Systemic Innovation In The Making

The Social Productivity of Cartographic Crisis and Transitions in the Case of SEEIT

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The Social Productivity of Cartographic Crisis and Transitions in the Case of SEEIT

Nicolaj Tofte Brenneche

Doctoral School of Organisation and Management Studies

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The Doctoral School of Organisation and Management Studies (OMS) is an interdisciplinary research environment at Copenhagen Business School for PhD students working on theoretical and empirical themes related to the organisation and management of private, public and voluntary organizations.

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Nicolaj Tofte Brenneche
St. Gallen, November 2013

Dansk resume

Den langsigtede omstilling til bæredygtige energisystemer manifesterer sig allerede i dag i væsentlige omstillingsbestræbelser i den måde forskning og innovation på energiområdet tilrettelægges på. Med ambitiøse europæiske og nationale målsætninger for omstilling til bæredygtige energisystemer melder der sig en omstillings-kompleksitet, der udfordrer gængse definitioner af videndomæner og deres indbyrdes forhold. Således åbner langsigtede systemforandringsmål for en bred vifte af udfordringer, der overskrider de etablerede rammer for, hvad der typisk angår energiforskningens forskellige domæner samt afgrænsningen af, hvilke fagområder og aktører, der kan bidrage til viden og innovation på energiområdet. For eksempel opstår der nye behov for at knytte forbindelse mellem ekspertviden og aktører indenfor energieffektivt byggeri med ekspertviden indenfor energisystemanalyse og –plan-lægning, som følge af forventningen om, at netop byggeriet i fremtiden kommer til at spille en mere central rolle for, hvordan energisystemer konstrueres og styres. Der kunne nævnes talrige andre eksempler på, hvordan energiforskningen som komplekst videnfelt i dag er konfronteret med en ny, åben omstillingskompleksitet, der som en kraftfuld virtualitet transformerer det landskab energiforskningen udgør og opererer i.

Det er ønsket med nærværende ph.d. afhandling at foretage en undersøgelse, der bidrager til at belyse de udfordringer energiforskningen møder i bestræbelserne på at bidrage til langsigtede systemomstillinger. Det er især hensigten at bidrage til forståelsen af det som i feltet og i litteraturen kaldes for *systemisk innovation.* Der er her tale om en form for innovation, som vedrører transformation af *relationelle ordener* i den måde forskning og innovation tilrettelægges og udfoldes på. F.eks. den type innovation som opstår, når etablerede viden- og aktørdomæner danner nye, effektive samarbejder henover faglige og institutionelle skel. Frembringelsen af en ny relationel orden (en ny topologi) vedrører således ikke i første omgang kommercialisering af specifikke teknologier eller produkter som innovationsbegrebet ofte henviser til. Begrebet systemisk innovation vedrører et andet plan og en række andre problemstillinger, herunder især spørgsmål angående organisering af samspil om innovation og systemomstillingsprocesser. Det er her omstillingskompleksitet blandt andet manifesterer sig i form af nye samarbejdskonstellationer henover aktør- og videndomæner. Det er sådanne konstellationer og deres betydning for systemisk innovation ph.d. afhandlingen sætter sig for at undersøge med udgangspunkt i et eksempel på et europæisk strategisk partnerskab kaldet "SEEIT" (Sustainable Energy Education, Innovation, and Technology).

Afhandlingen etablerer en *kartografisk tilgang* til at undersøge partnerskabet empirisk og analysere dets organiseringsprocesser. Den kartografiske tilgang rummer både en metodisk og analysestrategisk komponent, som gennemgås i særskilte kapitler til forberedelse af selve analysen. Som analysestrategi, søger den kartografiske tilgang at etablere et processuelt blik på det empiriske materiale således at analysen fokuseres på frembringelsen og omdannelsen af organisatoriske løsninger således som disse udfolder sig i løbet af partnerskabets udvikling. Den kartografiske tilgang betoner især, hvordan partnerskabet og det felt det opererer i, skaber potentialer for samarbejder gennem divergerende kartografiske processer, hvorved transitionsudfordringer defineres, forhandles og problematiseres, og hvordan dette kartografiske arbejde udgør en organiserende drivkraft, som trækker på de potentialer for samarbejde de selv skaber. Den kartografiske analyse fokuserer på disse processer og deres måde at skabe organisering og potentiale for samarbejder, hvor etablerede videndomæner og koordineringsløsninger viser sig utilstrækkelige for håndtering af omstillings-kompleksitet.

Som metodologisk ramme har den kartografiske tilgang *in(ter)vention* som sit omdrejningspunkt. Dette indebærer en forskningsmetode, der bygger på aktiv deltagelse i og samarbejde med det felt der undersøges. Forskningsmetoden tager udgangspunkt i en *performativ* videnforståelse som tilsiger at forskning udgør en aktiv og skabende proces, der ikke blot udvikler 'viden om' men også 'viden for' det felt det undersøger og deltager i. Der er altså tale om en videnforståelse og metodetilgang, som betoner forskningens konkrete måde at medskabe de verdener den undersøger og som forsøger at gøre en dyd ud af dette fremfor at insistere på en mere traditionel videnform, der søger sin legitimitet via distancering til sit empiriske felt og den form for 'objektivitet' distancering håber at kunne indstifte.

Analysen af SEEIT partnerskabet viser, hvordan omstillingskompleksitet frembringer en slags *kartografisk krise* i form af divergerende problem-diagnoser, fragmenteringsproblemer og en lang række andre koordineringsudfordringer. En kartografisk krise har intet at gøre med mangel på kompetencer. Der er tale om en form for krise som opstår når veletablerede videndomæner møder en ny kompleksitet de ikke kan favne uden at blive transformeret i processen. Her opstår der en række udfordringer så som rivaliserende problemdiagnoser og løsningstilgange som forsøger at 'sætte sig' på problemdefinitionsmagten og således gøre sit løsningsperspektiv gældende som mere effektivt end alternative løsningstilgange. I sådanne kartografiske kriser opstår der muligheder for at kombinere og gå på tværs af hidtil adskilte viden- og aktørdomæner. Det er et opportunt sted hvorfra systemisk innovation og dermed ny interaktion kan tage form. Dette viser analysen af SEEIT visse eksempler på og udgør som sådan et forsøg på at demonstrere anvendeligheden af den kartografiske tilgang til analysen af systemisk innovation.

Analysen giver desuden anledning til visse refleksioner over de praktiske udfordringer der melder sig når strategiske partnerskaber bliver ’svaret’ på udfordringen om at styrke samarbejde om innovation og systemomstilling på energiområdet. Afhandlingen åbner således for en diskussion om hvordan partnerskaber på den ene side kan danne ramme for håndtering af omstillingskompleksitet og organisering af systemisk innovation og på den anden side hvordan dette åbner for en kompleksitet for de involverede partnere samt det policy-miljø partnerskabet agerer i som kræver en forøget grad af fleksibilitet og ”systemvisdom” som også Gregory Bateson pegede på.

Med den kartografiske tilgang og analysen af SEEIT søger afhandlingen at bidrage med nye tilgange til studiet af systemisk innovation og organisering af samspil om omstilling til bæredygtig energi. Udover de praksisorienterede diskussioner, søger afhandlingen således at bidrage tværfagligt til innovationsforskning samt organisationsforskning og peger på et frugtbart krydsfelt mellem disse forskningsfelter.

English summary

The long term transition to sustainable energy systems is already having an impact on how energy research and innovation is being organized. With ambitious European and national goals for energy system transitions, a new transition complexity challenges established domains of expertise and other established actor domains. Thus, system transition complexity opens up for a broad range of new relational problems which transgress established definitions of expert domains and which areas of expertise ‘belong’ to energy research and which actors are relevant for energy research and innovation. As an example hereof, the long term prospective of transformed energy systems actualizes a need for combining expert domains and actors within energy efficient buildings with expert domains and actors within the modeling, planning and management of energy systems of various kinds. Many other examples could be listed illustrating how energy research as a complex field of knowledge production and innovation confronts a new, open transition complexity, which transforms the landscapes of energy research.

It is the overall purpose of this dissertation to inquire the nature of the system transition challenges for energy research and particularly to contribute to our understanding of *systemic innovation*. Systemic innovation has to do with the transformation of a *relational order* in how energy research and innovation is organized. For example, the kind of innovation which grows from the formation of new constellations of expert domains and other actors involved in energy research and innovation. This kind of innovation is not first and foremost about commercialization of new technology as the innovation literature and innovation policy discourses usually tell us. Systemic innovation unfolds on a different level and entails different kinds of transformations such as the transformation of cooperative frameworks and coordination solutions

which potentialize and actualize new interaction processes across otherwise disconnected actors and expert domains. This is a level where transition complexity becomes manifest in how it puts pressure on established domains and their "proper place" vis á vis other domains of expertise within energy research. New actor constellations are being formed in response to system transition complexity and it is the role of and challenges for such constellations that this dissertation will put focus as a means to inquire systemic innovation in the making. The dissertation does so with an empirical point of departure in a European partnership called "SEEIT" (Sustainable Energy Education, Innovation, and Technology) formed in 2009.

The dissertation establishes a *cartographic approach* to studying this partnership as an instance of ongoing systemic innovation. The cartographic approach comprises methodological principles and an analytical strategy and serves as an alternative to established analytical frameworks in innovation studies. As an analytical strategy, the cartographic approach puts focus on processes of systemic innovation understood as interaction in the making. In particular, the analytical strategy is to focus on how the partnership, and the field in which it operates, creates potential for interaction through divergent cartographic processes whereby transition challenges are being defined, negotiated and problematized, and how these cartographic processes constitute an organizing force which feed on the potentiality for interaction they generate themselves. The cartographic approach focuses on such processes and their way of creating (or destroying) potential for cooperation where established domains of various kinds and established means of coordination are insufficient for dealing with system transition complexity.

As a methodology, the cartographic approach center stages *in(ter)vention.* This implies a research practice building on active participation and cooperation in and with the empirical field. The theoretical point of departure for this is a *performative* understanding of knowledge production saying that research is inherently creative and performative rather than merely objective and representational. Research generates not only knowledge ‘about’ something, but it also actively participates in generating the worlds it inquiries. Situatedness and in(ter)vention are keywords in this innovation research practice as opposed to distance and representation as a precondition for objectivity.

The analysis of SEEIT shows how transition complexity arrives as a form of *cartographic crisis* involving problem-diagnostical rivalries, fragmentation problems and a range of new coordination challenges. A cartographic crisis does not refer to a lack of competence on the part of those involved in the SEEIT partnership. Rather, a cartographic crisis grows from the encounter between well-established knowledge systems and actor domains and an open-ended system transition complexity which these systems and domains cannot deal with without undergoing transformation in the process. In a cartographic crisis a variety of relational problems emerge such as how to diagnose transition challenges and translate these into actual steps in research and innovation, how to combines heterogeneous actors in new cooperative settings, and so forth. In this context, a variety of problem-response conventions and presuppositions strive to set their mark on defining problems to be solved by means of certain solutions or approaches. Cartographic crisis thus involves competition and rivalry. But it also opens up new potentiality for interaction, unfamiliar combinations of expert domains, and new actor constellations. A cartographic crisis is thus a fertile ground for systemic innovation to take shape which the analysis of SEEIT will illustrate. In all, the analysis will seek to demonstrate the plausibility of a cartographic approach to studying systemic innovation in the making.

The cartographic approach and the analysis of SEEIT opens up for some reflections regarding the practical challenges related to the formation of strategic partnerships as a response to system transition complexity. Today, partnerships are often a key element in innovation and science policies and are supposed to enhance cooperation and coordination capacities and therefore reinforce the interaction between fields of expertise and across sectorial boundaries. The analysis of SEEIT opens up for a discussion about how partnerships on the one hand may strengthen transition complexity responsiveness while on the other hand introducing a new complexity for research management and policy systems alike. Partnerships might be very effective in relation to specific aspects of systemic innovation but they also increase the need for thinking innovation and innovation policy instruments systemically which might be a particularly difficult challenge.

With the cartographic approach and the analysis of SEEIT, the dissertation aims for contributing to our understanding of innovation as inherently systemic and the challenges of organizing cooperation as a response to system transition complexity. Besides the practice oriented implication discussions this opens up for, the dissertation seeks to make a cross-disciplinary contribute connecting innovation studies and organization process studies.

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Acronyms

CBS	Copenhagen Business School
DG Energy	General Directorate for Energy (European Commisssion)
DTU	Technical University of Denmark
EERA	European Energy Research Alliance
EIT	European Institute of Innovation and Technology
KIC	Knowledge and Innovation Community
SEEIT	Sustainable Energy Education, Innovation, and Technology
SET Plan	Strategic Energy Technology Plan
TU	Technical University (e.g. TU Munich, TU Delft)

Opening

March 2012. The SEEIT partnership is gathered at the Technical University of Denmark for a two days' workshop on "Sustainable Buildings And Their Future Energy Solutions". The workshop has attracted almost 50 participants from across Europe. Many are engineers, but at this workshop there are also many social scientists. The range of perspectives is broad, and they are mixed up purposefully in how the workshop has be designed. It is an intense workshop. Many interaction potentials that need to be explored. Many projects that could be promising. The workshop gives everyone a taste of system transition complexity. Or rather, what happens when this complexity is being invited into a cooperative process.

We learn about the long term transition to low carbon energy systems in Denmark. We learn about new technological solutions to modeling energy dynamics in buildings and their role in future energy systems. And we learn about why the construction of energy markets do not automatically support sustainability transitions. It all has to do with a long term transition of energy systems. Sometimes it seems that this is the only thing that binds these diverse presentations together. A thin and fragile thematic line on the verge of dissolving into fragmentation. But they are also small cartographic operations constructing a problem to respond to. Seeking to draw the line which carves out a problematic context for the partnership to respond to collectively.

The partnership coordinator walked up to me during a pause. He was energized as always when new project potentials were prospering. At this occasion he was also struggling as he was supposed to come up with a frame that would synthesize the many perspectives, and thus help sustain the cooperation process after the end of the workshop. "We need a theory of complexity to handle this!", he said to me. I didn't *come up with a brilliant answer. I felt slightly paralyzed by the vast range of prospects for cooperation the workshop generated.*

How to respond, in concrete action, to system transition complexity? How to organize cooperation for systemic innovation? How to face transition complexity without getting stuck in the vast range of potentials for interaction it opens for?

1. Introduction

1.1. Energy systems in transition

> *"By 2050, the sum of the potential of all the low-carbon energy sources exceeds the expected demand. The challenge for a sustainable global energy system with low CO2 emissions by 2050 is therefore to utilise this potential in the energy system in an economically attractive way. It will not be possible to develop the energy systems of the future simply by improving the components of existing systems."*
>
> [Larsen and Petersen 2010: Risoe Energy Report]

Despite economic crisis, the pursuit of long-term transitions to low-carbon energy systems remains a high priority in European policy making. In recent years, the EU Commission has invested considerable efforts in building up a system transition momentum through the setup of ambitious goals for reducing carbon dioxide emissions and for developing and implementing new sustainable energy technology solutions while increasing significantly overall energy efficiency. The Strategic Energy Technology Plan (the SET Plan) has become one of the main frameworks through which the EU Commission has co-constructed a system transition agenda in cooperation with member states, the European energy industry, and the European energy research environments (EU COM 2007b, EU COM 2010b, EU COM 2011b).

At the same time, European energy research and innovation programmes are being reframed so as to become more responsive to system transition challenges. This is a key priority in the coming EU framework programme for research and innovation called "Horizon 2020" (EU COM 2011a). One of the ambitions behind Horizon 2020 is to organize European research cooperation in order to address and solve "grand societal challenges". In the energy research field one of the main challenges is to develop new means of cooperation connecting a variety of fields of expertise within and beyond the traditional scope of energy research domains which tend to be organized according to energy technologies (e.g. wind turbines, photo voltaic, bio-energy technology, conversion and storage technologies, etc.). When responding to system transition challenges, such specializations are seen as necessary but insufficient for contributing to comprehensive system transition processes (Højgaard 2012). Thus, cross-cutting research integrating a variety of technical fields of expertise with social science and humanities is pointed to as an important part of how the Horizon 2020 should help render European energy research more oriented towards constructing and solving system transition problems. The cross-disciplinary tendency in the field reflects, along with other tendencies of re-organizing energy research, that it makes a qualitative difference for the organization of energy research and innovation to become responsive to system transition challenges. The complexity of system transitions puts pressure on established ways of organizing research and innovation, opening up for new organizational developments and responses.

What is implied when "system transitions" are pointed to as a challenge that calls for new actions and cooperative efforts within energy research? As indicated in the quote above from the Risoe energy report 2010, the transition to low-carbon energy systems involves far more than replacing old technologies with new sustainable energy solutions. Thus, the challenges exceed by far the mere substitution of e.g. coal fired power plants with off-shore wind parks. One of many sources of system transition complexity resides in the volatility of renewable energy sources like wind and solar energy which are anticipated to play an important role in future energy systems. Traditional energy systems have been constructed topologically on the basis of a controlled energy production. Coal, oil and gas are energy sources we can utilize in a controlled manner so as to continuously adjust the production and distribution of energy in its various forms to meet fluctuating demands. In a system transition scenario where e.g. solar and wind energy sources play a major role, this system control regime changes drastically. The scenario implies that the production of energy is no longer subject to control in the same way as in fossil energy-based energy systems. Thus, future energy systems cannot be assembled on the basis of an energy production control regime. At the same time, however, the law of grid parity (match between energy production and energy demand) as a condition for well-functioning electricity systems, or the demand for heating or cooling of buildings according to user needs will not disappear. Energy systems must continue to deliver energy according needs. Altogether, this means that system transition scenarios, as indicated in the Risoe energy report, implies fundamental system transformations at the topological level opening up not only for technological change, but also new economic and commercial structures and system-user interfaces.

Thus, when energy research policies call for e.g. “smart grid technology”, “smart cities” projects or “integrated energy solutions” this is closely connected to the overall system transition challenge of moving from energy system regimes built upon control with energy production towards new system solutions incorporating volatile energy sources and balancing energy production and energy demand in completely new ways. When energy research is called upon to respond in new ways to system transition challenges, the implications of this is therefore not merely to ramp up research activities in individual fields of energy technology research. The system transition challenges are more profound because they confront energy research with a broad range of *relational problems* such as how to best combine and integrate different energy systems, how to strike a balance between energy efficiency and energy production in future energy systems, and how to reconstruct sustainable energy systems "in flight", that is, building upon existing systems while gradually introducing new solutions. The fundamental challenges include how to organize across fields of expertise and sectors so as to become fit for solving system transition problems involving multiple actors and stakeholders.

In addition to the mere complexity of transforming energy systems at the topological level, energy research and innovation efforts are being pursued under the condition of system transition processes being inherently open-ended and emergent. This means that while there might be constructed relatively clear system transition objectives in e.g. the aforementioned European SET Plan process, the actual transition processes remain open to a variety of forces that may completely alter the political, economic, cultural and technological conjunctures which affect system transition processes (Hughes 1983, Geels and Schot 2007, Farla, Markard, Raven and Coenen 2012, Turnheim and Geels 2012). Thus, when speaking of "system transitions" one much be careful to avoid presuming that transition trajectories can be delineated in beforehand or that they follow sequential structures which can be conceived, designed and implemented accordingly. This implies that while we might study historical cases of energy system transformations (see e.g. Geels 2002 and 2006), *ongoing* transition processes are yet to be actualized and their "next state" remains contested and virtually open-ended for those involved in realizing them. System transition processes are continuously evolving landscapes where a multiplicity of interests and actor constellations are being formed and where no single actor can command or otherwise coordinate the full spectrum of processes that yield new system solutions.

We thus have before us an empirical field where the *organization of systemic innovation* is a major challenge that cuts across the many actors involved in assembling future energy systems. Processes of systemic innovation may for example take place in context of the SET Plan process of constructing “joint strategic agendas” and translating these into investment priorities within energy technology research, infrastructural investment plans, and energy system planning activities. But processes of systemic innovation also include the broad range of efforts in energy research to develop new approaches to cooperation across well-established domains of expertise including expert domains that are not traditionally associated with energy (e.g. various social science and humanistic disciplines, IT technology, advanced material science, etc.). Systemic innovation thus has to do with reconfiguring systems of knowledge production and innovation so as to render these responsive to the challenges of coordinating and driving processes of system transitions. In this context, innovation concerns far more than the commercialization of new technology, as innovation management literature as well as innovation policy instruments persistently invites us to assume. Rather, *processes of systemic innovation* whereby new means of coordination and cooperation evolve become a central challenge for practice as well as for innovation research to understand and act upon. In context of energy research, systemic innovation involves a *becoming collectively responsive to system transition complexity* which remains open-ended and irreducible to any single research agenda or any single system transition perspective. This affects, for example, how energy research is being organized, which problem-constructs are being promoted as “critical”, and how energy research assembles fields of expertise in new cross-disciplinary constellations.

It is one of the main ambitions of this dissertation to contribute with theoretical and methodological approaches that might improve the practical and academic engagement with such processes where a broad range of relational problems (balancing coordination with competition, connecting fields of expertise, bridging old system solutions with new, and so forth) are becoming increasingly central for energy research and innovation to solve. Thus, where we often see questions of energy system transition focus on e.g. which technologies to invest in, how much system transitions will cost, or how to construct energy markets so as to stimulate investments in renewable energy, etc., the kind of transition questions pursued here has to do with *the transition to transition* within the organization of knowledge production and innovation in energy research. For example: Which transitions and displacements in the organization of research and innovation become part of responding to system transition complexity? How does different kinds of transition efforts condition the capacity for interaction? What are the challenges of rendering energy research responsive to energy system transition complexity? We might characterize such questions as second order transition questions and the former set of questions as first order transition questions. One of the purposes of this dissertation is to give priority to the seconder order transition questions which are often squeezed out by first order transition questions (how to get from A to B, which technology to invest in, etc.). Questions of the second order becomes important, as I shall pursue much further in the dissertation, because they help us focus on *ongoing transitions dynamics in the approach to transition*.

Thus far, I have allowed myself to introduce the challenge of energy system transitions and systemic innovation in very general terms. In order to arrive at a more focused set of research questions I will in the following elaborate the coordination problem of organizing processes of systemic innovation. I will point to a tendency within the field of energy research to form strategic partnerships and alliances as a means to align and promote strategic interests and build up cooperation across fields of expertise. These new actor constellations are interesting because they are – I will argue – symptoms of how the energy research field currently seeks to respond to different aspects of organizing systemic innovation. They offer therefore interesting empirical examples of how system transition complexity translates into specific organizational arrangements through which processes of systemic innovation unfold.

