. Finally, the presented work adopt a complex responsive processes perspective on knowledge development and innovation, involving a view that such processes are emerging conversational patterns of

meaning and identity (Aasen, 2009). These are patterns which evolve in the interplay between interdependent individuals representing different organizations, fields, interests and commercial considerations. Taken together, it is found that the ideas of Open innovation, the concepts of ‘Mode 1’ and ‘Mode 2’ knowledge production, and the perspective of complex responsive processes, represent a promising basis for the exploration and explanation of knowledge development and innovation in transdisciplinary, multipartner R&D consortia.

Contribution

The intention of the innovation oriented activities integrated in the R&I initiatives is to increase consortium partners’ attention towards collaboration and innovation, and to support them with knowledge about how to handle such processes, including their own part in it. The expectation is that this will promote the development of commercial valuable knowledge and technology, as well as encourage the dialogue between the research communities and the industrial partners. Although this study is within the particular context of climate research, the publication of experience gained from these processes should be relevant both to science studies, to the innovation research communities, and to research and business managers charged with a responsibility for similar processes.

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