1.2. Elaboration of the coordination problem

> *"A new way of working at Community level requires an inclusive, dynamic and flexible means of guiding this process, defining priorities and proposing actions – a collective approach to strategic planning. Decision-makers in the Member States, industry, and the research and financial communities have to start to communicate and take decisions in a more structured and mission-oriented way, conceiving and implementing actions together with the European Commission within a cooperative framework. We need a new governance structure."*
>
> [Strategic Energy Technology Plan, EU COM 2007b: 9]

The persistent agenda-setting efforts in the EU and at member state levels are closely tied to a system transition coordination problem. When energy systems are anticipated to go through fundamental changes, a variety of actors are affected and multiple strategic interests are at stake. Competing actors with a stake in how future energy systems are constructed politically, technologically, commercially etc. are all dependent upon the constructive cooperation of others since no single actor can govern system transition processes. As pointed to in the SET Plan quote, this makes coordination a key challenge: How to align strategic interests, investment horizons and actual collaborative processes so as to create and sustain a system transition momentum over a long time period without prematurely fixating system transitions on the basis of current levels of knowledge and technology? Obviously, this is an enormously difficult task and no single actor is capable of performing coordination effectively under these conditions. Thus, the SET Plan offers itself as a process framework within which a variety of strategic interests and agenda-setting efforts may take shape and interact. The SET Plan may operate with specific transition targets of e.g. reducing CO2 emissions, investment plans in renewable energy research, etc. But these objectives and priorities are never entirely fixed but continue to be negotiated and translated at different levels over time.

The overall system transition processes thus take shape in an evolving landscape which is continuously influenced by political, technological and economic developments which at times might be quite disruptive – consider for example the impact of the Japanese nuclear break down on German energy planning. Hence, while coordination efforts are being pursued at a variety of levels from EU to national and regional levels of coordination, the system transition processes they try to frame and align are far from stable and linear, but emergent and open-ended. This is a key aspect of the overall system transition complexity organizers of energy research and innovation are facing and it is the extreme nature of the coordination problem that makes it interesting to inquire how involved actors respond organizationally to these challenges.

Besides the SET Plan process there are several other symptoms of energy transition actors from research, industry and policy systems seeking to establish new means of coordination and cooperation. One symptom which I would like to emphasize is the ongoing formation of strategic partnerships and alliances in the European landscape of energy research and innovation. These emerging actor formations are being set up for a variety of reasons. The SET Plan process has instigated a range of "platforms" and initiatives which work as frameworks for mobilizing strategically important actors.

Other partnerships evolve as more focused collaborative endeavors where e.g. a few universities form strategic alliances within specific fields of shared interests so as to combine resources and gain impact on European agenda and priority-setting processes.

Thus, the tendency in the field to form partnerships and alliances have many sources including policy initiatives like the SET Plan and Horizon 2020 both of which give priority to partnerships as a vehicle for "renewed collaboration" and innovation. Partnerships are also echoing mainstream innovation discourses pointing to how the potential for newness resides outside organizational and institutional boundaries (as mapped by Lopdrup-Hjorth 2013). The purpose here is not to trace the genealogy of strategic partnerships in the field. Rather, as I will pursue further in chapter 3, I take the formation of strategic partnerships as an empirical point of departure for inquiring how actors investing in such organizational arrangements strive to become collectively responsive to system transition challenges. The ongoing formation of partnerships provides an interesting empirical context for studying how energy research seeks to move beyond established disciplinary and institutional boundaries as a means to enhance coordination and cooperation activities while constructing new problems to respond to through e.g. cross-disciplinary collaboration in combination with policy oriented strategic investments in the negotiation of European road maps and priority-setting activities. In other words, the formation of strategic partnerships and alliances is seen in this dissertation as a manifestation of how the organization of energy research and innovation is being reconstructed as a means to enhance the capacity in the field to organize processes of systemic innovation and solve the broad range of relational problems these processes entail.

More specifically, the empirical point of departure is a particular case of a strategic partnership called "SEEIT" which I have been practically involved in since its initiation in 2009. SEEIT is an acronym for *Sustainable Energy Education Innovation and Technology.* As I will expand on later, I consider SEEIT as an interesting example of how the open-ended topology of energy system transitions challenges the organization of knowledge production in energy research and innovation, and how this translates into a variety of efforts to solve the many relational problems this stirs. Thus, the process this partnership has gone through since its initiation in 2009 provides illustrative examples of the complexity opening up when the topology of energy systems and the structures of associated knowledge production systems can no longer be taken for granted but need to be re-configured. I consider such reconfiguration efforts to be processes of systemic innovation, and the analysis of the SEEIT process will show how such processes unfold and intensify through collective efforts to establish new means of coordination and cooperation.

The ongoing formation of partnerships and strategic alliances provides a good empirical entry point for a second order transition analysis as introduced above. The reason for this is that such partnerships explicitly adress system transition challenges. They are often set up, as in the case of SEEIT, with a purpose of strengthening the capacity to act upon system transition complexity through the development of new means of coordination and cooperation. This means that not only are such partnerships seen to be solutions to very narrow technical or organizational problems. They are also constructed as a means to open up for new approaches to cooperation and therefore not necessarily contractually well-defined on the basis of very specific projects – they operate, or strive to become able to operate, as frameworks for cooperation and systemic innovation. The processes of interaction and learning this opens up for are interesting because they allow us to inquire examples of what I call *transition to transition*. That is, transition in approaches to responding to system transition complexity and the wide range of relational problems and interaction potentials this generates.

1.3. Transition cartographies and the cartographic approach

In order to analyze such processes from a second order perspective, the dissertation will develop a *cartographic approach.* The point of departure for this is empirical in the sense that the SET plan process and the variety of strategic partnerships and alliances are all involved in diagnosing and translating problems of energy system transitions. These efforts may unfold through the construction of technology road maps, as we often see in the SET plan process. Or they may unfold more implicitly when e.g. a partnership like SEEIT formulates the "problematic context" to respond to. Road maps, context problematizations, and a variety of other associated activities are *cartographic* in how they strive to stabilize transition maps collectively as a means to coordinate (what are the coordinates for joint movement?) which at the same time perform a *potentialization of interaction*. They are creating and enacting *transition cartographies* and it is the social productivity of such processes which the cartographic approach is set up for studying – and intervening in.

The purpose of setting up the cartographic approach is therefore to analyze ongoing transitions in the organization of energy research responding to system transition complexity. The approach establishes a second order perspective on system transition processes in the sense that it puts focus on "transitions to transition" in the organization of energy research and innovation. What transitions are energy research and innovation going through in order to become responsive to system transition complexity?

We are typically familiar with the term ‘cartography’ as the art of making maps. Traditionally, a cartography describes the conventions and methods for making maps, and the cartographer is the one who is competent in map making. Along these lines we tend to think about maps as entities, for example a 2-dimensional graphical representation of space. In this form, we know maps as spatial representation of landscapes, oceans, cities, etc.

In the academic field of cartography studies, the entitative and representational understanding of maps has been deconstructed in multiple studies and critical analyses (See e.g. Kitchin and Dodge 2007, Wood 2010). Thus, Kitchin and Dodge describe an “ontological crisis” in the field of cartography studies moving from a traditional understanding of maps as authoritative representations of reality (authorized by cartographic conventions on proper methods of map making) to a processual understanding of *mapping* as a fluid and emergent process whereby map making efforts unfold dynamically in response to evolving and changing relational problems. The final and authoritative map no longer exists, only emergent mappings which are intertwined with all kinds of conventions and knowledge, but that never arrives at a final point of having mapped something entirely.

Processes of mapping are evolving in accordance with the emergent relational problems they strive to frame and respond to and as such mappings are seen as an *open-ended relational and systemic effect* rather than the expression of the proper use of stable cartographic conventions for how to map a reality “out there”. Emergent mapping becomes a component in stabilizing certain realities and come to terms with new relational problems for which established conventions of knowledge and means of organization have become insufficient (Kitchin and Dodge 2007). Thus, the notion of cartography no longer refers to a stable set of rules and conventions regarding the production of maps, but rather to the processes of mapping where relational problems are constructed and responded to.

This general understanding of cartographic processes resonates well with how the term will be used in this dissertation and how the cartographic approach will be developed: The processual understanding of mapping has a special relevance for describing and understanding ongoing system transition efforts in energy research and innovation. For example, the SET plan process may be considered to be a comprehensive set of cartographic processes whereby energy system transition challenges are being formulated, negotiated and translated into specific relational problems for cooperative efforts to respond to. These processes do not stabilize *the* map for a subsequent system transitions to take place. Rather, cartographic processes help construct a transition agenda and a process outlook that cuts across actors and *potentialize interaction* towards certain transition objectives. Thus, cartographic processes, or the ongoing construction of *transition cartographies*, play an important role in collectively diagnosing, negotiating and translating complex system transition challenges into actual cooperation. The power of these cartographic processes has to do with their capacity to construct relational problems so as to actualize interaction and systemic innovation. The challenge for a cartographic approach then becomes to analyze how the construction of transition cartographies potentialize interaction differently and what role transition cartographies play in driving processes of systemic innovation – in short, their social productivity.

The point of departure for developing a cartographic approach is therefore an empirical observation and description of the field as in a state of "cartographizing", that is, of developing not only mapping processes per se, but the very capacity to establish transition cartographies as a means to potentialize interaction and drive processes of systemic innovation. The academic point of departure for developing the cartographic approach will be a critique of established approaches in innovation studies to analyzing innovation as "systemic in nature". This critique, which I will unfold in chapter 2, leads me to arguing for a need of a new approach to studying processes of systemic innovation with a focus on the relational constitution of agency, and the relational constitution of innovation research as a practice of studying processes of systemic innovation. Thus, the cartographic approach has two legs the first being a methodological leg and the second being an analytical strategy. The approach will in particular draw upon the thinking of Gregory Bateson and Gilles Deleuze as a means to develop a systemic and processual understanding of cartographic processes and their 'organizing power' (or lack hereof) in the pursuit of new approaches to systemic innovation. As a methodological frame, the approach builds on a performative understanding of knowledge (Law and Urry 2004), and introduces a situated (Haraway 1988) and in(ter)ventive (Steyaert 2011) innovation research practice.

1.4. Research questions and purpose

To sum up the steps made on the previous pages, the point of departure for this dissertation is the ongoing efforts taking shape in energy research and innovation to become responsive to system transition complexity. What we see in energy research is an increasing focus on developing new approaches to strategic coordination and cooperation across actors and fields of expertise in order to address complex and long term system transition challenges. One empirical manifestation hereof is the formation of strategic alliances and partnerships between institutions creating linkages between policy level strategies, institutional level strategies and collaboration activities in research, education and innovation. These efforts involve the setup of heterogeneous constellations of actors contributing with knowledge and approaches from a diverse range of disciplines and positions in relation to future energy systems. The formation of such strategic constellations is driven by innovation policies but also by an acknowledgement within energy research that transitions to decarbonized energy solutions disrupt established knowledge production organization in the field – both in relation to disciplinary specializations, but also the wider problem-setting and solution approaches organizing energy research. Facing a broad range of relational problems opening up in context of inherently open-ended system transition scenarios, energy research engages in new cooperative settings such as strategic partnerships. This effort constitutes an example of how research engages with processes of systemic innovation.

On this background, the dissertation will pursue the following research questions:

1) What are the methodological and analytical challenges for innovation research studying systemic innovation in the making?

2) In the case of the SEEIT partnership, how is system transition complexity constructed as a problem to respond to, and with what effects for the partnership's capacity to organize cooperation across the domains it spans?

3) Given the cartographic approach and the analysis of SEEIT, what are the practical implications of organizing systemic innovation through strategic partnerships?

These questions reflect an ambition to develop a methodological and analytical approach to studying systemic innovation in the making at an organizational level of analysis. However, a key element in the theoretical apparatus is to view organizing processes as inherently systemic – as a relational effect. Accordingly, even though focus is put on a case of organizing systemic innovation through strategic partnerships, the processes of organizing are analyzed as relationally constituted within the partnership and within the relations the partnership constructs to the wider field in which it operates. The analytical strategy for this will be a key aspect of the cartographic approach.

1.5. Scope and outline of dissertation

As already indicated, a main ambition of the dissertation is to draw a line between wider system transition processes and the case of the SEEIT strategic partnership. The dissertation builds first and foremost on a genuine interest in understanding what transitions to sustainable energy systems imply for the organization of energy research and innovation, and for the study hereof. Thus, the dissertation has a purpose of inquiring what the role for innovation research might be as a contributor to *understanding and performing* processes of systemic innovation. Furthermore, a key ambition is to develop a framework for analyzing *ongoing* processes of systemic innovation and thus to help qualify how steps towards system transitions might be taken here and now rather than escaping – as many transition studies tend to do – into "overview models" where agency gets lost in several layers of black boxing. This also implies that the dissertation aims for improving our knowledge regarding organizational responses to system transition complexity and to derive some implications for practice in light hereof.

One of the implications of these ambitions is that the dissertation puts more emphasis on developing the cartographic approach and pursue an empirical organization process investigation than on providing comprehensive literature reviews as a basis for constructing research questions and contributions. This prioritization implies certain challenges such as positioning the work against established research and specifying contributions. The purpose of the next chapter is therefore to read selected parts of innovation and organization studies as a means to point out the academic relevance and need for introducing a new approach to studying processes of systemic innovation. The implication chapter following the analysis will then pick up on this problematization and elaborate the contributions. Thus, the dissertation tries to strike a balance between inscribing itself into a collective research community dialogue while sustaining a cross-disciplinary and empirical research agenda which has a value in itself and a potential for contributing to ongoing academic debates and efforts in innovation and organization studies. With this in mind, the rest of the dissertation is structured as follows:

In chapter 2, I will read and problematize innovation systems and system transition literature which seek to deal with some of the same questions as I have raised in relation to organizing processes of systemic innovation. The purpose is to point at how these fields within the broader area of innovation studies are conceiving of the systemic nature of innovation and how this translates into analytical frameworks which on the one hand center-stages interaction processes across multiple actors as a driver of innovation while on the other hand sustaining analytical and methodological approaches that tend to fixate agency assumption rather than inquiring the emergent nature of relational agency during processes of systemic innovation. Furthermore, I will point to how these innovation and system transition perspectives are embedded in a methodological tradition where detachment and distance to the empirical field is a necessary element in producing objective knowledge. Thus, the practice of doing systemic innovation research sustains a detached point of view as a means to make rational knowledge claims about the practice of others'. This feature of contemporary innovation research implies that "the relational and dynamic nature of innovation processes" remains something which innovation research studies as if it was not an active part of creating innovation processes (we can think here of the similarity between Kitchin and Dodge's critique of classical cartography and the critique indicated here in relation to the epistemological and ontological assumptions of innovation studies). In light of these limitation, I will point to a potential for linking innovation research with resources in organization process studies and post-structuralist theories. The outcome of chapter 2 is an anticipation of the academic contributions which I will try to substantiate through the development of the cartographic approach and the analysis of the SEEIT partnership.

In chapter 3, I will introduce the SEEIT strategic partnership and the field in which it operates. The chapter serves two purposes. Firstly, it introduces the empirical material so as to lay the ground for a subsequent analysis. Secondly, it prepares the ground empirically for developing the cartographic approach in chapter 4 and 5. Thus, while the style in chapter 3 will remain mostly descriptive, the chapter also serves the purpose of explaining on an empirical level why we may consider the SEEIT partnership and the field in which it operates cartographically, and why this should be considered an inherent aspect of organizing systemic innovation in response to system transition complexity.

In chapter 4, I will develop the first part of the cartographic approach where I focus on the methodological question of how to study ongoing processes of systemic innovation. The chapter has two component: A process descriptive component where I describe and explain the research process I have gone through as a participant in the SEEIT partnership. Then a more conceptual component where I develop the cartographic approach as a performative and in(ter)ventive innovation research practice

(Haraway 1988, Law and Urry 2004, Steyaert 2011). This move responds to the critique developed in chapter 2 of innovation research being detached from actual processes of innovation offering an alternative way of performing systemic innovation research.

In chapter 5, I will develop the second part of the cartographic approach which is the analytical strategy of studying processes of systemic innovation as emergent cartographies, or, processes of *cartographizing*. The analytical strategy draws on the work of Gregory Bateson and Gilles Deleuze & Felix Guattari as a means to develop a processual and relational understanding of systemic innovation offering an alternative to established innovation research. Especially, the analytical strategy will help me establish an analytical focus on how cartographic processes become socially productive for example by connecting diverse disciplines in cooperative activities. The introduction of Bateson's systemic thinking helps me qualify the notion of innovation being inherently systemic in a way that differs from how this is being conceptualized in the innovation literature. Deleuze and Guattari are introduced to conceptualize innovation processes in a way that captures the open-endedness of innovation and the challenges this present to innovation organization. The combined and selective reading of Bateson and Deleuze & Guattari is intended to expand the analytical repetoire available for the study of systemic innovation and specifies the analytical strategy of the cartographic approach.

In chapter 6, I will perform the first part of the analysis of SEEIT where I focus on the formation of SEEIT in 2009 and the subsequent process of operationalizing the partnership in 2010-2011. The partnership was initiated as a so-called KIC proposing consortium responding to an entirely new EU innovation policy framework called Knowledge and Innovation Communities (KIC) under the European Institute of

Innovation and Technology (EIT). The partnership succeeded in producing a competitive proposal but failed to win the competition against its main competitor InnoEnergy. Chapter 6 explores the formation phase and the process following the KIC rejection.

In chapter 7, I will perform the second part of the analysis where I focus on a cartographic transition within the SEEIT partnership which, after a process of stagnation, re-charged the cooperative process providing an example of how a partnership may respond creatively to system transition complexity and to the cartographic crisis this entails in the organization of knowledge creation and innovation.

Chapter 8 discusses the implications of the cartographic approach vis á vis established innovation research and organization process theory, as introduced in chapter 2, and suggests a number of implications for practice on the basis of the analysis of SEEIT. Giving emphasis to implications for practice is also an important element in chapter 7 which reflect the performative and in(ter)ventive research agenda. The chapter will put particular focus on discussing the cartographic approach as a potential contribution to an in(ter)ventive and processual analysis of systemic innovation. The nature of this contribution is cross-disciplinary in a way which remains foreign to established innovation studies which, according to ongoing "identity debates" within this field (see e.g. Martin 2012), is becoming increasingly mature as a discipline in itself. The implication chapter therefore plays an important role in developing the contribution discussion because the ambitions driving the dissertation are not formed on the basis of a more traditional gap-spotting exercise of positioning the proposed contributions. This means that the translation of the cartographic approach into a language of contribution is not entirely self-evident in a disciplinary sense. As part of following up on the critique developed of innovation studies and the practical implications of the analysis performed, the chapter will draw up some lines for further research emerging from the dissertation.

Finally, *in chapter 9*, I will summarize the overall argument developed and the main points of the dissertation in a concluding chapter. This chapter will also address some of the limitations that came to characterize the dissertation which in many ways continues to be an expression of a living learning process. Thus, the concluding chapter will contain reflections on the work performed and potentials for improvement this gives rise to.

2. Problematizing Innovation Management and Organization Process Studies

2.1. Introduction

In the previous chapter, the aim was to introduce the problem of organizing innovation in context of open-ended energy system transition scenarios and how this problem is migrating into the realm of technology research affecting the fabrics of knowledge production and the organizing strategies pursued in the fields of sustainable energy technology research. The complexity of system transition processes increases as the politically determined priorities for including and significantly expanding renewable energy in the energy systems mature and become manifest in regulations and investment priorities in the energy sector. One way in which complexity surfaces is that in order to build a momentum in system transition processes, coordination across multiple, heterogeneous actors has to become effective. However, coordination has to be pursued on the condition that the transition processes it seeks to coordinate are inherently open-ended and contested politically, scientifically and technically. System transitions thus take shape in processes where knowledge, politics and organization-creation are dynamically intertwined making coordination at different levels a highly challenging task to render effective. This led me to a problem statement establishing a focus on how cartographic processes help solve these coordination problems by potentializing and actualizing cooperation across disciplinary and institutional boundaries in the case of the SEEIT strategic partnership.

The purpose of this chapter is to forge a link between established research and the analysis provided in this dissertation. The reading of established literature will not be pursued through a traditional “gap-spotting” literature review, but through a problematization of particular streams of research within innovation and organization studies (Alvesson and Sandberg 2011). The purpose of problematizing established literature is to challenge dominant assumptions structuring particular fields of research and to open up to new problems, alternative methods, and cross-disciplinary inquiries. Such a reading strategy is relevant when influential fields of research mature and become increasingly self-referential with regard to key concepts, theories and methods. A problematizing reading strategy thus challenges the credo of specialized research dialogues – not because well-established dialogues and self-referentiality is per definition wrong or inhibitive for advancing knowledge, but because management challenges such as organizing towards complex energy system transitions facing policy makers, companies, research environments, etc. call for re-addressing basic assumptions in order to reinforce the empirical and analytical sensitivity in research with the aim of gaining relevance for practice (Ghoshal 2005, Van de Ven and Johnson 2006, Sandberg and Tsoukas 2011).

I will pursue the argument that the challenge of organizing systemic innovation presents innovation and organization research with a number of problems that calls for re-visiting basic assumptions and methods in the research fields contributing with knowledge that qualifies for understanding and acting upon systemic innovation in context of open-ended system transition processes. In other words, not only can we observe how energy system transitions pose great challenges in relation to innovating and coordinating in practice. They also pose a clear challenge for those involved in studying system transition processes. These processes are dispersed in time and space, ongoing and open-ended. How may we from an innovation perspective analyze such complex processes? By means of which empirical methods, theories and analytical strategies?

By reading selected contributions from innovation and organization research, the aim is to pave the way for the cartographic approach developed in chapter 4 and 5. I will do so by pointing at how established innovation research frameworks have fundamental limitations when it comes to researching and analyzing relational processes of innovation and system transitions. The argument is that on-going processes of systemic innovation remain largely uncharted (as pointed to also by Akrich, Callon and Latour 2002) within innovation management research. The reason for this may be found in the way in which innovation management research has conceived of "the systemic nature of innovation" in fields such as innovation systems research and more recently in sustainability transition research. As I shall elaborate further below, the conception of the systemic nature of innovation is embedded in what Kwa (2002) calls a romantic holism which is an influential ingredient in systems thinking across research fields in social science and natural science. Romantic holism influences how innovation research constructs key concepts such as innovation systems and helps explain why innovation systems research tends to sustain a functionalistic view of agency despite its long-standing ambition to better understand how innovation grows out of interactions and relational dynamics between heterogeneous actors in industry, science and government agencies. The way in which innovation systems research sustains a functionalist perspective on agency and the organization of complex innovation processes also feeds into a specific research practice of detachment from the interactive processes innovation research seeks to elucidate. This detachment is a core part of why innovation systems research remains inherently incapable of studying ongoing processes of systemic innovation and will be an important point of departure for developing an alternative approach pursued in subsequent chapters.

After the reading of innovation management literature, I will briefly connect with a particular stream within organization studies namely the ongoing debates on improving organization process research through the introduction of process philosophy. This stream of organization research suggest us to consider organizations as inherently fluid and in a state of becoming (e.g. Tsoukas and Chia 2002, Cooper 2005, Hernes 2008, Langley, Smallman, Tsoukas and Van de Ven 2013). The stream opens up for additional theoretical and conceptual resources of relevance for studying processes of systemic innovation. For example, this literature offers a relational and processual view on agency which innovation management literature tends to lack. The introduction of the process theory stream in organization studies, and particularly some of the critical discussions this has stirred (Weik 2011, Steyaert 2012), thus opens up for a potential cross-disciplinary contribution in-between innovation and organization research and it paves the way for developing the cartographic approach as a process analytical framework.

The combined reading of selected contributions from innovation and organization studies form the problematization needed for constructing the cartographic approach as a way to link between the problems preoccupying innovation and system transition research by means of theoretical and methodological resources emerging in organization studies. The problematization is therefore also a preparation for a certain analytical strategy which purposively seeks to bridge between fields which tends to be separated even though the problems addressed are intersecting. For example, the observation made repeatedly in innovation systems research that innovation processes are inherently systemic and relationally constituted is one of the key points of departure in process oriented organization research (see e.g. Tsoukas and Chia 2002 and Cooper 2005). The specific linkage between the study of innovation as inherently systemic and organization process research therefore offers a potential cross-disciplinary contribution of value to both camps, as I shall seek to further substantiate throughout this chapter and follow up on in the implication chapter after the analysis. I will begin by offering a reading of innovation systems research and the emerging stream of system transition studies. The reading of innovation studies will take up the greater part of the chapter while the organization process stream will only be touched upon as a minor step stone preparing the development of the cartographic approach.

2.2. Reading innovation literature

When positioning academic work vis á vis innovation management research, one faces a very broad and heterogeneous field of contributions. One reason for why I select the more broad and systems oriented innovation management research has to do with the ambition in this dissertation of improving our understanding of innovation processes as "systemic". What I find to be the most relevant point of entry into innovation management research is therefore contributions where the systemic intertwinedness of innovation is taken as a point of departure and where the research agenda is to study the complex social bodies arranged towards generating innovation which has developed at least since the 1970s and particularly throughout the 1980s and 1990s within e.g. innovation systems research (Nelson and Winter 1982, Lundvall 1992, Freeman 1995). More recently, stronger focus has been put on understanding innovation in context of complex system transition and specific "systemic instruments" for promoting and organizing innovation in society (Geels 2002, Geels and Schot 2007, Smits, Kuhlmann and Shapira (eds) 2010, Martin 2012).

As a consequence of devoting attention to these areas within innovation research, more product oriented innovation management literature will not be explored. Also, the very influential and comprehensive literature on collaborative approaches to organizing innovation between firms and universities, including the open innovation perspective (Chesbrough 2005), will not be explored. The reason is that this field does typically not address system transitions as a specific challenge for organizing innovation but focuses on interaction processes between limited actors. Also, this part of innovation management literature has a strong tendency towards promoting and building analysis upon assumptions about how to organize innovation systematically thus assuming the actual possibility for managing innovation by means of process systematization and a resulting ideal of rational decision-making as a precursor for success in innovation (see e.g. Benson and Dvesdow (2003) for an example hereof). However, as Akrich, Callon and Latour (2002) have pointed to, the underlying assumption of the possibility of clarity in information to render decisions regarding innovation rational and optimal is typically not valid if we study processes of innovation empirically. Indeed, the basis for making 'optimal decisions' is often non-existent and this is an inherent aspect of the complexity that defines innovation in the first instance, and a 'fact of life' for those involved in actual innovation processes.

Furthermore, the "systematization school" in innovation management literature lacks relevance because processes of systemic innovation are irreducible to e.g. individual products, processes and technology development activities. Rather, systemic innovation takes shape through complex processes of interaction where agencies-in-progress are negotiated and constructed as a means to give direction to and build up momentum in collective efforts (Bijker, Hughes and Pinch, (eds) 1989, Freeman 1991, Cato, Arthur, Keenoy and Smith 2008, Arentsen, Rossum and Stenge 2010, Rip 2010, Smits, Kuhlmann and Shapira (eds) 2010, Martin 2012). With its emphasis on formalizing innovation processes and decision-making, the systematization school, by means of its epistemological and ontological presuppositions and their corresponding methods and theories, systematically shields itself off from understanding systemic innovation as a process where e.g. unforeseeable events (Hughes 1983, Akrich, Callon and Latour 2002), institutional (Aldrich and Fiol 1994, Jay 2013) and infrastructural (Van de Ven 1993) change dynamics, collective entrepreneurial organization (Hargrave and Van de Ven 2006), chaotic tensions during the course of 'innovation journeys' (Cheng and Van de Ven 1996, Van de Ven, Polley, Garud and Venkataraman 1999), and a wide range of other complexifying and incompatible system transition dynamics (Martin 1996, Geels 2010, Farla, Markard, Raven and Coenen 2012, Turnheim and Geels 2012) are central ingredients. Thus, focusing on contributions within innovation studies which explicitly aims for understanding innovation as inherently systemic and organized through a variety of complex social bodies in society allows me to narrow down my reading of innovation literature to *innovation systems research* and the emerging field of *sustainability transition research*.

This being said, the scoping of the innovation literature review implies that influential contributions of potential relevance are left out or remains marginal in the conducted review. Thus, the more innovation process oriented contributions from e.g. the Minnesota Studies (Van de Ven, Angle and Poole 2000) will not be major part of the review, but I will touch upon this contribution in connection with arguing for the need of improving the process orientation in innovation research. Finally, the priority given to innovation systems research has to do with the success of this stream in gaining influence as an innovation policy framework (Lundvall 2007). This is important because it implies that the understanding of innovation as systemic as developed in this stream of innovation research impacts practice in a variety of ways and it is precisely part of the problematization pursued to point at a need for repositioning innovation research vis á vis the practice it aspires to understand and improve. Due to the wide influence of innovation systems research, particularly in policy making that affects the framework conditions under which for example energy research develops new organizational arrangements, this stream of research becomes important to relate to and problematize if we are to position new research-practice interactions with relevance for wider policy efforts to support processes of systemic innovation.

2.3. Introduction to the concept of Innovation Systems

Already in the 1960s, RAND Corporation economists pointed to the market failures in relation to securing sufficient investments in research and development (Arrow 1962) as an argument for why non-market, public funding to research and innovation should be seen as a normal part of sound policy towards long term wealth creation in society (Hounshell 2000). Here we find a recognition of the systemic nature of innovation in the sense of an interplay between societal objectives, state regulations, market structures, human capital resources and high-risk research-driven inventions supported by public funding. Since the 1970s (Nelson and Winter 1977) and particularly the 1980s and 1990s (Nelson and Winter 1982, Freemann 1987, Lundvall 1992, Freeman 1995) the framework of innovation systems and evolutionary perspectives on innovation have advanced the view within the economics of innovation management that innovation processes unfold through interactions between a variety of actors (companies, public agencies, universities, research laboratories and users) and that policy instruments can affect these interactions directly and indirectly using an innovation systems framework to detect lacking support mechanisms.

Compared with its roots in neo-classical economics theory, contributors to the innovation systems concept along with the evolutionary perspective understands their work as a cross-disciplinary and problem-oriented research agenda (Lundvall 2007, Fagerberg, Fosaas, Bell and Martin 2011). As Lundvall (2007: 109) formulates it, *“(t)he most important problem with neo-classical theory is not that it is too abstract. It is rather that it makes the wrong abstractions. In a context where knowledge is the most important resource and learning the most important process, neo-classical theory tends to abstract from the very processes that make a difference in terms of economic performance. These processes remain as a crucial foundation for innovation system analysis. The focus is upon how enduring relationships and patterns of dependence and interaction are established and dissolved as time goes by. New competences are built while old ones are destroyed. At each point in time there are patterns of collaboration and communication that shape the innovation system but, of course, the system is also evolving in a process of creative destruction of both knowledge and relationships.”*

The innovation systems framework thus builds on the acknowledgement that innovation is a complex and systemically intertwined social endeavor where no single actor can be viewed and understood in isolation from the various interactive relationships it is embedded in. In some versions of innovation systems frameworks, the national territory is used as a spatial demarcation for mapping interaction patterns constituting innovation systems (Lundvall 1992). In other versions, sectors (Malerba 2005), regions (Cooke, Uranga and Etxebarria 1997), and more recently global actor constellations (Haakonsson 2012) are used as an empirical point of departure for mapping patterns of interactions and their effects on innovation. Across these variations of innovation system frameworks, the recurrent assumption is that an innovation system (as a noun) refers to a higher-order, emergent solidification of interaction patterns between heterogeneous actors engaged in innovation. However, as Lundvall (2007) points to, the innovation systems framework is a research framework as well as a policy making framework, and thus a concept which is organizing knowledge production within innovation research as well as creating international agendas in policy making oriented towards diagnosing and stimulating “knowledge economies” (see also Godin 2004 for an analysis of the role OECD has played in constructing and disseminating innovation models internationally).

This duality in the use of the concept goes mostly unnoticed. This means that it is normal to find in the literature a shift back and forth between using the construct of innovation system as a concept projecting an image of an empirical field and using the concept as an analytical framework, a focusing device as Lundvall (2007) calls it, for researchers along with policy makers to map and diagnose innovation processes. The innovation system concept is therefore more an ideal for how to establish a view upon innovation as a complex and systemic activity seen from the point of view of policy making than it corresponds with a certain empirical system per se. The system concept, as Lundvall (2007) also points to, may easily be translated into a mechanistic logic where a system is supposed to be constituted and governed by laws we can map and subsequently use as a basis for “constructing and implementing” systems of innovation. Lundvall warns against such interpretations pointed at the meaning the system concept, according to him, is given in innovation systems research: *“The original choice of “system” referred to a few simple ideas. First that the whole is more than the sum of its parts, second that the interrelationships and interaction between elements were as important for processes and outcomes as were the elements and that therefore we might expect each national system to develop its own unique dynamics (…). The innovation process may be seen as in intricate interplay between micro and macro phenomena where macro-structures condition micro-dynamics and vice versa new macro-structures are shaped by micro-processes. In a dynamic context this means* *that we need to understand systems as being complex and characterized by co-evolution and self-organizing."* (Lundvall 2007: 100-101).

The innovation systems approach thus grew from a critique of traditional, neo-classic theories in economics to incorporate and focus upon interaction patterns and learning processes taking shape in a variety of contexts. This agenda has co-evolved with a corresponding growth in policy attention towards innovation as the key to sustain competitiveness in industrialized economies (Godin 2004, Smits, Kuhlmann and Shapira (eds) 2010). The movement made by innovation systems research has therefore been to better understand the complexity of innovation processes by qualifying and constructing models for analyzing innovation as inherently systemic, as the previous quote from Lundvall (2007) illustrates.

2.4. A romantic conception of innovation systems as a complex whole

The break-out from neo-classical economic theories was influenced by "holistic" thinking in relation to conceiving of innovation as a complex phenomenon. A way of thinking which Kwa (2002) traces back into population science, biology and computer science domains of thinking and further back to the romantic world view by Rosseau that while reality contains heterogeneous elements these all belong to a higher-order unity in relation to which each element finds its proper function, meaning and direction. Such a whole is not merely a construct in the mind of the knowing subject. The whole is understood to be real and forms an integrated unity in which parts have their identity and function due to their specific incorporation in the whole – a functionalist understanding of wholes and parts. In order to understand parts including their interactions, we must look upwards and understand the greater whole they belong to and are functionally determined by. Romantic holism, as conceived by Kwa, has therefore nothing to do with being naïve – it is a specific way of conceiving complexity: *"romantic holism integrates individuals who appear to be a heterogeneous lot at the phenomenological level to a single entity at a higher level of organization."* (Kwa 2002: 25).

This is in line with the conceptualization of the system in innovation systems analysis where the sum of the parts form greater wholes which Lundvall calls National Innovation Systems. This system concept deals with complexity by constructing a greater whole (the innovation system) establishing a gaze where complex innovation processes can be viewed from above. Lundvall (2007) points out that this is not a mechanistic system theory – the "micro-levels" can form new greater wholes and are therefore not fully determined by the systems they may be embedded in. However, even though this suggests a more fluid understanding of how innovation systems take shape over time, the basic understanding remains that a system is a larger whole where certain patterns of interaction and processes of learning solidify and can be rendered object for system analysis and policy interventions based on an understanding of the specific parts-to-whole formations any given innovation system may comprise (Lundvall 2007: 99pp).

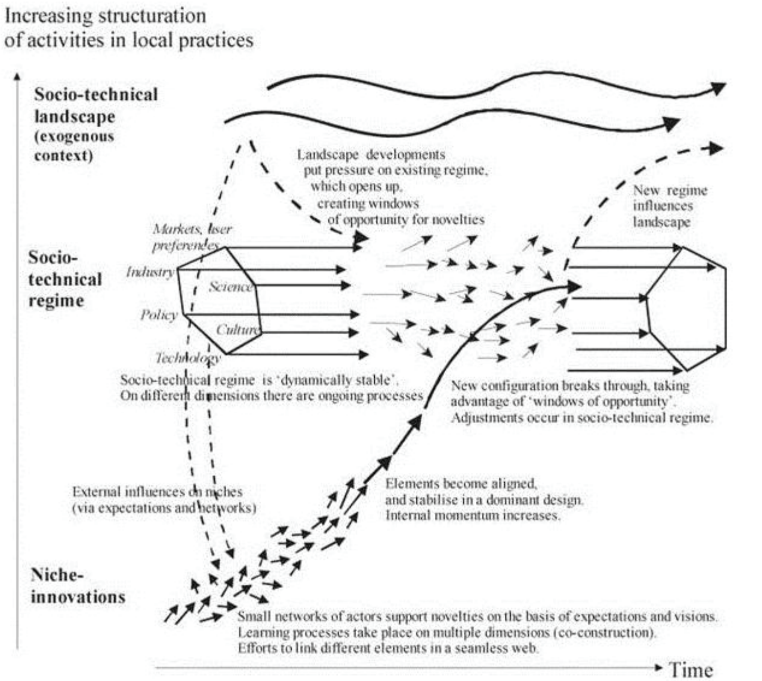
Why is this important? The romantic holism in innovation systems research establishes an ideal construct (the innovation system) which organizes its own research activities (which part of the system do you focus on?) and speaks about innovation systems as positively given entities which can be mapped, adjusted and change over time, as Lundvall also mentions in the quote above. Also, the romantic holism underpins a construction of levels of analysis from the higher order system level to specific functional parts of “the system” that helps distribute and fix agency cross systems parts.

The romantic holism thus allows for constructing an ideal model of a greater whole which subsequently serves as an organizing model for distinguishing between levels of reality (micro, meso, macro) with clear parts-to-whole distinctions derived from the overall systems concept. The link to romantic holism partially explains why the innovation systems agenda has had such a big impact on policy makers. It affords not only the researcher but also the policy maker a gaze from over and above innovation processes that allows itself to make a number of assumptions regarding the nature of agency and how to intervene in the now stabilized interaction patterns. Even though its promoters in innovation research continue to remind us that innovation systems are complex and in-progress, the innovation systems model establishes a convenient map for research and policy makers for sustaining sweeping assumptions about functional determinations of agency and hierarchical levels of organization defined through the innovation systems construct. The construct of innovation systems thus creates a distanced position of research (and policy makers) where a variety of empirical, analytical and conceptual decisions and operations can be made without ever having to engage in actual processes of organizing innovation. The habitus of research this supports is one of distant observation and interpretation of data which stems from the theoretically constructed concept of innovation systems.

In the perspective of innovation systems research, the acknowledgement of innovation as being systemic in nature translates into a framework that paradoxically re-installs isolated agency through the functional, parts-to-whole agency delineation. This results in a research agency devoted to studying patterns of inter-action between functionally black-boxed agents (universities, companies, users, etc.). As I shall return to below, this is a fundamental limitation to further advancing our understanding of innovation as systemic and our understanding of the agency formations we find in fields where infrastructural transitions are in-progress such as in the field of energy. Before I take up this limitation and suggest an alternative approach to studying innovation as systemic, I will briefly visit an emerging field of research within innovation studies, namely the so-called sustainability transition research field (STR). This plural field of research devotes special attention to system transition processes, and therefore this should be given voice in a project that shares this interest.

2.5. Sustainability Transition Research and the Multi-Level Perspective

During the past decade there has been a growing focus within innovation research on system transition management and governance of complex infrastructural transformations such as energy system transitions (Geels 2002). This research has formed a theoretically heterogeneous constellation of research efforts grouped under the banner of Sustainability Transition Research (STR), as proposed by Markard et al (2010), and reviewed also in Markard, Raven and Truffer (2012). STR draws on the innovation systems approach, but has a stronger tie to evolutionary thinking in the economics of innovation (Nelson and Winter 1977, Nelson and Winter 1982, Rip and Kemp 1998, Rip 2010). It is characteristic for the STR field that the construction of analytical models builds on retrospective analysis of e.g. energy system infrastructure transformations (e.g. Geels 2002, Geels 2006, Verbong and Geels 2007). This implies that the literature contains many sweeping models and conceptualizations collapsing vast empirical complexities into transition model constructions which are then used as analytical frameworks to conduct research into ongoing system transition activities (e.g. Quitzau, Hoffmann and Elle 2012). Within the STR field the so-called multi-level perspective, MLP, (Geels 2002, Geels and Schot 2007) has gained strong influence. The MLP framework is a good illustration of the nature of model-construction efforts taking shape in STR. The model is translated into a diagram which we find in e.g. Geels and Schot (2007):



Source: Geels and Schot 2007: *Typology of sociotechnical transition pathways,* p401

The ambition is to draw a map of vast system transition processes that captures how multiple levels of organizing are involved in building momentum for and realizing complex system transitions. The focus is put particularly on changes at "regime level". Socio-technical regimes comprise a vast array of actors and "dimensions" including technology, culture, science, policy, industry, markets, and user preferences (Geels and Schot 2007). These socio-technical regimes are constructed in the model as moving from one stable state to another stable state through a process of transition. Transition research thus takes as a point of departure that a system transition is a process between two stable states at “regime level”. Already here, the romantic holism shows its face in how the regime is constructed as a form of ideal, higher order structure which is deprived of empirical clarity but populated only by vast black boxing operations that collapse complex actor formations. One operation which has a strong bearing on the STR field’s mode of studying system transitions is the hierarchical structure of levels of analysis (an attribute of romantic holism). “Landscapes” above which places “exogenous contexts” such as changing economic conjunctures and other kinds of “exogenous shocks” outside and above the regime level, and “niche innovations” below operating at the boundaries of established “regimes”. One of the problems with installing this kind of micro-meso-macro hierarchies is that they lack empirical sensitivity towards how such levels are exactly not hierarchies but related in multiple ways with no clear structure in terms of ontological or structural levels. This has been a key point in ANT analysis for decades (Latour 1993, Callon 2001) and seems to be important to sustain when studying system transition processes where the abstractions and construction of levels of analysis such as in the MLP diagram decontextualizes system transitions and black boxes how system transition processes evolve.

Furthermore, the reliance on ex-post case studies spanning several decades of past examples of energy system transitions is a problematic feature of STR studies because it disconnects its models and concepts from one of the defining characteristics of ongoing system transitions namely the open-endedness of the process. To operate as e.g. a research partnership in a state of transition introduces a specific complexity which the MLP framework does not capture. This makes the STR contributions disconnected from the practical challenge of organizing cooperation in the midst of a system transition process.

While Geels and several other researchers from the STR field such as Markard and Truffer (2008) thus open up for a broadening of analytical approaches within innovation and system transitions studies, the project remains traditional with respect to the role of theory and analysis in relation to innovation and system transitions. Thus, the task for research is to construct an analytical model from the traditional position of detached analysis allowing the researcher to obtain what Haraway (1988) characterizes as a “god-like” point of view over and above the world of inquiry. The multiplication of ontological assumptions introduced by Geels (2010) is therefore contained in a traditional academic, analytical stance where ontology is merely a matter of analytical options that allow for certain kinds of argumentation and analysis – not a matter that matters in the empirical field. As Law and Urry (2004) point to this mode of analysis sustains a modernist single-world worldview where there might be a multiplicity of perspectives available for research, but only one, single world to be analyzed (see also Law 2004 and Haraway 1988 for a similar observation). Consequently, the STR field is embedded in a well-known division between an empirical, single world and the analysis hereof which has a particular effect in this field of research due to its observation of the complexity of system transitions: The complexity ‘out there’ is translated into a highly inclusive, to the extent of completely elusive, analytical framework which seeks to represent or otherwise cover the multiple levels and agencies at work in system transitions.

As in the case of innovation systems research, the STR field points at innovation and system transition processes as carried by dynamic interactions and multiple actors, but their analytical and methodological solution the studying this constrains a an actual, empirical account of such processes and the agency-formations they help bring about and transform. Instead, key elements in the analytical task such as agency and interactions remain a matter for the innovation researcher to determine by means of definitions derived from models and other constructs from the academic field. This makes the accounts of innovation as systemic and system transition processes decontextualized and confined in ideal-constructs such as innovation systems and MLP models.

2.6. From romantic holism towards baroque conceptions of complexity

When reviewing two influential analytical frameworks in relation to understanding innovation as inherently systemic, one striking feature is the degree to which these frameworks are detached from the practices they aspire to understand. This detachment is both temporal and spatial. Temporal in the sense that case studies of innovation systems and system transitions are often developed retrospectively thus affording the analyst the luxury of hindsight that those involved in innovation practices per definition do not enjoy. Another temporal detachment appears in the agency assumptions we find in the frameworks. Agency is determined by means of theoretical assumptions even when this is done by combining several theoretical agency models as we find in the MLP approach to system transitions analysis. This produces a timeless and decontextualized determination of agency invoking an image of innovation actorship determinable by means of universal and a priori assumptions, the structure of which we know also from methodological individualism in economic agency theories. This is a fundamental problem in relation to studying and understanding the systemic nature of agency in context of innovation processes because one of the defining features is that preserving, building and negotiating webs of agency are intrinsic to processes innovation and system transitions (Hughes 1983, Bijker, Hughes, Pinch 1989, Latour 1991, Law 1992, Latour 2005). The detachment from the relationality of agency in context of innovation and system transitions therefore implies, I would argue, that innovation systems research and STR remain inherently incapable of coming to terms with the practices they aspire and claim to better understand. The embeddedness in a system discourse building on a romantic holism plays an important part in the analytical and conceptual operations leading to a detached position outside "the innovation systems" and the setup of decontextualized agency assumptions.

As an alternative to a romantic holism, Kwa (2002) points at a "baroque" conception of systems and complexity. This conception comes very close to the thinking applied in actor network theory (Latour 1993, Callon 2001), in the work by Gregory Bateson (Bateson 2000, 2002) and in the philosophy of Gilles Deleuze (2006) which are, besides actor network theory, key resources for the approach taken in this dissertation. As Kwa explains, the baroque conception of complex wholes involves no argument for the existence of systems operating independently as higher order wholes organizing parts, but rather the continuous formation of multiple wholes-in-progress. In accordance with this conception, agency is situational and relationally constituted, not functionally determined. This means that agency is never taken for granted through introductions of functional delineations of agency, but is always seen as problematic and under transformation, and agency may relate to multiple greater wholes simultaneously. Patterns of interaction which stabilize agency formations in e.g. university-industry partnerships or other kinds of research and innovation constellations evolve and stabilize, but they remain situational and transitional, not universal nor a priori.

Where romantic holism looks upwards in order to detect a unifying system from which functionally defined parts (agency) and their interaction patterns can be delineated, the baroque conception looks downwards in the sense of inquiring how specific agency formations evolve and transform over time without any reference to a higher order system (Kwa 2002). The reviewed innovation literature has a strong tendency to look upwards and construct innovation system concepts or system transition models which help define levels of organization, and interaction patterns between functional parts of systems. This feeds into the uptake of innovation concepts in policy making where similar operations of detachment is a known feature (Rip 2010). It is not unusual to find formulations in innovation literature that repeats the observation that innovation policy is too instrumental and "modernistic" in its logics and expectations towards how to intervene in innovation in society (Lundvall 2007, Rip 2010). But given the tendency in the innovation literature to sustain metaphors and concepts for complex wholes which directly invites to think about innovation systems as positively given systems comprised by functions and patterns of interaction, this "trait" of policy making seems to be closely connected with a very similar one within innovation research itself.

The tradition in innovation research to look for patterns and unifying system concepts restricts, I will argue, the progress of innovation research in relation to understanding how actor formations take shape and, not the least, how to study *ongoing* actor formations – how to study systemic innovation and processes of system transitions in the making. This calls for a research approach which avoids constructing overarching models and unifying complex wholes as positively given systems in favor of a situated study of how organizational solutions evolve in the midst of open-ended system transition processes. This resonates with the baroque conception of complexity as unfolded by Kwa (2002) and it seems to resonate with the nature of the challenges facing those involved in coordinating cooperative processes in energy research where we do not yet know the solution to complex system transitions, but where multiple actor formations evolve in competing and complementary constellations. In this context, agency is not something we can take for granted in innovation research if we want to develop insight with relevance for those operating in the midst of system transition processes.

The critique of innovation studies' lack of capacity to grasp the processual nature of innovation has also been advanced within innovation research itself. The contributions from e.g. Van de Ven and the Minnesota Study helped open more process oriented research streams within innovation management research (see e.g. Van de Ven 1986, Van de Ven 1993, Van de Ven, Polley, Garud and Venkataraman 1999). As noted in one of the reports from the Minnesota study: *"Very little is known about how innovations actually emerge, develop, grow, or terminate over time. Yet an appreciation of the temporal processes is fundamental to the management of innovation. Most innovation scholars and managers view the innovation process as a simple sequence of developmental stages (such as idea invention, design, testing, implementation, and diffusion). However, these simple phase or stage models often lack empirical validity."* (Van de Ven, Angle and Poole 2000: 5). Van de Ven is an example of an innovation scholar who also bridges into the field of organization studies. In particular, Van de Ven has engaged in debates within organization process studies where exactly the temporal and relational nature of organization has gained increasing attention the past two-three decades. Thus, in order to expand the analytical and methodological repertoire available for innovation and system transition research, I will briefly connect with recent developments in organization studies where the incubation of process philosophical theories and concepts has helped advance organizational research into theorizing and studying agency and organization as inherently processual and relationally constituted. The brief reading of this literature (which by no means is intended to be a full overview) is a stepping stone for developing the cartographic approach as a cross-disciplinary research strategy for studying processes of systemic innovation.

2.7. Reading organization process theory

As pointed to in the introduction chapter, coordination and cooperation are highly complex tasks for which new organizational solutions are being formed in the energy research area. There is a need for inventing organizational solutions which can help complex actor constellations make cooperative steps of system transitions within energy technology research, market uptake of technologies, new regulatory frameworks etc. The technological ingenuity goes hand in hand with organizational creativity and an overall attempt to build momentum through improved coordination processes (e.g. the SET plan process) across a broad range of actors involved in energy research and innovation. There is, therefore, a special organizational challenge connected to system transition processes and this makes it relevant to consider how organization research might contribute to further understanding how organizational solutions evolve in this field and how we might approach the study hereof.

In a certain field within the broad area of organization studies, we find a particular stream which devotes attention to strengthening the analytical and methodological tools available for studying the processual nature of organization. This stream is characterized by introducing philosophical resources for building new process theories for organizational analysis. The stream of organization process theories using specific "process philosophers" has invested in developing organizational theories on the basis of a process metaphysics (Tsoukas and Chia 2002, Cooper 2005, Langley, Smallman, Tsoukas and Van de Ven 2013) taking as a point of departure organizations to be in a state of continuous flux and transformation and has made a strong effort to come to terms with this in the study of organizational life. The purpose hereof is to create new process theories of organization which *"attempt to reach explicitly or implicitly toward a* process ontology *based in process metaphysics (Whitehead 1929) in which the world itself is viewed fundamentally as made up of processes rather than things. In this view, entities (such as organizations and structures) are no more than temporary instantiations of ongoing processes, continually in a state of becoming."* (Langley, Smallman, Tsoukas and Van de Ven 2013: 5). An influential contribution that helped upon up for this process ontological orientation was the 2002 Tsoukas and Chia publication *On Organizational Becoming: Rethinking Organizational Change.*

Not unlike parts of the critique that I have formulated in the reading of innovation systems research, Tsoukas and Chia argues that organizational change research need to transgress dominant assumptions about how change in organizations occurs, how organizational forms take shape and which role human intent plays in shaping organizations. They argue that organization change research tends to sustain a static and entitative view of organizations, an ontology of being, which makes it impossible to explain how organizational changes come about, organization as emergence, and organizational change as an ongoing process. As noted, this is not fundamentally different from the critical reading of innovation literature provided above. Here too, I find ontological and epistemological frameworks which give priority to studying innovation through fixed agency assumptions yielding a research practice of constructing "patterns" and "structures" which – if implemented – should improve innovation processes. The structure-process divide is indeed also a fundamental challenge in innovation studies along the same lines as those problems pointed to in Tsoukas and Chia (2002).

As a way to transgress the limiting ontological assumptions guiding organizational change research, Tsoukas and Chia (2002) argue for an ontological reversal in organization studies so that rather than understanding processes through structures and entities, we should understand organizational forms and structures through a process ontological view. They argue for a move in organization studies from a ontology of being to an ontology of becoming. This argument must be understood in light of the critique they formulate towards organizational change research which they consider to sustain an entitative and substantialist understanding of organizations and organizational change. This privileges structures over processes and lead to an understanding of organizational change as something which can be conceived, designed and implemented by managers without considering the emergent and dynamic nature of how organizations evolve. This critique (which in many ways corresponds to the critique of Kant's philosophy in *Sein und Zeit* by Heidegger) of the structuralist tendency in organization change studies leads Tsoukas and Chia to argue for a reversal of the ontological assumption: That is, from being over becoming to becoming over being.

This implies, however, as Weik (2011) points to, that the process ontological move suggested by Tsoukas and Chia (2002) sustains an ontological "versus", only in a reversed edition. By this Weik means that Chia and Tsoukas' *kehre* sustains an opposition of ontologies which in the end opens up for fundamental limitations only in a reversed order compared to the "being over becoming" way of thinking they want to transgress. This way of distinguishing between and render opposite ontological views is sustained in recent publications on process studies. Thus, processes "*can be viewed* *from different ontologies of the social world: one a world made of things in which processes represent change in things (grounded in a substantive metaphysics) and the other a world of processes, in which things are reifications of processes"* (Langley, Smallman, Tsoukas and Van de Ven 2013: 4) referring to Tsoukas and Chia (2002). Arguably, without fully tracing this specific way of formulating the question of ontology in organization process studies, the question tends to be formulated as an *opposition* of ontologies where the processual view is considered as more accurate and in line with how reality really is thus yielding a better understanding of how temporal and transitory stabilizations (organizational forms, categories etc.) emerge and transform in time (Weik 2011).

Why does it matter how the ontological question is being formulated here? As Weik points to, one the implications of the ontological oppositioning in organization process theory is that process research becomes incapable of conceptualizing the actualization of organization as a form of structural stabilization of relations, or whatever kind of stability we might think of. If there is an opposition between becoming and being, and if becoming *always* rules over being, as the ontological reversal made in Tsoukas and Chia implies, then this perspective lacks an analytical solution to explaining the actual emergence of organizational forms and stability. Just like the "being-over-becoming" lacks a solution to understanding processes. *"If we assume a kind of 'primordial soup' that is entirely made of continuous change, where does form come from? It seems to be a kind of deus ex machina."* as Weik formulates it (2011: 667).

As an alternative to sustain an oppositional view of the two ontological positions, Weik points to the importance of understanding *relationality* as a retaining capacity in processes of organizing which co-exists with creative, transitory and emergent activities. For example the relationality of linking past, present and future states, or linking *"contemporary 'neighbors' through similarity or interdependence."* (op.cit: 668). Weik thus promotes a new move in the study of organization processes that leaves behind the ontological opposition between being and becoming, substance and process, in favor of a "being-becoming model" where relationality conceived as a retaining capacity, and activity conceived as emergent and creative, are alternating but always co-present in organizing processes. *"They, in fact, have to be present at the same time because the transition of potentiality to actuality needs both"* (op.cit.: 668). In such an integrative view, organization becomes an expression of divergence, and fundamentally different driving forces at work simultaneously and in ways that are mutually stimulating. For example a tension between competition and complementarity between interests within and across organizations, as Gregory Bateson also points to in his systems theory.

The ontological reasoning developed by Weik is in line with the thinking underpinning the work of Gregory Bateson as well as Gilles Deleuze & Felix Guattari which form the basis of the analytical strategy I will develop in chapter 5. Indeed, Weik refers also to the work of Gilbert Simondon (1992) and his theory of the individuation process which Deleuze also draws upon. Here, substance and form are seen as inherently connected and mutually constitutive rather than ontologically separated and in opposition. The stance taken in this dissertation is in line with the critique and proposals presented by Weik: In order to further advance the study of processes of organizing, including those involved in organizing processes of systemic innovation, the 'ontological divide' constructed and sustained in organization process theory needs to be reconciled in more integrated models and theories. Otherwise, we end up sustaining, in a reversed format, many of the fundamental limitations Chia and Tsoukas (2002) pointed to in their critique of the substantialist ontology in organization change research – only in a reversed version where 'structure', 'form', 'categories', etc. are treated as secondary and thus subjected to the transformative force of 'becoming'.

Weik (2011) is a good example of the fruitful debates following the opening of the ontological question in Chia and Tsoukas (2002). Another recent critique which I find to be important for developing a contribution to organization process studies, is the critique raised by Steyaert (2012) that organization process studies tend to stay within a representational form of knowledge production (see e.g. Langley, Smallman, Tsoukas and Van de Ven 2013 and Bruns 2013 for recent examples hereof). Thus, the "processual move" in organization studies is a move made mainly from a detached research position from where the process analyst can develop better process conceptualizations and models of processes going on "out there". Referring to the work of Thrift (1999) and Law (2004), Steyaert argues for a *"conception of the world as associational, as an imbroglio of heterogeneous and more or less expansive hybrids, as a performance of many worlds"* (Steyaert 2012: 155). Discussing how process theory may carry on with researching in such a world, Steyaert concludes that *"theories cannot represent these rhizomatic becomings* [with reference to Deleuze and Guattari's use of the concept of rhizome in Deleuze and Guattari 2002]*; nor do they exist so we can see the world (or organizations) better. They are practical means of going on and adding to the world"* (Steyaert 2012: 156). For Steyaert, this implies a becoming entrepreneurial of research practices – a move into an experimental and performative research practice that – for organization process studies – would imply to step away from a representational mode of theorizing into a more intense and affirmative relation with organizing processes.

Thus, after some decades of import of process philosophical thinking and process metaphysical elaborations and debates, Steyeart makes a plea for stepping into the zone of performative knowledge creation and thus engage in adding to organizational processes rather than theorizing from a far. This is one possible way of drawing a line of demarcation within the growing field of process philosophical organization studies, namely, a line between a traditional, distant position of theorizing and a situated and performative mode of theorizing processes. Alternatively, we could say, following Steyaert, that process theory needs to become processual itself, to become vulnerable towards actual processes of organizing through new performative research methods.

Quite often the critique in process philosophical research goes in the direction of more traditional streams in organization and management studies pointing, for example, towards the lack of capacity to grasp the complex unfolding of practices in organizations when organization theory introduces strong assumptions about time, structure-agency relations, etc. (e.g. Sandberg and Tsoukas 2011). However, while process philosophical resources might help advance the conceptualization of processes of organizing, there is much to be done in terms of committing this stream of organization research to empirical research and develop new methods and research practices which explores more consequently how process analysis may itself become processual and relationally constituted beyond the traditional, representational image of research. Thus, while I consider this stream of organization research to be part of my own legacy and while I will also make use of process philosophical concepts and arguments from Gregory Bateson, Gilles Deleuze and Felix Guattari, I follow the critique from Steyaert that process studies need to move beyond theorizing processes from afar. This stream needs also to find ways of performing processes and commit to contributing to practices of organizing in order to demonstrate the strengths of process philosophy to improve organizational work at large.

Together, the critique from Weik (2011) regarding the ontological divide in organization process studies along with the critique from Steyaert (2012) pointing the tendency in organization process studies to sustain a representational mode of theorizing processes, form the point of departure for a potential contribution to organization process studies. Along with responding to the limitations in innovation systems theory, the purpose of the cartographic approach will be to suggest one possible way to make steps in the directions pointed to by Weik and Steyaert respectively.

2.8. Conclusion: Potentials for a cross-disciplinary contribution

In the introduction chapter, I pointed to a fundamental organizational challenge facing the field of energy technology research organizing towards system transition objectives. I stressed the open-endedness of energy system transitions and the challenging problem of researching and innovating towards new and yet unknown system solutions incorporating a variety of energy technologies building on new system topologies while cutting across fields of expertise and sectorial boundaries. I pointed to a need for innovation research focused on how new potentials for interaction in response to the wide range of relational problems inherent to system transition processes are being constructed, actualized (or destructed). There is a need for understanding systemic innovation *in the making* and advance our understanding of the processual struggles inherent to actualizing new cooperation and coordination solutions in complex actor constellations like strategic partnerships.

In order to prepare for a contribution with such features, I have in the current chapter pursued a dual reading and problematization strategy as a means to show how such an inquiry might be developed in-between established innovation and organization research. This is also in line with a plea from within innovation systems studies calling for more cross-disciplinary research linking innovation management and organization research (Nooteboom and Stam 2008).

Thus, the reviewed innovation systems literature persistently points to patterns of interaction as drivers of innovation processes. However, the methods and analytical frameworks used sustain a detached engagement with these processes. This implies that the methods dominating the field preconfigure innovation systems research to reproduce a practice of studying systemic innovation from afar. This is an unproductive limitation in that it prevents innovation systems research from obtaining more processual research methods, as I shall further elaborate in chapter 4. In combination with sweeping agency assumptions, the distanced research methods in innovation systems studies imply an inherent lack of capacity to studying systemic innovation in the making even though the relational dynamics and "systemic perspectives" on innovation since long has become a dominant view in this field (Kuhlmann, Shapira and Smits 2010, Martin 2012).

This calls for introducing new methods and analytical strategies which allows for a relational and processual inquiry of systemic innovation in the making – that is, how relational potential is created and turned into new, performative associations across e.g. disciplinary and sectorial divides. Specifically, I pointed to the need for introducing "baroque" systems theories since many of the limitations inherent to innovation systems research are linked, I argued, to the predominance of romantic holism as a foundational assumption regarding the nature of 'innovation systems' and their parts-to-whole organization. With the two legs of the cartographic approach, the aim is to develop and render plausible such an alternative strategy for studying systemic innovation in the making.

In the reading of organization process research, I pointed to how this stream within organization studies has opened up for foundational debates in organization studies with regard to the ontological and epistemological underpinnings and their corresponding implications for method, theory and research practice. Following Weik (2011), I pointed to how the process stream tends to sustain an ontological dichotomy between "being" and "becoming", structure and process, which is an obstacle for this field to inquire and help explain the actualization of organization as structure and formatting of processes. The critique of structuralist thinking in organization change analysis has therefore lead to an ontological reversal which however calls for renewed critique in order to reach more integrative theories to understand how "being" and "becoming" are inherent aspects of the same process, rather than two separate "perspectives" we might choose between in our analytical work. With Steyaert (2011, 2012) I pointed also to the potential of further developing performative research methods as part of enriching the process stream in organization studies. This would offer an alternative to a representational mode of knowing processes which tends to prevail despite the processual turn and its embracing of the processual nature of all things and beings. This should, I would argue, be integrated in the understanding of knowledge and knowledge production in order to fully mature in the actual research practice of the field.

In combination, the readings of innovation and organization process studies reveal a potential for a cross-disciplinary contribution which on the one hand picks up the problem of understanding patterns of interaction in the making which remains to be a core problem in innovation systems research, while on the other hand mobilizing resources for studying such processes within the field of organization process studies, particularly the recent critical debates that opens up new developments in this field. This, in turn, also opens up for a feedback loop from innovation studies towards organization process studies in the sense that in innovation research, we are confronted with a clear intellectual and practice challenge of analyzing the *actualization* of potentiality in a variety of contexts and problem-areas. To make a contribution to innovation studies implies therefore a strong attendance to processes (which the resources from organization process research helps me accomplish) but at the same time one commits also to respond to the question of how the new enters the actual – that is, how 'being' and 'becoming' are each other's condition of possibility rather than each other's opposition.

These are some of the potential contributions I find to be the outcome of problematizing innovation and organization studies. In the following chapters, I will develop the approach taken in this dissertation in response to these challenges. I will begin by introducing the empirical field of study and the SEEIT strategic partnership in particular. The purpose is to introduce at an empirical level what I suggest to call cartographic processes. These processes play an important role in organizing energy research towards open-ended system transition objectives and new organizational solutions are being developed to incorporate a capacity to coordinate cooperation strategically in order to solve a variety of relational problems inherent to energy system transitions. Strategic partnerships are examples of such organizational efforts.

After having introduced the empirical field, I will engage with the question of method. Thus, in chapter 4 I respond to the question of how to study systemic innovation in the making. I will elaborate my research process and suggest a methodological framing using Law and Urry's (2004) performativity of method argument along with Steyaert's

(2011 & 2012) arguments of doing process research through in(ter)vention and experimentation. The methodological chapter is the first leg of the cartographic approach which is suggested as an alternative way of studying systemic innovation in the making beyond traditional method conventions which prevail in innovation research as well as organization process studies, as pointed to in this chapter.

The second leg of the cartographic approach is the construction of the analytical strategy which I will embark on in chapter 5. The challenge here is to develop an analytical strategy which prepares for an analysis of SEEIT as a process of systemic innovation in the making – a process of *cartographizing*. I will predominantly draw upon key concepts and arguments from the work of Gregory Bateson and Gilles Deleuze & Felix Guattari. The analytical strategy is constructed with an explicit aim of providing a 'baroque' alternative to the romantic holism which dominates the systems thinking in innovation studies as pointed to previously in this chapter. Thus, the analytical strategy of the cartographic approach seeks to prepare an analysis of tensions, and intensifications of interaction processes and the social productivity of heterogeneity and "charged mixtures" of fields of expertise and diverging strategic interests. We will therefore arrive at an analytical strategy which gives priority to rivalry, divergence, and creativity which are different manifestations of socially productive intensifications of the SEEIT partnership process.

Together, the two legs of the analytical strategy will open up for an alternative, complexity affirming approach to studying and analyzing systemic innovation in the making which I will use to develop three examples of cartographic intensifications and their social productivity in the case of SEEIT in chapter 6 and 7. After the analysis, I will return to the proposed, potential contributions developed in this chapter and I will elaborate on a number of implications for the practice of organizing processes of systemic innovation through strategic partnerships, as promised in the introduction chapter.

3. Introduction to the empirical field and SEEIT

3.1. Introduction

The purpose of this chapter is to introduce at an empirical level how cartographic operations are central for coordination and cooperation in context of organizing energy research towards open-ended system transitions. The main focus will be put on contextualizing and introducing the SEEIT partnership and the process it has gone through since its initiation in 2009. The context is important and I will therefore begin with outlining some of the main European energy research and innovation policy frameworks that constitute a core part of the agenda-setting apparatus in relation to the European perspective on energy transitions. Obviously, developments regarding future energy solutions are influenced by a vast variety of political, technological, cultural and economic forces. I will therefore focus on those which have explicitly influenced the SEEIT process.

The introduction to the empirical field and SEEIT specifically will show how the partnership is part of a wider set of alliance formation activities in relation to making steps towards long-term energy transitions. I will point to how a variety of cartographic processes are involved in this agenda- and priority setting context where energy research institutions, policy makers and the industry participate in translating long-term energy transition objectives into problems to be solved. The cartographic processes that characterize the field include e.g. technology road map constructions, problem-and-approach definitions, and conceptual inventions. The political and multi-organizational construction of road maps in relation to energy transitions is also pointed out in literature devoted to foresight processes and road map practices as particularly significant (Henry, Sedgwick and Robinson 2013). These cartographies in progress help perform coordination of cooperative approaches to knowledge creation and innovation in a field where such approaches are notoriously difficult to render productive. In this chapter, I will also introduce the evolvement of the SEEIT partnership and explain why I consider the partnership to provide us with relevant empirical material for studying processes of systemic innovation and open up for how a focus on cartographic operations may help us refine our understanding of how processes of systemic innovation in energy research evolve and the organizing dynamics hereof. The chapter thus serves as a first, empirical step into the establishment of a cartographic approach which, besides explaining the importance of cartographic processes in the empirical field, consists of an analytical and methodological chapter.

3.2. The Strategic Energy Technology Plan and EERA

> *"A new way of working at Community level requires an inclusive, dynamic and flexible means of guiding this process, defining priorities and proposing actions – a collective approach to strategic planning. Decision-makers in the Member States, industry, and the research and financial communities have to start to communicate and take decisions in a more structured and mission-oriented way, conceiving and implementing actions together with the European Commission within a cooperative framework. We need a new governance structure."*
>
> [Strategic Energy Technology Plan, EU COM 2007b: 9]

In the EU innovation and research policy frameworks (EU COM 2009, 2010a, 2011a, EIT 2009) and energy transitions (EU COM 2007a, 2007b, 2010b, 2011b), strategic alliances and partnerships are repeatedly pointed to as central for improving coordination and cooperation. This has been a key feature of European innovation policy making for more than a decade (Borrás 2003) and does not belong to the energy field exclusively. In the energy field, vast resources have been invested in building up an agenda for an overall energy transition to take place across Europe. The EU Commission's General Directorate for Energy (DG Energy) has made a comprehensive effort to creating such a European energy transition agenda involving industry, research and governments. The Strategic Energy Technology plan (the SET plan, EU COM 2007a) is the key policy instrument for formulating and processing this agenda (EU COM 2007b).

The SET plan was initiated in 2007 with the purpose of building a coordinated momentum towards long term energy system transitions using 2020 and 2050 objectives as a strategic horizon as projected in *An Energy Policy for Europe* (EU COM 2007c). The SET plan has focused on mobilizing key actors from the energy sector and the European energy research community and has been a catalyst for the formation of a number of strategic alliances across Europe devoted to influence the direction of policy making. For example, a number of Technology Platforms have emerged as part of the SET plan structure. These platforms help frame a direct involvement of the energy industry and create linkages between industrial actors and research institutions. The SET plan has thus established a process where the politics of energy transition agenda setting can play out involving a variety of actors. One of the main types of activities is the construction and ongoing negotiation of technology road maps for the different technological fields structuring the SET plan. This includes wind technology, solar technology, bioenergy technology, energy efficiency (the "smart cities initiative"), electricity grids, fuel cells and hydrogen, sustainable nuclear energy and carbon capture and storage. Each field gathers a composition of actors from research and industry and varies a lot in terms of how far these constellations have reached in performing coordination and cooperation effectively. For example, the wind initiative and the smart cities initiative have in different ways come further than the carbon capture and storage initiative. Furthermore, the SET plan comprises a set of cross-cutting governance initiatives including the SET plan Steering Group, the SET plan Information System (SETIS) and the European Energy Research Alliance (EERA).

The latter was formed as a “bottom up” movement gathering the 15 strongest (within sustainable energy research) energy research centres from Europe. The Danish national energy research centre Risø, today an integrated part of DTU, was one of the driving actors in creating EERA and continues to play a central role in its activities. The coordinator of SEEIT, Jørgen Kjems, is the former director of Risø and is therefore closely connected to the European landscape of energy research institutions. The “bottom up” image of EERA is of course somewhat misguiding given the status of the constituent partners which are powerful research centres such as the German Helmholz Institutes, the French CEA, and similar national research centres with a historically strong and still institutionalized position in energy technology research. In several cases these institutions was formed and continues to function as the national bodies for nuclear energy research, including in some cases, national weapon systems research. Thus, EERA was founded as an elite group of strong research centres in need of a common strategic platform for participating in the implementation of the SET plan. Today, EERA gathers more members including universities, but with the constituent research centre partners populating the executive committee. EERA focuses first and foremost on creating stronger coordination and cooperation within European energy technology research. For this purpose, a number of joint programmes has been formed around technological fields and, as in the SET plan process, different joint programmes show different degrees of success with respect to accomplishing their coordination and cooperation objectives.

The interaction between the SET plan and EERA has matured to become very close in the sense that the SET plan presents itself as integrating EERA and EERA presents itself as *the* enabling body for the SET plan to become effective. At a policy level, this linkage has become a mutually supportive composition of agenda setting engines which informs European priorities and approaches in relation to governing, driving and realizing the long term energy system transition objectives which the EU Commission has set out to reach in its 2020 and 2050 policy frameworks (EU COM 2010b, EU COM 2011b). Clearly, this constellation is far from the only strong alliance when it comes to influencing energy (innovation) policies in Europe. The various industrial organizations and lobby alliances play a big role in what we can characterize as the overall "cartographic battle" of energy transitions. The point of highlighting the SET plan and EERA in particular is to contextualize SEEIT because these agenda setting actors have had a particular strong influence on how SEEIT was created and how it has evolved as a partnership. Furthermore, the SET plan as well as EERA and other actor formations in the field such as the SEEIT partnership are closely interwoven at the level of which persons are involved. This has not been the focus of the analysis pursued here, but one realizes quickly when participating in e.g. SEEIT partnership meetings that there is some redundancy in who participates in these agenda setting processes. Thus, as already mentioned, the SEEIT coordinator is active in other policy influencing bodies parallel to SEEIT and this is true for several of the other SEEIT steering group members. Similar observations can be made in the case of the wind energy joint programme in EERA where a limited group of DTU researchers, operating on behalf of DTU, are deeply involved across policy agenda setting alliances with a bearing on future priorities in European wind energy research. The agenda setting apparatus in European energy research thus comprise first and foremost expertise institutions within energy technology research – in most cases well-established energy research institutions with a long track record as dominant energy research actors in their respective national contexts as well as on a European level.

3.3. The Innovation Union and EIT

> *"The European Union should commit to creating a true "Innovation Union" by 2020 by taking collective responsibility for a strategic inclusive and business-oriented research and innovation policy, to tackle major societal challenges, raise competitiveness and generate new jobs."*
>
> (Europe 2020 Flagship Initiative - Innovation Union, EU COM 2010a: 8).

> *The delivery of the EIT's strategy is centered around Europe's most exciting "innovation experiments", the Knowledge and Innovation Communities, KICs. KICs are bringing together the key actors in the knowledge triangle: research, education, innovation, entrepreneurship and business; co-locating people from diverse backgrounds (industry, SMEs, academia, nationality, gender, discipline ...) to work together across the innovation chain from education through to economic impact. KICs will be testbeds where we will address some of the critical questions for Europe's future success in the knowledge economy: "what makes people and teams innovative?"; "can we train entrepreneurs?"; "what makes an innovative place?"; "can open innovation work for an advanced manufacturing industry?"; "how can we measure innovation?"."*
>
> [European Institute of Innovation and Technology, EIT 2009a: 4]

The SEEIT partnership was formed in 2009 as a consortium proposing a set-up for a Knowledge and Innovation Community (KIC) under the newly established European Institute of Innovation and Technology (EIT). EIT was constructed as an initiative "outside" the established DG structure in the EU Commission with its own headquarters in Budapest. While EIT is seen as an integral part of the overall European "Innovation Union" framework, EIT is defined as more autonomous with regard to defining the means whereby it contributes to the strategic objectives in the EU frameworks for innovation and research (EU COM 2011c: 6). The main purpose of the EIT is to select and support a number of KICs. The first round of KIC calls was in 2009 in the fields of energy, climate and information and communication technology. SEEIT was formed in response to the energy call.

In the EU innovation policy landscape, EIT is seen as a key platform for improving innovation and entrepreneurship in Europe through the formation of strategic collaborations between universities, research laboratories and firms. The KICs target "grand societal challenges" (EU COM 2009, 2011a) where long-term strategic alliances are seen as a key part of the organizational solution to delivering results. This means that the KICs target areas characterized by high systemic complexity such as the energy sector, healthcare, agriculture, information and communication technology, climate and transportation in line with the overall EU "Innovation Union" policy framework (EU COM 2010a).

Compared to the energy research agenda-setting apparatus introduced above, the EU innovation frameworks including the EIT institution is a different story. Where the SET plan and the various actor formations in energy research related hereto has a strong focus on energy technology research and gathers the European energy elite, the innovation agenda apparatus is far more inclusive in its scope cutting across all aspects of the economy conceived to be of importance to innovation and knowledge-based economies. Ontologically speaking, the energy elite agenda apparatus builds on and continues to invest strongly in an energy technology-centered reality where institutions and actor constellations have stabilized around energy technology research and policy for many decades. This ontology is absent in the innovation frameworks. Rather, a characteristic of the innovation frameworks, including the EIT is a lack of a "hard core ontology" of any kind. As illustrated in the above 2007-quote framing the EIT initiative, the KICs are seen as testbeds for an open-ended set of issues related to innovation and entrepreneurship. One can already begin to imagine the clashes this opens up for in the formation of SEEIT where exactly these two agenda setting apparatuses play a formative role with the EIT provided an open-ended, "blank spot" in its call for KIC proposals, and the majority of the SEEIT partners deeply involved in the SET plan process.

The initiation of SEEIT as a partnership responding to the EIT call for Knowledge and Innovation Communities was therefore not a situation where the partners could use familiar ways of crafting research proposals, defining problems to be solved and prescribing the proper method to deal with problems identified. In a cartographic understanding of this, SEEIT could not rely on known ways of drawing maps connecting problems to research methods and organization. This cartographic instability was reinforced by a very open-ended call made the EIT. The call was clearly constructed in an open-ended way with regard to defining how the "new modes of collaboration for innovation" could be set up. This strengthens the cartographic nature of SEEIT's initiation – not only did it rest on a critique within the field itself of insufficient collaboration, it also responded to a call for new collaboration solutions that left open the question of how an affirmative, new approach would look like. This was up to the KIC proposing partnerships to 'solve' – the map had to be constructed by the KIC proposing consortium.

The SET plan along with the launch of the EIT with its focus on innovation-centered collaboration thus played a formative role for SEEIT and I shall therefore get back to this in subsequent chapters. For now, it suffices to point out that SEEIT was initiated in context of European policies in relation to innovation and energy systems transition – policies where coordination through converging multiple strategic horizons is a key aspect of the overall approach. These strategic horizons and their organizing effect on the present, is a central aspect of how SEEIT took shape in its initiation and subsequent pursuit of rendering the partnership productive. We could say that SEEIT – seen from the point of view of European policy tendencies – is part of a wider build-up of a strategic, anticipative capacity in relation to organizing and creating momentum in complex system transition processes – not only in the field of energy, but also in other areas of central importance to future growth and welfare (Højgaard et al 2012a, 2012b). With the SET plan framework, the energy area, compared with other "grand challenges", demonstrate a particularly strong orientation towards developing such anticipative structures and processes making this area a good case for studying ongoing efforts to organize systemic innovation. In the following, I will provide a brief outline of the SEEIT partnership process, its composition and activities so that we have a clear sense of what the partnership is about.

3.4. Outline of the SEEIT partnership process and composition

Outlining SEEIT is not easy because the partnership was initiated and constructed in context of a specific call from the EIT and then, after its KIC proposal lost to its main competitor “InnoEnergy”, transformed into something else even though the initial rationale remained more or less the same. SEEIT is a series of events and encounters more than a coherent and integrated organization even though the partnership has informally stabilized a minimum of organizational solutions, as I shall elaborate below. Seen from the point of view of process analytical approaches to organization studies (e.g. Tsoukas and Chia 2002, Cooper 2005), this is a normal way of understanding any organizational phenomenon. In the case of SEEIT the processual nature of the arrangement is brought to an extreme in the sense that SEEIT throughout its history remains an “in-between” organizational aspiration and process more than a consolidated case of organization. Another way of characterizing SEEIT is that it is a process of recurrent organization creation, or organizational entrepreneurship (Hjorth 2012), more than a solidified structure. In particular, I will argue that SEEIT is a process of changing cartographic intensifications through which the partnership as an organizational phenomenon takes shape. In the following outline, focus will be put on describing the process of SEEIT at a glance, the partner composition and organizational solutions it has maintained in the period of study of 2009 to 2012.

As mentioned, SEEIT was initiated in 2009 as a response to the first EIT call for KIC proposals and was coordinated by the Technical University of Denmark, DTU, in particular the former director of the Danish national laboratory for renewable energy (Risø, today an integrated part of DTU), dr. Jørgen Kjems.

The EIT rationale was to establish and render economically sustainable a number of KICs serving as a form of strategic collaboration platforms for a variety of innovation and entrepreneurship projects integrating education, research, entrepreneurship, and innovation among constituent partners. The time horizon for a KIC was 7 years of 25% co-funding from the EIT. The KIC partners were thus expected to deliver 75% of the total KIC funding, the majority of which was anticipated to arrive from industry partners. The planned annual budget was 100 million Euro. This rather unusually high amount of money must be seen in context of the definition of the nature of the co-funding obligations stipulated by EIT. The co-funding requirement included the option of using funds obtained from other European funding programmes as well as national funding programmes when accounting for the funding of the KIC activities. The co-funding of 75% was therefore not necessarily “new” money. More important was the demand that a significant part of the co-funding should come from industry partners.

The SEEIT KIC proposal was constructed during the Summer of 2009 and was submitted on August 31. At this stage, the SEEIT partners comprised 23 energy sector companies, 10 universities and 5 research centers all of which with comprehensive resources in renewable energy technology in terms of research, education and/or business investments. The KIC partnership comprised the following partners:

Industry partners: ASTER Science Technology Business, Centre Ricerche Fiat (CRF), CESTEC, Chemtex Italia srl, ENEL, Indesit, Pirelli, STMicroelectronics, Thales Alenia Space Italy (TASI), Dong Energy A/S, Vestas Wind Systems A/S, Fortum Corporation, Neste Oil Corporation, Stora Enso Oyj, UPM Kymmene Corporation, E.ON Energie AG, Linde Group AG, Q-Cells SE, Schott AG, Solarworld Innovations, REC, Elkem Solar, Eneco.

University partners: Technical University of Denmark (DTU), coordinator, Copenhagen Business School (CBS), Delft University of Technology (TU Delft), Technische Universität München (TUM), Aalto University (Aalto), Polytechnical University of Torino (Polito), Norwegian University of Science and Technology (NTNU), Albert-Ludwigs-Universität Freiburg, Aston University (not partner after

KIC phase), University of Konstanz (not partner after KIC phase). In 2011, the University of Oldenburg joined the partnership.

Research center partners: SINTEF (Norway), Fraunhofer Institute for Solar Energy Systems (Franhofer ISE), Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), VTT (Finland), ECN (Netherlands).

The SEEIT KIC map highlighting co-location centers

The partnership proposed to set up 5 co-location centres each focused on coordinating the partnership activities within the chosen five technology focus areas (wind energy, solar energy, bioenergy, energy efficiency and energy systems). The KIC proposal contained several sections elaborating a diverse range of tools the KIC was to introduce as a means to strengthen innovation and entrepreneurship within and across the technology focus areas.

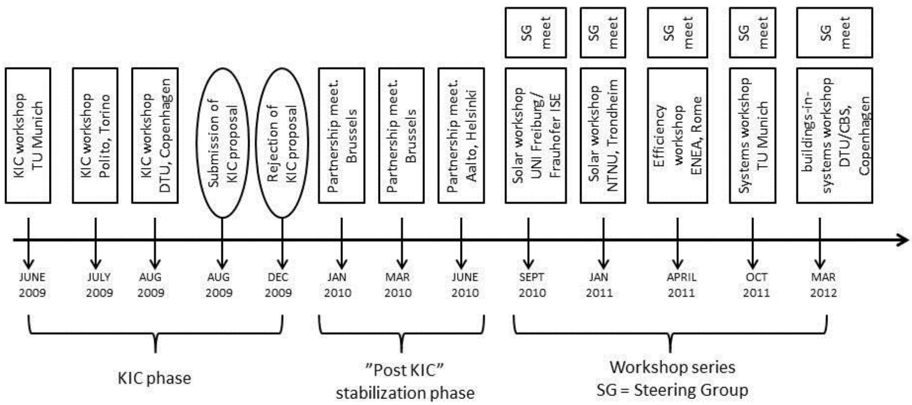
While the industry was to play a central role in the KIC collaboration, the co-location centers were to be placed at the technical universities allowing for a variety of industry partners to become associated.

The KIC proposal from SEEIT reached the final round of evaluation, a hearing in Budapest in December 2009, but came in second and lost to the competing consortium "InnoEnergy" coordinated by Karlsruhe Institute of Technology. The decision to grant

InnoEnergy the KIC status was made by the EIT board in a secret vote. Thus, in the end it was not clear on what criteria the decision to distribute substantial EU funding was made. EIT was still a very new institution (a director and coordination secretariat was barely in place) and this seemed to influence the process of evaluation where the EIT board had a relatively high degree of freedom which it used in a particular, secretive way to make its final decision.

Despite (and probably also due to) the frustration of the defeat, the university and research center partners decided to continue the partnership collaboration. The investments made during the Summer and Fall of 2009 in a shared strategic objective and collaboration framework were seen as too promising to be merely abandoned after the EIT board's rejection. Also, the partners anticipated that in the future, partnership arrangements like SEEIT would have a central role in the European landscape of innovation and science policy. Already in early 2010, when the considerations about how to carry on with the partnership process, there were signs of a shift of thinking in the EU framework programme for research and innovation towards a stronger emphasis on strategic partnerships as receivers of large funding rather than a project by project based funding system (EU COM 2011). In the spirit of having composed a competitive KIC proposal and in light of future potentials for strategic partnerships to gain more weight as receivers of funding, the SEEIT partners thus decided to continue the partnership collaboration. The firms that were part of the KIC proposal did not continue as core partners but remained part of the arrangement in the sense that firms would be pulled in during subsequent project development activities. The continuation of the partnership was therefore first and foremost an agenda carried out by the universities and research centre partners.

In the period of 2010-2012 the partnership organized a series of workshops and steering group meetings with the aim of catalyzing collaboration activities in research and education connected to its five technological focus areas within renewable energy. This "focus" was very broad and inclusive but resonated with the KIC concept which remained a key part of the SEEIT framework. Also, at this point, after a long and intense process of partnership mobilization and conceptualization it did not seem feasible nor relevant to reconstruct the partnership rationale and approach despite the fact that the SEEIT KIC framework of course relied on dedicated funding it had not received.



Overview of SEEIT partnership meetings and workshops 2009-2012 (excluding preparatory workshops and meetings in the Fall of 2009 and project-specific meetings and workshops)

An important aspect of continuing the collaboration after the KIC phase was to gain recognition in the EU Commission as a strategic partnership alongside other strategic formations related to the Strategic Energy Technology Plan.

The "post-KIC" phase was therefore only partially 'internal' to the partnership in terms of finding a focus and securing partner commitments. Equally if not more important for the continuation of SEEIT was the linking of the partnership to ongoing policy making at EU level in relation to implementation of SET plan goals and the translation of energy transition objectives in the EU into strategies in research and innovation. Being well-connected to the EU Commission's General Directorate for Energy, the SEEIT coordinator Jørgen Kjems, together with other Steering Group members, managed to put SEEIT on the map of important strategic partnerships with a bearing on the implementation of the SET plan. One of the key arguments was that the 10 university partners represented a very large pool of students and thus future engineers and entrepreneurs upon which the implementation of SET plan targets would be highly dependent. This positioning resonated with the SET plan reasoning which at this point in time began to actively focus on the human resource aspects (rather than merely technology road maps per se) of transforming energy systems. SEEIT could position itself as an ideal partner for this to be addressed. Later on, the EU Commission began a process of mapping existing and future needs for energy-related education in light of the SET plan objectives, and SEEIT was among the actors involved in populating the panels set up to do the analysis and provide recommendations. The link between SEEIT and ongoing EU policy making illustrate also a strategic dimension of why the SEEIT partners would continue the collaboration process. Securing the recognition of SEEIT in the EU Commission as an actor in the overall SET plan process was important for securing "upwards" as well as "downwards" legitimacy.

3.5. Partnership organization

The core of university and research center partners has with a few exemptions been quite stable over time. University of Oldenburg entered the partnership in 2011 while Aston University and University of Konstanz did not continue after the rejection from

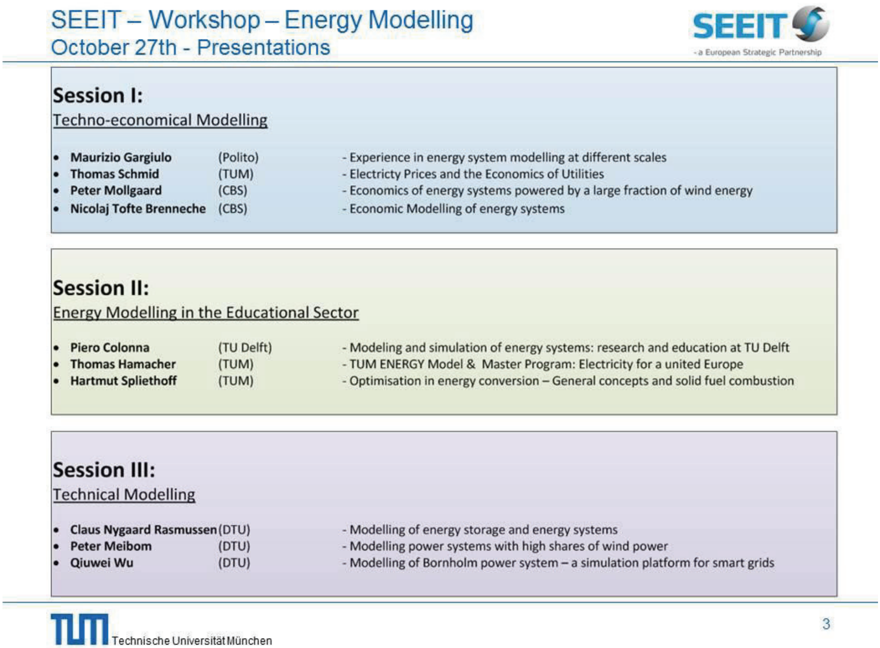
EIT. Not surprisingly, those who had been most involved in the KIC process were those who could see a reason for continuing after the rejection. Among the research centres VTT (Finland) and ECN (Netherlands) did not continue their membership, but remained linked due to the close ties with their respective national technical university partners.

Formally, the partners of SEEIT are institutions, but for each partner it varies what this implies in terms of actual participation. At some partners, SEEIT is anchored in the central administration pulling in researchers from different research departments depending on the activity SEEIT puts focus on – this is the case for e.g. DTU, Sintef, NTNU, Delft and Aalto. In other cases, the partnership is tied to a specific research department. This is the case for TU Munich where the department of energy systems analysis is de facto partner. In some cases, the anchoring is weak in the sense that no clear tie to an organizational level (central administration, department level) is established at the partner. This is the case for e.g. CBS and ENEA. The anchoring is therefore "opportunistic" or pragmatic more than consistent. This is not surprising given the institutional variations across partners.

Each partner has a seat in the SEEIT Steering Group (SG). Again, the actual implication of this varies from partner to partner. In some cases, the SG member is an appointed representative for a dean or research director in the central administration – in other cases the dean or research director him/herself is actively participating in SG meetings. During 2010-2012, the SG meets approximately twice a year typically in connection with a partnership workshop pulling in participants from the partners depending on the topic of the workshop and the mobilizing effectiveness of the respective SEEIT anchors. The SG meetings typically consist of agenda points related to ongoing EU policy developments in relation to the SET plan and tendencies in the ongoing reform of EU's framework programme for research and innovation. The SG members would then discuss the prospects for SEEIT in light of these tendencies and receive information from the working group and individual partners on ongoing projects and workshop activities. Several of the SG members have senior management positions at their home institution and are involved in other European strategic alliances besides SEEIT. This means that the discussions in relation to policy tendencies are based only partially on published policy documents. Informal access to policy makers plays an important part in the ongoing interpretations of the policy tendencies and the positioning of SEEIT herein. The connectedness of SEEIT in the wider European landscape of energy and innovation policy strategies is therefore a key element in the SG meetings.

In order to give operational support, SEEIT has a permanent Working Group (WG) consisting of research advisors, research assistants and administrative supporters. The WG thus plays a vital role for making workshops effective, mobilizing participants, and for supporting project initiatives with e.g. fundraising expertise. The SG and the WG constitute the continuity of SEEIT in terms of participants and frequency of meetings.

SEEIT workshops are typically driven by the hosting institution in collaboration with the coordination team at DTU. The format is simple in the sense that the workshop is a compilation of presentations given by the participants typically focused on their respective research and collaboration interests. Because of the technology oriented focus areas and the dominance of technology research partners, the majority of presentations is about technical research and research problems that calls for technical research in order to be solved. The majority of participants are energy technology engineers and researchers with a natural science background. At the workshops there is typically also members from the WG to support with input regarding funding opportunities as back up of project spin outs.



[Example of workshop agenda , TU Munich, October 2011]

3.6. Project spin-off examples

To turn wide reaching strategic partnership aspirations into actual cooperation projects is always a difficult task – especially when the strategic aspirations deliberately point beyond established ways of organizing research collaborations. When reviewing the performance of SEEIT in terms of successful project proposals after the KIC phase in

2009, one finds only a limited number of cases. The difficulties with rendering the partnership productive will be a central part of the analysis of SEEIT and I will therefore not enter this here, but only list some examples of the kind of collaboration projects pursued.

In 2010 the partnership submitted a proposal for a joint ph.d. school in buildings' energy efficiency under the EU Erasmus Mundus Joint Degree framework (EMJD). The idea was to combine business school competences and technology research competences in a proof-of-concept ph.d. framework emphasizing innovation and entrepreneurship. CBS (that is, myself) was the coordinator. The proposal received fairly good evaluations but was rejected. A similar attempt was made in 2011 but was abandoned by CBS due to a lack of proper anchoring of the project and a clash between the project and internal CBS strategy controversies in 2011. Another example of a joint project is an Erasmus Mundus wind energy M.Sc. programme which was the first successful joint project in the partnership. In this project the technical university and research center partners focused on developing a joint programme combining existing wind energy competences. The wind master programme is a spin-out activity and can by no means be said to belong to SEEIT. But the programme was catalyzed by the SEEIT process and continues to be administrated by several SEEIT partners.

In 2012, the partnership produced a joint research proposal focused on creating new building design approaches to integrating technical, environmental and economic performances of energy efficient buildings. The proposal incorporated an attempt to set up a cross-disciplinary approach spanning technical, organizational and economical competences, but had to constrain this according to the evaluation criteria in the target EU FP7 call which did not embrace cross-disciplinarity to the same extent than SEEIT pursued in this particular project. The project was a spin-off from a process in SEEIT that successfully mobilized a broad range of researchers. The proposal itself did however not receive funding.

These project examples illustrate how SEEIT has aspired to become operative at a number of levels including a SET plan agenda level and specific cooperation activities among partners where new types of energy education and research proposals have been constructed. Clearly, the project activity level has been a challenge to render productive. Partly due to the difficulties of assembling the right group of people to form a project proposing team when partners are scattered across Europe. And partly due to the point of departure for SEEIT namely to develop new approaches and activities that puts focus on energy transition challenges beyond usual ways of composing energy research and education programmes. In a cartographic perspective, the difficulties of turning SEEIT into a productive partnership illustrate that its activities need to be understood systemically, and not just as a local partnership process. Thus, many of the project cooperations reflect the constitutive purpose of SEEIT of turning complex system transition agendas and scenarios into actual project cooperations. However, this kind of ambition is notoriously difficult to pursue because it constantly finds itself at the boundaries of established systemic problem-response constellations setting boundaries between e.g. disciplines, which SEEIT seeks to mix up and transgress.

Such established constellations, or cartographies, are to be encountered in many contexts including evaluation of research and educational proposals, individual participants' expectations and categorizations of what SEEIT is and which activities it should pursue, and so forth. Constantly, in its pursuit of cooperation towards systemic innovation, SEEIT finds itself in-between the familiar and the un-grounded. In this sense, there is something disruptive about SEEIT and the project aspirations it pursues.

Symptomatically, one of the more smooth processes of cooperation which turned into a successful application was one where the partnership linked well-established and directly complementary competencies within wind energy education. This was not a disruptive project, but was composed on the basis of established structures and educational systems. The ph.d. school on the other hand was clearly disruptive in its attempt to fuse an engineering with a business school ph.d. framework. These characteristics imply that we might consider SEEIT as an instance of systemic innovation and an example of how organization evolve in a process where the problematization that enables joint efforts cannot be taken for granted, but has to be established.

3.7. SEEIT as an instance of systemic innovation

SEEIT is an example of ongoing efforts to establish effective coordination and alliance formation towards inherently open-ended system transition objectives. This makes SEEIT interesting for the purpose of understanding the organizational challenges related to establishing new coordination and cooperation solutions in a field largely populated by well-established actors and institutions. In this sense, SEEIT is process material for understanding how agency is relationally constituted and how relational agency unfolds (and breaks down) in between a future yet to come and established systems of knowledge production and innovation.

This kind of case material is not standard in the field of innovation management research which, as we also saw in the reading of innovation systems and system transitions research, has a tendency to respond to complexity by always adding yet another factor or dimension to be included in the construction of higher order coverage models such as “innovation systems” or the “multi-level perspective”. Studying SEEIT as a process allows us to relate in an alternative way to the problems of complexity, systemic embeddedness of cooperative innovation processes and the coordination hereof. Thus, with the case of SEEIT, we move “downwards” rather than “upwards” when inquiring the complex, systemic embeddedness of innovation processes. This allows for an organizational level analysis of the evolvement of coordination approaches to making cooperative innovation processes productive, and it allows for sustaining a qualitative, empirical anchoring of the inquiry rather than organizing the analysis according the pre-established coverage models constructed on terms which are detached from ongoing processes of innovation.

SEEIT is an example of an ongoing process of constituting relational agency in a field where several similar agency formations are taking shape. In some cases with a high degree of involvement from industry, in other cases, like SEEIT, with a dominance of university and research centre actors. Again, this makes SEEIT an unusual empirical example for innovation research. Major parts of innovation management research defines innovation as processes of commercialization or firms’ uptake of new technologies, organizational solutions etc. (this is also stressed by Lundvall 2007 in his review of the innovation systems framework). This is not a helpful presupposition when inquiring processes of systemic innovation such as those we see in the energy sector. Here, the politics of knowledge and innovation is a central part of the overall innovation process and does not necessarily imply commercialization of new technology. Rather, systemic innovation processes include agenda-setting apparatuses and transition politics within energy research. Here firms are also active, but the innovation challenge has not first and foremost to do with commercialization of new technology, but the overall organization of knowledge production including the invention of new ways of making coordination of cooperative innovation processes effective in a situation where those who has coordination responsibilities (such as energy research centres, universities, their alliances along with policy agencies etc.) face a transition reality they are fundamentally unfamiliar with and cannot know the outcome of.

In this context, systemic innovation cannot be restricted to commercialization and it cannot be studied in accordance with established analytical frameworks which presuppose that innovation is manifest mainly as commercialization of new technology. The point and challenge about systemic innovation is, on the contrary, that it confronts practitioners, organizations and institutional arrangements with a tendential and open-ended landscape of energy transition processes. In this context, established means of coordination are confronted with a tendential reality which puts pressure on historical and institutionalized solutions to coordinating energy research and innovation. As introduced also in chapter 1, this means that not only must the topology of energy systems be re-configured in order to integrate turbulences of renewable energy. This turbulence stretches into the organization of knowledge production and territories of energy technology research.

Therefore, rather than trying to squeeze in SEEIT as a case for innovation management research where we study "a certain part or function of the innovation system", we might consider SEEIT as a different kind of empirical material for innovation research. A material which can help us improve our knowledge and methods in relation to inquiring processes of systemic innovation where knowledge and innovation politics and organizational inventiveness are intertwined in complex ways. This is where people involved in constructing new approaches to coordinating complex cooperative approaches to innovation are situated. They are not situated in an organizational reality we can describe as a function within an innovation system. They are making up solutions, mixturing established and new approaches, sometimes embracing, sometimes fleeing from unfamiliar ways of cooperating. Their efforts relate to well-established practices of knowledge creation in their respective fields while translating complex system transition agendas in a variety of ways into local, situated efforts to make cooperation work and enhance coordination capacities in the field they are involved in. SEEIT and the many similar coordination and cooperation bodies we find in the energy transition field play a piloting and probing role in a context where no "innovation system" as such exists, but need to be invented along the paths of transition movements. This makes SEEIT, I suggest, an empirical instance of ongoing systemic innovation processes within energy research and innovation.

3.8. SEEIT as a cartographic process

Having introduced the SEEIT partnership, I would like to touch upon why I consider SEEIT to be an example of a cartographic process. From the outset in 2009, SEEIT has been characterized by being a process of searching for ways of connecting partners in research and education activities which translate system transition objectives into actual cooperation processes. This has entailed numerous discussions within SEEIT about the rationale and organizational solutions to making the partnership productive – discussions which have not only been local in the sense of dealing with immediate challenges of organizing the partnership, but also connected to wider efforts in the field of European energy research. This means that the focus and organization of the SEEIT partnership has been discussed vis á vis other strategic alliances (e.g. EERA, EUA (European University Association), and others) in order to avoid duplicating agendas. Apart from these discussions related to putting SEEIT onto a "bigger map" of European alliances, there has been an ongoing effort to define the focus of SEEIT. This has involved different attempts to conceptualize SEEIT as an organization. For example, the coordinator has used the terms “engine” and “catalyst” to express his ideas about how to understand the organizational solution SEEIT should aspire to deliver. All along, these attempts to define and develop the understanding of what SEEIT was and should become can be understood as a cartographic process of stabilizing a collective problem-response constellation which would render SEEIT productive as an “engine” of cooperation and systemic innovation.

As the analysis of SEEIT will further elaborate, the partnership was from the outset characterized by several instances of problematization and rivalizing versions of how to understand the problem for which SEEIT should compose solutions. This is an expression, I will suggest, of SEEIT being closely entangled with ongoing efforts to develop new problem-response constellations within the energy sector at large and specifically within energy technology research. Thus, SEEIT is part of a wider tendency in the field of searching for new ways of situating and problematizing energy research as a responsive agent in relation to complex system transition processes. As a symptom hereof, we find e.g. a number of different attempts within energy research to establish new contexts for research to engage with innovation. This could be “living labs” or “demonstratorium-settings” where research interacts directly with users, companies, and other stakeholders to experiment with and deliver solutions for specific energy system changes. Jørgensen (2012) refers to this as the construction of “new arenas for development”. In the ongoing development of new research programmes at EU level and at national and regional levels, we also find numerous attempts to construct new “holistic” approaches to energy research integrated multiple disciplines addressing system transition challenges (see e.g. Højgaard et al 2012 for a policy advice example and Horizon 2020, EU COM 2011a). This is more an ideal than an actualized situation, but the mere fact that this remains one of the persistent ideals in the field suggests a recognition of a challenge of constructing new problems for energy research to respond to. Of course, this is only a tentative reading that calls for further elaboration which I aim to satisfy in the analysis of SEEIT.

This is why considering SEEIT as a cartographic process might help us understand the nature of the process the partnership goes through and understand in what sense this partnership along with similar activities in the field belongs to a process of systemic innovation. This is a process where established problem-response constellations encounter an new transition complexity that calls for revisiting and reconstructing problem-responses – not only at a local partnership level, but systemically across a variety of actors involved in energy research and innovation. The cartographic approach allows us to consider both the performativity of established problem-response constellations and the cartographic crisis and creativity which emerge when established cartographies no longer perform coordination and support cooperation effectively.

3.9. Sum up: A field in transition

The aim of this chapter was to provide an entrance into the context in which SEEIT is operating and introduce the evolvement of SEEIT, its activities and outcomes in the period of 2009-2012. The chapter has shown how the EU agenda-setting activities in relation to building a momentum towards long-term energy transitions across Europe involve the formation of a variety of alliances and strategic partnership arrangements. These actor constellations are pursued as a means to enhance coordination and cooperation capacities within and across fields of expertise in relation to energy technology research and innovation. I have pointed to how a variety of cartographic processes help constitute actor formations at different levels – both at a general EU level of coordination through the SET plan process, and within strategic alliances such as SEEIT. The cartographic understanding of the field and SEEIT thus has to do with the many attempts to construct and intensify actor formations so as to gain a collective momentum and make steps towards energy transition objectives.

Dramatizing this we might consider the field as a "cartographic battle field" where multiple actors and actor-constellations participate in making, giving direction to, and translate energy transition agendas into cooperation processes in multiple ways that I propose to frame cartographically. These processes are inherently complex and irreducible to standard micro-macro level distinctions such as those we found in e.g. the multi-level perspective in system transitions research in chapter 2. Rather, cartographic processes are involved in the ongoing and open-ended potentialization of interaction through e.g. strategic alliances and partnerships like SEEIT, EERA, KICs, etc. To understand this field as unfolding cartographic processes also underlines the political nature of innovation in context of complex system transition processes. The "landscape" of energy is in a state of transition. This stirs numerous kinds of activities and actor formations which invest in stabilizing the direction for energy transitions in the future. This goes on in relation to setting priorities for investments in energy research, in the construction of energy market regulation, and so forth. All these activities are cartographic in how they involve the negotiated and contested construction of a real yet to come which translates into certain problem-definitions and thresholds to be overcome by investments and organizational solutions in the present. As such, cartographic processes are a central ingredient in the organizing processes of systemic innovation which are inherently political and constantly about how to gain momentum through the potentialization and orchestration of relational agency-in-progress.

In this way, cartographic processes provide an empirical entry point into studying how responses to the coordination problem evolve processually and how different coordination efforts affect processes of cooperation. Such an inquiry requires that we study ongoing processes of coordination and cooperation such as those we find in the SEEIT partnership which was born in the midst of energy transition agendas and has evolved as an attempt to translate such agendas into cooperation activities. This makes SEEIT an empirical instance of systemic innovation where we are not in the realm of commercialization of new technology, but rather in the realm of probing and piloting new approaches to coordinating and cooperating towards open-ended system transition objectives. As a case for innovation research, SEEIT operates in a tendential landscape where shifting priorities and agenda-settings are giving shape to the overall process of energy transitions and policies intended to support such transitions. Moreover, SEEIT is an example of how an organizational process of partnering evolve in context of such a landscape where the partnership seeks to establish itself as an attractive translator of complex system transition challenges into actual cooperation activities. SEEIT is therefore more than a case that has to do with "cartographic battles". It is also a case of partnering in the midst of an open-ended system transition process where those with a stake in energy research seek to sustain and construct new agency-formations.

In the next chapter, I will focus on the methodological question of how to study such cartographic processes. I will give priority to explaining the research process I have gone through and how the cartographic approach came to take center-stage in my analysis of SEEIT. The cartographic approach grew out of my participation in SEEIT rather than being merely a theory-derived conceptualization. The method chapter also engages in a more basic discussion related to the question of how to study empirically processes of systemic innovation. This relates also to the critique developed in chapter

2 of established innovation management research as being detached from the processes it theorizes. After the method chapter I will develop the analytical strategy as the last preparation of the actual analysis of the SEEIT partnership.

4. The cartographic approach - Part 1: Researching cartographic operations performatively

4.1. Introduction

When social scientists study innovation, the point of view is typically one of distant observation, measurement and interpretation. This has to do with a certain understanding of scientific knowledge as representational and objective (Haraway 1988, Law 2004), but also a certain social science habitus which sustains an asymmetrical relationship between the researcher and the empirical field where the researcher is the one who does conceptual and analytical work, and where "the empirical" is constructed as more or less passively available for the researcher's detached point of view. The empirical world is rendered object for the gaze of the researcher according to methodological conventions agreed upon among researchers in their respective academic fields. This means that "practice" or "the empirical" is not afforded a capacity to generate own concepts in relation to itself and its evolvement – this remains the domain of the one who studies the practice of others according to principles which are foreign to the practices under investigation.

As we saw in the previous chapter, this is also a predominant feature of innovation management research where assumptions regarding the nature of agency in relation to innovation processes are introduced at the level of theory and used to construct overarching models such as innovation systems which are then used as a device for analyzing vast fields of knowledge creation, commercialization and policy making processes. As pointed to in chapter 2, this creates an asymmetrical relation between knowledge production practices in innovation management research and the broad range of practices involved in actual innovation processes. A similar critique of innovation studies methods was formulated by Akrich, Latour and Callon (2002) pointing to the ways in which innovation management studies tend to introduce assumptions about innovation processes that fits their rationalistic decision-making theories and how these have been used in retrospective case studies which “allows” the researcher to pass judgment over innovation practices which are only possible in hindsight (a form of detachment).

Following Haraway’s critique of objectivity through detachment and distance (1988) and the observations made by Akrich, Latour and Callon (2002), when conducting research into innovation, we thus face a basic choice between, on the one hand, reproducing a research practice that constructs for itself a transcendent point of view above and beyond the empirical field it inquires or, on the other hand, engaging in an alternative innovation research practice that avoids constructing imaginary points of view situating itself in the midst of the practices it aspires to make rational knowledge claims about. This represents an inversion of traditional objectivity criteria that also resonates with the aim of doing innovation process research performatively (Law and Urry 2004, Steyaert 2012). Thus, rather than organizing innovation research by means of detachment from innovation processes in time and space, the approach offered here will open up for an innovation research practice that engages in ongoing processes, and takes on the risk of experimentation and probing open-ended processes which practitioners involved in innovation face continuously.

The performative and in(ter)ventive approach to doing systemic innovation research has developed during the course of the research process leading up to this dissertation. The method, therefore, was not a pre-conceived research design that was subsequently implemented. Rather, the method approach developed as a process of research-field interaction where I as a researcher did not detach myself from the field of inquiry but pursued my research through establishing collaborative relationships in the field. This constitutes a different process of becoming researcher compared to the more normal process where research becomes research as it adheres to principles of knowledge production agreed upon exclusively among academic peers.

The empirical research process has taken me through various experiences with the practice of creating and coordinating the SEEIT partnership, of pursuing cross-disciplinary research activities in-between technology and innovation research fields of expertise, and of bridging between very different institutions of knowledge production (in this case a business school and technical universities). The process has taken me through multiple EU funding applications, SEEIT partnership workshops and steering group meetings, and through high-intensity collaborations as well as fragmented and frustrated efforts to make the partnership effective. In many ways, therefore, the research process has co-evolved with the SEEIT partnership and the research methodology has therefore matured during the course of participating in making SEEIT work.

The chapter will be structured in the following way: First, I will introduce the steps I made during the research process and thus provide an overview of what I did. Then I will take up the methodological questions related to doing situated innovation process research performatively and in the in(ter)ventive research practice I derive from this. I will end the chapter by pointing to how the approach pursued here opens up for an new role for innovation management research that I will elaborate further in the chapter on implications following the analysis of the SEEIT partnership process.

4.2. The research process at a glance

The research journey leading to this dissertation began in the Summer of 2009 when I as a CBS research assistant joined the DTU-based coordination team that was set up to drive the process of creating a European partnership delivering a KIC proposal for the newly established EIT. In the following sections, I will draw a picture of the research journey I have gone through. The picture will not include all details but will seek to provide the reader with an overview of the research process and its entanglement with the partnering process shaping SEEIT. The research process overview also serves as a stepping stone for entering a methodological elaboration of the research practice which evolved during the course of the research journey. As mentioned above, this journey was not designed as a distanced study of the practice of others. Rather, the research process was driven by a search for ways of establishing a productive partnering practice – a search which was not merely my own, but a shared process among the SEEIT partners and the coordination team in particular.

At the outset of the process, my involvement in the SEEIT partnership was not conceived by me as a process of doing research. I considered it more as an involvement that could provide access to an "actual" case study of e.g. how energy engineers work and how they organize towards accomplishing innovations. In other words, a rather traditional way of staging social science studying organizational practices. However, this view changed as the partnership process continued and I began to realize that the SEEIT partnering process in itself and my involvement in it might be considered as an instance of systemic innovation – and possibly an interesting one as well. Finding myself in the midst of a partnering process with key actors involved from the European energy research scene opened up for thinking differently about the means and ends of doing innovation research. This was however not the starting point of the process.

When I joined the SEEIT KIC coordination team in June 2009, I knew very close to nothing about energy technologies, energy (research) policies or the emerging landscape of European strategic alliances within energy technology research. One of the first of many unfamiliar references I encountered during the first meeting at DTU was the “SET plan goals” which was mentioned repeatedly as a primary point of reference for defining the scope and purpose of the KIC proposal. The making of the KIC proposal was a challenging task that was not like a usual EU research project. The KIC proposal was to comprise two main components: A proposal for how to scope and organize an innovation-centered, European-wide partnership ecology that would increase significantly the capacity to coordinate and cooperate at a European level, and a signed consortium agreement among the partner institutions. This was to be completed during approximately three Summer vacation months. I became part of the coordination team because the coordinator, Jørgen Kjems, had invited professor Mette Mønsted at CBS to participate in making the proposal which was to focus on organizing partners towards generating innovation and therefore not a proposal describing technical problems and solution approaches. Mette Mønsted pulled me into the process and I subsequently spend most of my Summer that year in the interim KIC coordination office at DTU together with the coordinator Jørgen Kjems, a former director of the Danish national research laboratory for renewable energy, Risoe, and the international alliances officer Maria Skou (today head of Innovation Centre Denmark in Seoul).

My role during this time was to act as a kind of co-writing secretary to the coordinator. This meant to help draft sections for the KIC proposal, to write up agendas for and minutes from the weekly partnership telephone conferences, to help organize the partnership workshops, to communicate with partners and to participate in writing up the final proposal. This last function illustrates my role at this stage quite well. The final proposal was written in a highly intense process of drafting, iterating, re-drafting and negotiating sentences with partners. In the very final stage I took care of managing the constant flow of fragments of inputs from partners into the proposal document. In this process I experienced the negotiated crafting of a strategically important proposal supposed to assemble a heterogeneous set of partners in a shared framework without compromising the strategic integrity of the individual partner. This position of mine in the coordination team and the writing tasks this entails was a good way to enter a field of European strategic partnering and an opportunity to write my way into the language this field uses.

The SEEIT KIC process in 2009 thus constituted a particular passage for me into the empirical field of European strategic partnering which became formative for the subsequent research journey. In particular, it positioned me in the midst of a partnering process that challenged traditional ways of practicing innovation and organization research. It left no convenient outside for me to position myself in as a means to "merely" observe and analyze the practice of others. Rather, the partnering process and the evolvement of my research process became intertwined as I strived to find ways of participating that would actually add to the process of partnering and organizing collaboration activities. The role as an organizer and as a researcher thus became coupled from the outset. After the formative KIC phase, this coupling continued making the process of partnering and the process of researching closely connected. There was a very clear sense of "we are in this together" in the KIC experience and the subsequent pursuit of making the partnership perform. A move into an observing and interpretative position was simply not an option that made sense and this confronted me with a challenge that lead me into questioning and experimenting with the practice and performativity of innovation research.

4.3. A co-evolvement of the partnering process and the research practice

After the rejection of the SEEIT KIC proposal from the EIT board in December 2009, my role changed from being closely entangled with the coordination team to being a participant from CBS in the partnership. The connection to the coordination efforts did not dissolve, but due to the rejection and the consequent change of intensity in the partnering process, the coordination team effort did no longer require the same investments. Also, my work situation changed from being a research assistant to being a ph.d. student with 3 years of funding from DTU and CBS – a direct result of my involvement in the KIC process.

From early 2010 onwards, I continued to work with partners, particularly at DTU, to help make the SEEIT partnership turn productive. It was during this process that I started realizing how the SEEIT process in itself could be considered as an interesting instance of organizing processes of systemic innovation. This perspective developed over time as the collaboration process went through various attempts to make the partnership perform at a project level. For example, during 2010 and 2011 I was deeply involved in an attempt to establish a joint ph.d. school (under the EU Erasmus Mundus Joint Doctoral programme) across partner institutions that would link research training in the field of energy efficiency of buildings with training in innovation management and entrepreneurship. Through this collaboration process, where I acted as the coordinator, I got first hand experiences with the challenge of translating between a partnership horizon seeking to pull partners together, and the multiple horizons of the individual partners including their respective institutional constraints and strategic priorities. The joint doctorate project matured during 2010 and 2011 but was abandoned before submission of a second proposal in 2011 due to leadership controversies at CBS.

During the period of 2010-2011, I participated in almost all partnership workshops and steering group meetings. Each partner took turn in organizing workshops and steering group meetings: Solar energy workshops in Trondheim and Freiburg, Wind energy workshops in Copenhagen and Delft, Bio-energy in Helsinki, energy systems in Munich, and energy efficiency in Rome and Copenhagen. As introduced in chapter 3, these workshops were set up with the purpose of identifying and initiating joint applications for research and education programmes in the EU funding systems. The workshops performed differently and provided me with an opportunity to understand how different technology fields are staged in terms of how problems and approaches are constructed and pursued by researchers and in funding bodies.

During the same period, the partnering process went through different attempts to make its gatherings turn productive and my participation and research process evolved together with these efforts. Thus, up until the workshop and steering group meeting in Rome, April 2011, the workshops had mainly gathered researchers from university and research center partners with an established expertise in the technology area addressed in the workshops. Thus, the workshops sustained a technology-centered point of departure for identifying and mobilizing participants. With some exceptions, only limited efforts were made to design the actual workshop activity in a way that would support the objective of gathering and composing new collaborative ties. This meant that several workshops suffered from fragmentation. This was particularly clear during the Rome workshop on buildings' energy efficiency which was a tour de force in detailed reports on past research projects and highly incremental project proposals. The Rome workshop was a low-point in creating the partnership, but it also ignited a frustration which was part of a subsequent momentum during the following workshop activities in Munich, October 2011, and Copenhagen, March 2012.

Until the Munich workshop, my mode of participation had concentrated on the ph.d. school proposal and on participating in the various workshops listening to the ways in which the various technology areas were discussed and approached by mainly energy technology experts. At the Munich workshop this changed as I gave my first partnership presentation on "The dynamics of systemic innovation" (the full presentation is available in appendix 1). I will elaborate how this presentation performed and how it constitutes an example of an experimental and performative practice of doing innovation research. My participation in Munich was the first time I contributed as a researcher to the process and thus a key event in the research process. The shift of mode of participation intensified the research process and lead me to establish an analytical approach with cartography as the main concept. The process of participating was therefore also a process of becoming researcher and of establishing an analytical framework that would both enable me to do a process analysis and enable me to further refine my mode of participation. After the Munich workshop I participated in designing the following workshop at DTU in March 2012 together with colleagues from DTU and CBS. I also wrote a short text to the SEEIT steering group where I presented the idea of understanding SEEIT as a cartographic process (appendix 2).

The brief process overview indicates how the collective process of partnering and my research process co-evolved. As the partnering process went through different phases it offered me different opportunities for participating. And as I participated, my practice of doing research became increasingly mature as a performative and in(ter)ventive practice where I strived to add to the process of partnering by means of participating with process-generating input, as I will elaborate more detailed below. The overview thus describes a process characterized by a researcher-field relationship of a different kind than what we often see in organization and innovation management research. The relationship was not constructed by stepping outside, but by exploring and experimenting with establishing productive relations between the partnering process and my research practice. In this way, the partnering process brought me along its streams and movements and from this process evolved a performative and in(ter)ventive innovation research practice. In other words, the research process shared the risks of and efforts made in the partnership and positioned itself alongside, and symmetrically with the partnering process as opposed to the more conventional position of innovation management research working with data material from a distance in time and space.

4.4. The empirical material

The nature of the research process as introduced above has had an impact on how the empirical material has been gathered. Accordingly, I have avoided techniques of data gathering that would imply an explicit detachment between me as a researcher and the partnership as an object of study. Thus, no research interviews have been made even though making interviews is one of the most normal ways of gathering qualitative research data in organization studies. Similarly, I have at no point positioned myself as someone doing research into the practice of others in context of the partnership. This does not mean that I did not observe the practice of e.g. the coordinator, or the practices involved in crafting research proposals, defining problems and solution approaches used by the engineering researchers in the partnership. I have made many observations but not in a frame of interpretation and detachment.

The empirical material I have produced and gathered throughout the process comprise the following:

- Own notes from 12 partnership workshops and 8 steering group meetings from 2009 to 2012.
- Own notes from informal discussions with the SEEIT coordination team related to the progress of the partnership 2009-2012
- All documents, reports, minutes etc. from SEEIT meetings throughout the time period.
- All power point presentations from workshop and steering group meetings
- SEEIT e-mail correspondence from 2009 onwards
- All funding applications (including related draft versions and content negotiations on email and during workshops) produced by the partnership
- Related policy reports that have been actively mobilized in the partnership process (e.g. the EU policy documents on the SET plan or on Horizon 2020).

My own input to the process is part of the empirical material. For example, the KIC application delivered in 2009 was a truly collective effort where I contributed in various ways to organizing the KIC process and crafting the final proposal. I was deeply engaged in the ph.d. school applications and later on I contributed with a more matured input that I will elaborate further below. This means that the empirical material from the KIC process in 2009 and the subsequent series of workshops and steering group meetings have been generated partially by me as an input to the partnering process. No material is included which has not added to the process. Thus, my own reflections made in my office are not included as empirical material if they have not been introduced directly in the partnership or in discussions with the coordination team. My own reflections and conceptualizations of course feed into the analytical work conducted here, but the criteria for whether my own work counts as part of the field material is if it had been introduced as an input to the partnership.

An important source of insight has been the experience of taking part in the partnership process. This has been a learning process in as much as a it has been a process of developing empirical material. The more than 3 months of highly intensive work during the KIC process in 2009 with a primary base at DTU was very important for entering and gaining basic insights into the realm of European politics of energy technology research and energy systems transition efforts. Working shoulder by shoulder with highly experienced research managers and consultants from DTU and other SEEIT partners has been crucial for not only getting access to a lot of material, but also for understanding its meaning and relevance for the partnership process. During these intense processes I have had the privilege of participating (even though I had no energy-field credentials to show in beforehand) in core partnering processes and thus learning and observing in-situ how the SEEIT partnership was formed and has evolved since 2009.

The process of developing the empirical material reflects the intertwinedness of the research practice and the partnering process. SEEIT has offered me a chance to study processes of interaction in the making which is a core aspect of what we more broadly may understand as processes of systemic innovation. As already indicated in the introduction to this chapter, the methodological thinking that came to support my reflections and refinement of an in(ter)ventive research practice is rooted in a post-structuralist understanding of knowledge creation as performative rather than representational (Haraway 1988, Deleuze and Guattari 1994, Deleuze and Guattari 2002, Law and Urry 2004, Steyaert 2011). In the following sections I will elaborate this understanding of knowledge production and on the basis hereof suggest an in(ter)ventive research practice as an alternative way of studying systemic innovation in the making.

4.5. Doing systemic innovation research performatively

In Law and Urry (2004) we find an argument for a social science research agenda that assumes its responsibilities as a knowledge production that not only speaks *about* social worlds but participates in *enacting* and thus adding to social worlds. *"(W)e argue that social inquiry and its methods are productive: they (help to)* make *social realities and social worlds. They do not simply describe the world as it is, but also enact it."* (Law and Urry 2004: 390-391). This, they argue, is true not only for a social inquiry that explicitly thinks its own practice as a performative one, but certainly also for inquiries that would not think along such terms. Economics would be one such example of a discipline that by means of its measurements and calculation technologies actively constructs worlds rather than merely providing descriptive and analytical tools for knowing the world 'out there' (Callon 1998, Hacking 1999, Mackenzie 2006). Another example closer to the topics addressed here would be the field of innovation systems research which has successfully influenced how policy makers diagnose and approach problems related to supporting innovation in society (Godin 2004, Lundvall 2007, Godin 2009, Carlsson, Elg and Jacobsson 2010, Martin 2012).

Law and Urry (2004) point to the need for thinking and practicing social science as a performative, or enactive, mode of knowledge production in order to discuss and draw implications from the fact that we as social science researchers are not detached from the worlds we inquire but indeed participate actively in making them over time: *"(W)hat of research methods? Our argument is that they are* performative. *By this we mean that they have effects; they make differences; they enact realities; and they can help to bring into being what they also discover."* (Law and Urry 2004: 392-393). They point to several ways in which methods help produce realities. One is the "weak" version of methods having *effects* on the world. The more "strong" claim is that social science methods *produce* the worlds they inquire: "*The move here is to say that* reality is a relational effect. *It is produced and stabilized in interaction that is simultaneously material and social. (...) (W)e are* not *saying that reality is arbitrary. The argument is neither relativist nor realist. Instead, it is that the real is produced in thoroughly non-arbitrary ways, in dense and extended sets of relations. It is produced with considerable effort, and it is much easier to produce some realities than others. In sum, we are saying that the world we know in social science is both real and it is produced."* (Law and Urry 2004: 395-396).

Thus, doing research performatively does not imply that anything goes. Not any social inquiry has the power of producing worlds. To write an alternative story on innovation does not necessarily produce an alternative set of practices shared by communities involved in making future energy systems. Rather, it means that social science may work towards realizing certain worlds rather than others – and that it matters how social science operate, by means of which methods and theories. Not only in context of highly specialized debates within social science in journal articles but in the worlds social science inquire. For example the worlds of energy technology research and innovation. It thus matters in a literal sense how innovation research stages itself as a practice of knowledge production. It matters how innovation processes are rendering object for inquiry. And it matters how innovation research contributes specifically to stabilizing approaches to governing and managing innovation in practice. To paraphrase Haraway (1988) we need to take seriously that there is no such thing as innocent innovation research regardless of the methodological distancing maneuvers we might agree upon in academia. Thus, innovation research and the models, concepts and theories it produces are mobilized in practices of governing, promoting, and otherwise shaping innovation processes and participates therefore in multiple ways in the process of actualizing certain realities while excluding others (Godin 2004, Godin 2009, Smits, Kuhlmann and Shapira 2010). This is how innovation research and its products help realize worlds. And this is why innovation research will benefit strongly from not only thinking critically about its own role in making innovation happen, but also inquiring new methods for doing innovation research performatively so as to openly and directly engage in innovations in the making in the broad range of empirical fields covered by innovation studies.

Law and Urry discuss the implications of such a performative methodological stance: Along with the argumentation by Donna Haraway (1988) they argue that one fundamental implication is that social science methods move from questions regarding epistemology (what can we know about reality) towards questions regarding ontology: *"It is a shift that moves us from a single world to the idea that the world is multiply produced in diverse and contested social and material relations. The implication is that there is no single "world""* (Law and Urry 2004: 397). Where many social science methods tend to imply a single Euclidian world 'out there' available for us and our methods, the argument here is rather that no such single world exist but that multiple worlds are enacted and that it matters which worlds we (implicitly or explicitly) enact as we do our inquiries.

The performative stance in relation of social science method implies that we should pursue methods that actively admits to their performativity and make constructive use of the opportunities this opens for in relation to rendering the 'knowledge-power nexus' productive (Jensen and Lauritzen 2005). As Haraway (1988) points to, such an approach implies that we reject traditional versions of producing objective knowledge by means of detaching ourselves and using Euclidian single-world-methods in favor of research practices which take partial connectedness and situatedness as a point of departure for knowledge production: *"(N)ot partiality for its own sake but, rather, for the sake of the connections and unexpected openings situated knowledges make possible."* (Haraway 1988: 589-590). As Jensen and Lauritzen elaborate in their reading of Haraway, this opens up for an 'ontological relationism': *"Relationism, because connection, rather than separation and distance, is a necessity if anything is the be learned* [given Haraway's argument]. *Ontological, because connections can allow for the articulation of* new properties *of a situation or* new modes *of action."* (Jensen and Lauritzen 2005: 64). Thus, research moves away from a representational knowledge ideal towards an active and engaged form of knowledge production that seeks to affirm potentials of novelty by connecting with the empirical field.

The line of thinking provided by Law and Urry and Haraway thus offers a methodological frame for a performative innovation research practice. In context of this dissertation, the performative approach has evolved to become an in(ter)ventive research practice of problematizing and potentializing cartographies at work in the organization of the SEEIT partnership. The "discovery" of cartography as a key concept was an outcome of my first attempt to establish an analytical stance in relation to the problem of organizing energy research towards open-ended system transition objectives – an analytical move made not together with other innovation researchers sharing my concepts and theories, but together with SEEIT partners. In the following, I will try to elaborate this by introducing the argument of researching cartographies at work performatively and then exemplify this using the Munich 2011 in(ter)vention as a point of departure.

4.6. Conceptual in(ter)ventions

In Steyaert (2012) we find a call for a stronger emphasis on experimentation as a practice of "stepping aside", referring to Michel Serres (1995), who *"urges us to leave home or well-known territories, concepts and habits, to engage with other sounds and intensities and to go for the deep waters."* (Steyaert 2012: 157). The research process I have gone through has been more a process of stepping aside than a process of defining and pursuing a specific methodological road map. This implies that there has been an element of experimentation involved in my research process – not in the sense of setting up an experiment for or with others, but in the sense of "leaving home" and establish relations with a field of practice different from my own familiar ways of knowing, communicating and participating. In particular, the experimental element in my research process has evolved as a process of searching for ways of establishing a cooperative relation in context of the SEEIT partnership in a way that avoided convenient distribution of roles based on a functional division of labor between technical knowledge and social science based knowledge. This is particularly important because it has to do with challenging the normal ways in which knowledge production organizes itself according to fields of expertise. Challenging and experimenting with alternative ways of organizing knowledge cooperations is therefore a central aspect of a performative innovation process research practice. I shall elaborate some examples of this further below.

Steyaert (2011 & 2012) suggests us to invent new research practices that are entrepreneurial and performative and thus to engage in empirical research and theorizing practices that are alternative to traditional modes of knowledge creation in social science. He makes a plea for embracing experimental ways of researching through, for example, creating series as a means to multiply and add to the world rather than creating representations of the world. *"Multiplying (...) consists of creating a series. This is a Deleuzian tactic of conceptualizing the creation of a series – and, and, and – based on increasing the (number of) connections."* (Steyaert 2012: 164). The "Deleuzian tactic" relates to the understanding of philosophy as the practice of inventing concepts promoted by Gilles Deleuze and Felix Guattari (1994). Concepts are not merely related to a practice of thought and analysis, but are also socially productive. In this sense concepts perform cartographically in processes of organizing by condensing certain relations while shadowing others. Deleuze and Guattari consider concepts to be "fragmentary wholes" that totalize their components but remain permeable and connective. This means that concepts are never entirely closed nor rigidly defined in their structure, production of taxonomies and other forms of performative sedimentations, but may enter into new connections which transform them and their social productivity. For example how concepts help intensify cartographies as they open up for new virtual grounds yet to be differentiated and "charted". Concepts, therefore, afford us with what Deleuze and Guattari refer to as an advantageous place for experimentation to begin (Deleuze and Guattari 2002: 161) and an entry-point for an in(ter)ventive research practice.

Conceptual creativity is here taken to be more widely distributed across practices, including those related to scientific and technological knowledge production. In this way, conceptual work is not exclusively afforded me as an analyst, but something that goes on in the field I inquire – maybe not in the form of philosophical concept creation

(Deleuze and Guattari 1994), but in the form of totalizing heterogeneous components as a means to e.g. enact coordination in practice. This flattening out of conceptual creativity also means that conceptual material can travel back and forth between me as an analyst and the empirical field I inquire (for an elaborate investigation of such lateral relations, see Gorm Hansen 2011). Indeed, it makes it possible to put a special focus on the conceptual work carried out in the empirical field as a means to inquire its' way of producing organization and coordination and as a means to intervene performatively in how concepts organize in the field, e.g. in the process of partnering in SEEIT. Concepts provide an entry point for a situated, performative innovation research practice that not only commits to studying and mapping the practice of others' but engages in actively adding to the processes it inquires. If we consider concepts as socially productive, fragmentary wholes which help arrange coordinates in processes of organizing cooperation across heterogeneous actors and knowledges, we may, by exploring and intervening in such concepts help bring new processes of organization into motion and thus help create alternative ways of joint movement.

This understanding of concepts as socially productive connects directly to the concept of cartography and cartographic intensifications where conceptual work is an important ingredient. Thus, when a field such as sustainable energy research invests in concepts like "smart grids" or "smart cities" they are engaging, I will argue, in a process of concept creation which is not only discursive but also performative in relation to opening up a field of research and innovation investments that distributes vast resources and help organize a broad range of actors in new cooperation and actor compositions. The production of concepts is therefore also a (re)production of cartographies which help potentialize a yet unknown field of knowledge creation and innovation. Such potentializations are socially productive in the sense that they help mobilize and organize actors in strategic cooperations and partnerships, road mapping processes, and similar processes where energy transition agendas are translated and negotiated. For intervening our way into such processes as a means to add to their intensity and social productivity, a performative practice of conceptual in(ter)vention offers one possible route to pursue.

In the following, I will provide an example of how I have engaged in a performative and experimental process in context of the SEEIT partnership. I do not consider the process I went through as ideal or optimal in any way. The attempts I have made to develop a research practice which operates by stepping aside, away from convenient roles and ways of establishing cooperative relationships and enacting social science knowledge, constitute therefore not a final but an open-ended example of how we might pursue innovation process research performatively. The example I will focus on is my participation in the Munich workshop in October 2011. This step in my involvement in SEEIT came to be decisive for the overall research process because it was during and after the Munich workshop I established the cartographic approach as the analytical stance taken in my further research.

4.7. Adding to processes of cartographic intensification

As I shall develop further in the next chapter, I consider cartographies and cartographic processes to be manifestations of systemically intertwined habitual patterns of problem-responses which stabilize a complex web of presuppositions in fields such as energy research communities. Cartographies therefore connect otherwise dispersed actors and perform a reproductive role in sustaining a field's shared presuppositions and means of organizing. When cartographies intensify, they undergo change and new relational dynamics and potentiality for interaction emerge from this. In chapter 3, I introduced how the increase in map making efforts in the field of sustainable energy research and innovation is a symptom of such cartographic intensifications. The practical study of such processes may be pursued in multiple ways. The performative and in(ter)ventive approach aims at adding to these processes and help render them socially productive.

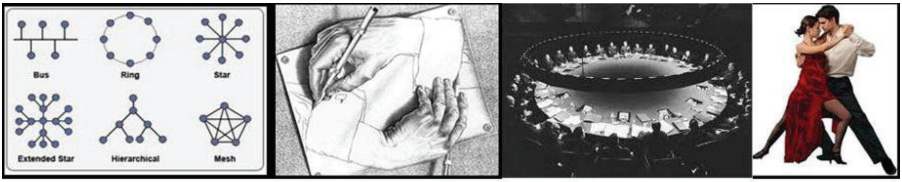
Given that we consider cartographies to be systemic problem-response constellations, how may we engage in studying their intensifications? One way in which cartographies intensify is when a new problematic context puts pressure of their taken-for-grantedness regarding, for example, how to properly respond to a given problematique. As we find in the field of sustainable energy research, the problematic context for energy research to respond to is exactly being contested and negotiated. This is a cartographic process, according to the vocabulary used here. One way in which we might "hack" our way into such processes and add to their intensification is therefore to engage in *problematizing* energy research and innovation. This is a form of cartographic in(ter)vention because it experimentally seeks to establish a problematic context for energy research and innovation to respond to. However, the way in which such a problematic context is being established makes a big difference for how the cartographic in(ter)vention performs. In order to provide an example of how a performative research practice works by means of cartographic in(ter)vention and problematization, I will focus on a phase in my research process where I for the first time in my involvement in SEEIT contributed as a researcher with an input to the partnership regarding the systemic nature of energy innovation and the organizational challenges this opens up for.

The Munich workshop was a cartographic high-point in the partnership process as well as in my own research process. After having participated at several workshops without an input of my own, the Munich workshop was the first time I was on the presentation list. This transition intensified my own learning process towards becoming researcher with a contribution of my own to the shared problems faced in the partnership. A key matter of concern was how I could add to the process of partnering by means of a presentation without escaping into convenient ways of staging social science either as a distant research practice or an instrumental staging suggesting ways of identifying and solving "social problems" related to transforming energy systems. The way I approached this was to focus on problematizing the relation between long-term and "distant" changes of energy systems and the organizational challenges these changes open up for in the present, for example in the ongoing organization of knowledge production and innovation in energy research.

The presentation I gave participated in intensifying the partnering process at the time by drawing a line in-between a key energy systems analysis concept (topology) and the organization of knowledge and innovation in energy research. Topology and topological diagrams belong to the normal ways of thinking about and representing energy system structures in energy research. Topological maps are for example often used to visualize future energy systems and how they assemble a variety of energy technologies and systems. The concept of topology is also important because the way it is used as a means to think about and represent the structure of energy systems is part of how energy system transitions are problematized in the field. Topology is therefore a key cartographic element in the systemically embedded practices of making distinctions between which problems to center-stage and which to exclude. As a cartographically important concept, topology thus offers an advantageous point of in(ter)vention which I tried to use as a point of departure for my contribution at the Munich workshop.

The workshop was organized by the Institute for Energy Economy and Applied Technology at the Technical University of Munich. The workshop was intended to fall into two parts – one part focusing on the economic and technical modeling of the dynamics of energy systems and the second part focusing on energy efficiency as a follow-up on the previous SEEIT workshop in Rome, April 2011. My own presentation was devoted to neither of these topics, but was placed in the category of economic modeling of energy systems. The pre-design of the workshop was therefore not about problematizing the relationship between energy system topologies in transition and the organization of knowledge production, but this was my take on adding to a process of potentializing the partnership for cooperation.

Accordingly, I composed a presentation aiming for potentializing the actual workshop gathering as a socially productive process whereby new possibilities for interaction might emerge to be explored. I did so by problematizing the relationship between inherently open-ended energy system transitions and the future organization of energy research. By turning system transition processes into an organizational rather than merely technological or economic problem, I tried to compose a cartographic in(ter)vention in how the problematic context for energy to respond to was normally staged in SEEIT. Specifically, by making a series of connections, I tried to establish a diagnostical map that might help intensify the process of cooperation by drawing up the line of a problem without giving a solution, but rather keep it open-ended and permeable for others to relate to.



A series: Topology/interdependency/war room/dancing

One sample of the series made in the presentation links topology with two different movement images of transition process organization: The centralized war room (taken from Dr. Strangelove by Stanley Kubrick) and dancing. Two images of organization process with relevance for the energy field where "war room" images of system transition organization remain a typical ingredient nurtured for example by system modeling tools that allows for very detailed technical and economical modeling which – ideally – should inform e.g. politicians when making reforms of energy policies. From an organizational point of view, the energy system modeling theme therefore invites to be problematized (not negated) so as to refrain from implicitly reproducing images of organization that only puts emphasis on building and qualifying decision-making capacities in relation to energy system transitions. As an alternative, the dancing image provides a stronger focus on the relational and processual dynamics of organization with its emphasis on a process of continuous creation of a space for joint movement (Steyaert 2012). In this way, the attempt was to move beyond a mere presentation of research towards an engaging research-creation practice (McCormack 2008) – or, an in(ter)ventive research practice as I suggest to consider it.

Modeling as a good point of intervention. Presentation would probably not have worked in the same way during other workshops. [Field note from Munich Workshop.]

What happened when I did this presentation at the workshop?

Certainly, it was an intense experience to take the podium for the first time offering a presentation which did not subscribe to the same performance standards as usually encountered in the partnership. The audience was a mixture of researchers working with modeling energy systems from a technological and economical point of view. Presenting them with an image of tango along with a bold attempt to diagnose "dynamics of systemic innovation", as the presentation was entitled, did not exactly make me feel at ease with the situation. As it turned out, the concluding slide showing the image of tango dancers gave rise to very positive reactions and the overall problematization was recognized by the audience. The Escher drawing I used to illustrate the interdependencies at work when organizing steps of energy system transitions was used by systems modeling researcher in a subsequent presentation – and the dancing image was affirmed by the same researcher as *"exactly what we need!"*.

The presentation thus somehow resonated with the views shared by several of the workshop participants. What was interesting for me was the social productivity of a series of connections from "a system topology in transition" to the juxtaposition of two different images of joint movement (war room vs. dancing). This series did not offer a problem-solution constellation but rather an open-ended diagnosis of a challenge to respond to within energy research, and within the SEEIT partnership. It helped stage a virtual ground for cooperation that did not translate into specified roles and functions for those involved, but kept the implied composition of knowledges and actors open and permeable. However, this was a permeability with direction in the sense that the series of connections made suggested a common ground in the form of a yet unresolved problem and a yet unknown process for energy research and SEEIT to engage with.

Such a series of connections helped intensify cartographies in the sense of recovering a yet undifferentiated problem to respond to without fixing it through a solution proposition. The "solution" was rather to add to the actual process of partnering without trying to subordinate this process to one particular cartographic framing. It kept the process of responding to the complexity of topological transformations open-ended and this – I would argue – was a key reason for why the performance resonated positively in the room. It 'stepped outside' of normal ways of staging a problem for research to respond to and helped potentialize a space for cooperation without fixing this according to one specific problem-response matrix. Drawing on Law and Urry's (2004) argument that research practices in social science participate in creating the worlds they inquire, the cartographic in(ter)ventionist response to this becomes one of entering a field and explore the opportunities for introducing new conceptualizations of problems to respond to and thereby help potentialize interaction which would otherwise lack a relational problem to engage with. Thus, the *intervention* aspect has to do with moving outside normal ways of constructing problems, but with a point of departure in recognized issues in the field such as the topological transformation of energy systems. The *invention* aspect has to do with the space for interaction the intervention potentializes. The inventiveness can be linked to a conceptual creativity of making a series of connections as I did in in Munich, but this is only one example of how spaces for interaction might be potentialized through new research practices (Steyaert 2011).

It is worth underlining that the performance in Munich was not an isolated event, but was a highpoint in my own process of becoming researcher, as well as a cartographic highpoint of intensity in the partnership, as we shall also see in the analysis chapter. The in(ter)vention practice is therefore not a hit-and-run kind of engagement but a relational process where I as a researcher gradually builds an insight into key concepts and problems that preoccupy the field in question. Without this, the alternative problematization of innovation and cooperation in energy research would not have been feasible. The in(ter)ventionist stance taken here therefore also implies a commitment to an engaged form of research practice which takes a stake in key problems, concepts and challenges at work in the field itself. This is what makes it a cartographic in(ter)vention because it seeks to intervene in and thus invent spaces for the actualization of interaction possibilities which would otherwise lack a connective force.

Innovation research then becomes a practice of affirming and render present a yet undifferentiated problem for which we do not yet have effective responses. This makes the innovation research practice an active, processual ingredient rather than a practice of studying others or studying the products of innovation processes. This practice entails an element of risk-sharing and experimentation in that it leaves a familiar comfort zone of using innovation methods to stabilize objects of study and propose proper ways of researching 'it'. Rather, the in(ter)ventive research practice and the knowledge productions it generates become a relational effect maturing through an engagement in and with the field it inquires.

The outcome of the Munich workshop was a decision to arrange a new workshop that should explore the opening that had emerged in-between energy systems modeling and buildings' energy efficiency. CBS and the Technical University of Denmark co-organized the workshop (again, a new development in the workshop approach) which turned out to be very productive and mobilized the largest level of interest since the intense days of the KIC application process in 2009. The Copenhagen workshop in March 2012 was also cartographically intensive and the outcome was the formation of cross-disciplinary group that submitted a joint research proposal (FP7) later the same year. I co-organized the Copenhagen workshop and wrote a short input to the SEEIT steering group where I introduced the concept of cartography as a way to understand the role of SEEIT as a framework for cooperation. The notion of cartography was embraced by the members of the steering group, but the concept was not adopted as a 'new keyword' for the partnership. It was clear that in terms of making in(ter)ventions, a text like the one I wrote on cartography (see appendix 2) was not as effective as performing a presentation as I did in Munich. However, it was useful for the process of conceptualizing cartography and for 'testing' its resonance in the SEEIT group.

As a research practice, the cartographic approach opens up for an innovation and organization research process which is performative and participatory. The cartographic approach as a form of in(ter)vention suggests a research practice which not only theorizes process from afar, but establishes itself in the midst of ongoing processes of organizing and from there problematize solution fixations in the field in order to help intensify a joint space for cooperation rather than repeating problem-response conventions. It is also a way to connect directly with a process at hand rather than merely participating by means to drawing yet another map of a world 'out there' or a 'system transition in the future'. A cartographic in(ter)vention problematizes and thus intensifies the relation between a shared problem and the potential shared process leading towards finding solutions for the problem. The cartographic in(ter)vention does not satisfy the need for solutions, but seeks to potentialize a cooperative process here and now. It adds to the problem-posing capacity of innovation and organization research – not only as an intellectual practice of posing problems, but as a means of participating performatively.

This cartographic approach thus became my version of "stepping aside" into unfamiliar grounds and my version of sharing the risks at work in the field of inquiry rather than distancing myself as someone studying the practice of others. This represents an alternative to established methods and research practices in innovation research and larger parts of organization process studies. Furthermore, I find the cartographic approach, and its emphasis on adding to processes, to be of particular relevance for advancing process studies in organization research. As pointed to in chapter 2, there is a tendency within this field sustain a representational knowledge format even though the theoretical apparatuses mobilized in process philosophy in many cases suggests a performative understanding of knowledge (e.g. Deleuze and Guattari 2002). In the implication chapter I will follow up on how I consider the in(ter)ventionist research practice to constitute a possible contribution to rendering process studies more processual itself, as suggested by Steyaert (2012).

4.8. Sum-up

The point of departure for this chapter was the observation made in chapter 2 that the majority of innovation research devoted to studying innovation as systemic relies on models which reproduce a fundamental distance between actual processes of systemic innovation and the research into such processes. The distancing move in innovation research, which we also find in many parts of organization research, means that neither innovation nor organization process research engage in performing situated process research. Against the distancing convention, this chapter has argued that in order to advance research methods in relation to studying processes of systemic innovation we need to experiment with new research practices such as performative research practices where innovation research places itself in the midst of ongoing efforts to organize innovation.

As I shall elaborate further in the chapter on implications, I find the in(ter)ventive research practice to be a potential contribution to organization process studies as well as the study of systemic innovation in the making. The clear advantage of the in(ter)ventive research practice, as it is developed here, is that it commits to contributing to ongoing processes of organizing innovation sharing the risks this entails with those working in the field. One such risk is that of stepping aside conventional ways of performing knowledge and expertise and enter cross-disciplinary "blank zones" where interaction is yet to be actualized. This is risky because it means that the researcher must leave home, as Serres formulates it, and search for new grounds, here and now, in cooperation with others. The systems of knowledge production and cartographies at work in the organization of innovation tend to support orderly structures, coherency and clear means-ends ways of approaching knowledge production. This is part of the background for why 'stepping aside' conventional practices of knowing entails an element of risk and experimentation. Also, an in(ter)vention might fail and the research practice was unsuccessful in its attempt to potentialize new interaction possibilities. In the case of the Munich in(ter)vention, the experiment succeeded partially and was strengthened by a simultaneous intensification of the partnership which the in(ter)vention was only one element in.

We have now made the first step of constructing the overall cartographic approach to studying systemic innovation in the making. The next step is to construct an analytical strategy that allows us to analyze how cartographic processes and their intensification help potentialize and actualize new interaction and how this opens up for a processual understanding of systemic innovation which may provide an alternative analytical approach compared with the innovation systems framework introduced in chapter 2.

5. The cartographic approach - Part 2: Analytical strategy

5.1. Introduction

In chapter 2 we saw how innovation research has evolved to become still more oriented towards understanding innovation as an outcome of cooperative processes between multiple actors (Kuhlmann, Smits and Shapira 2010, Martin 2012). The criticism I raised in relation to this development was that despite the growing attention to how interaction and frameworks for cooperation affect innovation, innovation research remains rooted in functionalistic agency assumptions which implies that there is a clear limit to how far into relational analysis this field can progress given its current epistemological and ontological conventions. When studying systemic innovation in the making, we need to employ analytical strategies which allow us to inquire the processes whereby new potentiality for interaction is constructed and actualized. We need to employ analytical strategies which 'move downwards' in order to understand the multiplicity of processes and relational dynamics that are inherent to the making of systemic innovation where "patterns of interaction" are yet to be determined.

This remains exactly the blind spot for innovation systems and system transition analysis given their continued devotion to construct higher order ideals such as innovation systems or transition pathway typologies in order to deductively derive a structured agency cartography which assigns multiple actors a proper place and a proper function to fulfill within "the innovation system". The academic purpose of developing the cartographic approach as an analytical strategy is therefore to provide an alternative to the 'upwards movement' of established innovation studies, and to establish a strategy for analyzing how systemic innovation in the making evolves as a process of constructing and responding to a variety of relational problems and to actualize interaction where established organizational solutions fail to support cooperation.

For this purpose, I will primarily draw on the works of Gregory Bateson, Gilles Deleuze and Felix Guattari. Bateson offers an understanding of the systemic nature of things and actors providing a fundamentally different point of departure than the innovation literature I criticize. Deleuze and Guattari help me establish an analytical approach to processes of actualization of interaction potential which sustains a view on these processes as inherently open-ended and relationally constituted. This has a clear relevance for studying systemic innovation in the making where we are interested in the processes whereby new cooperation and coordination solutions evolve, but are yet to be determined. The processual and open-ended probing of potential for interaction, and constantly evolving relational problems to respond to, call for an analytical strategy which can affirm these processes as multiple and open-ended rather than seeking to nail them down in a fix cooperation model.

On this background, the chapter arrives at the conclusion that the cartographic approach to analyzing systemic innovation in the making focuses on *processes of cartographizing.* These are processes whereby new map making capacities are being formed along the process of constructing, negotiating and otherwise probing interaction potential in the pursuit of new cooperation and coordination solution. Such processes are interesting because they take shape in situations where conventional ways of posing problems and derive approaches are being confronted with a new complexity that calls for going beyond the conventional in order to accomplish a renewed problem construction and pursue the openings of interaction potential this entails. Given that we understand systemic innovation in the making as the development of new means of cooperation and coordination in response to relational problems we are not yet familiar with, the suggested focus on *cartographizing* offers one potential way of engaging analytically with this while affirming the inherent open-endedness of complexity of these processes.

The chapter is structured in the following way: First, I will introduce Bateson's basic ideas about systemic dynamics and how this relates to the organization of knowledge production and cartography. With the concepts of *systems of presuppositions* and *transcontextual complexity* Bateson helps me arrive at an understanding of the systemic nature of innovation and knowledge production which incorporates both the reproductive and the transformational forces at work in processes of systemic innovation. Then I will introduce a distinction from Deleuze between two ways of conceiving of systemic innovation processes, namely the distinction between the virtual-actual and the real-possible. By the end of the chapter, I will explain how the analytical strategy developed differs from sense-making theory (Weick 1995) and actor-network analysis, and elaborate what it implies to focus on processes of cartographic intensifications with regard to the status is of individuals and their actions, statements etc.

5.2. A batesonian view on the systemic nature of innovation

Gregory Bateson's thinking (Bateson 2000, 2002) offers a system theoretical framework of particular relevance for analyzing systemic innovation in the making. In contrast to the systems thinking we found in innovation systems theory and system transition analysis in contemporary innovation studies, Bateson's approach enables us to inquire the relational, dynamic and open-ended constitution of agency. Here we find no ground for developing a comprehensive innovation system model from which we may derive agency as a part-to-whole function. Rather, agency remains a relational effect and intertwined with multiple system dynamics. "The systemic nature of innovation" in a batesonian view has therefore nothing to do with the emergence of higher order entity-constructs like "innovation systems". Viewing innovation as inherently systemic implies with Bateson that innovation processes are relationally determined in very diverse ways where actor-formations are created and rendered productive without any pre-determinable, functional agency as the structuring principle for interaction. To analyze processes of systemic innovation thus implies that we analyze interactions in the making and the relational dynamics evolving when new actor formations are constructed.

Bateson has recently been introduced to strategy theory (Chia and Holt 2009) and to institutional analysis (Zundell, Holt and Cornelissen 2012) and has been influential across a variety of scientific disciplines, including the work of Deleuze and Guattari where for example Bateson's process-ontological concept of *plateau* (Bateson 2000: 113) is a key reference in their conceptualization of *processes of becoming* taking shape without any reference to an external order or final point of climax. Bateson uses the concept of plateau to designate such processes and Deleuze and Guattari use this in their attempt to conceptualize processes of becoming that follow own intrinsic values and their relational dynamics rather than subordinating processes to externally given references of order (Deleuze and Guattari 2002: 21-22, 158).

The point of departure in all Bateson's work is the understanding of (the mixturing of) nature and society as inherently systemic and evolving according to system dynamics irreducible to entities. This means that no natural, social or individual phenomenon can be understood in isolation from the relational webs it is intertwined with. In other words, everything is a system, any entity is a community: An oak, a forest, a piece of desert, ecosystems, the human body, organizations, cities, etc. are all *"communities of creatures"* that *"live together in a combination of competition and mutual dependency"* (Bateson 2000: 434).

The combination of competition and mutual dependency is a key to understand Bateson's system concept. Any system is living and dynamic in the sense that all of its elements each has a Malthusian capacity without which they would not survive: An inherent expansive capacity of all species or entities in a system. At the same time, all sorts of balancing solutions are at play so that the expansive nature of elements does not become self-destructive. Thus, while one entity in a system may have a strong capacity for expansion, this comes at the cost of other parts of a system which the expanding entity is directly or indirectly dependent on. This is the case for ecosystems in nature where balancing expansive capacities is a normal part of how nature sustains itself in its ecosystems, and it true also for society and social systems. They too live in an *"uneasy balance of dependency and competition"*. The uneasy balance of systems composed by multiple expansive forces requires a variety of coordination mechanisms – a well-known feature of well-functioning markets, but also a classical insight in organization studies. However, one of the significant challenges of sustaining system flexibility through coordination is the tendency of human endeavors to become still more specialized in problem-solving knowledge and methods (Bateson 2000: 432pp). Bateson mentions the overall specialization and resulting fragmentation of scientific knowledge production and technological fields of expertise as one area where "system wisdom" gets lost in specialized and inherently partial problem-solving structures.

As an illustration hereof, he uses the example of modern medicine which is organized on the basis of increasingly partial problem-solving purposes (i.e. finding a cure to cancer, polio, etc.) which evolves into a systematized absence of knowledge of the body as a "*systemically cybernetically organized self-corrective system.*" (Bateson 2000: 437). Acknowledging that the discoveries of solutions to specific problems in medicine or any other field of science and technology are indeed extraordinary and valuable, Bateson sustains that they lack insight about the "total systems" especially the system dynamics whereby elements in systems interact and balance competition and dependency relations. The risk of this is that the ever-more specialized problem-solving capacities in science and technology (and in society at large) produce unintended system consequences without having nurtured a capacity to sustain system balances. This might generate all kinds of unintended run away patterns such as collapsing eco-systems during industrialization, reduction or collapsing of flexibility and balancing solutions in organizations when standardized management systems are introduced, and so forth.

Thus, Bateson distinguishes between the purposeful pursuit of solutions in response to specific problems and *system wisdom*, the latter being systematically excluded when e.g. scientific systems of knowledge production are arranged exclusively according to partial problem-solution purposes resulting in fragmentation and – in the end – a dangerous disturbance of the uneasy balances between the many interacting parts of eco-systems, bodies, and social systems (Batson 2000: 439). To introduce a concept like system wisdom is a challenge, Bateson admits, due to the "almost necessary blindness" that makes human activity possible. *"On the one hand, we have the systemic nature of the individual human being, the systemic nature of the culture in which he lives, and the systemic nature of the biological, ecological system around him; and, on the other hand, the curious twist in the systemic nature of the individual man whereby consciousness is, almost of necessity, blinded to the systemic nature of man himself."* (Bateson 2000: 440). System wisdom, therefore, is not a 'fix solution' we can design and implement trapped as we would be in our inevitable partial problem-responses, but rather a complex and systemic composition of balancing act where diverging forces are being incorporated in a variety of ways. To "system wisdom" belongs therefore terms such as complexity, flexibility, divergence, and, as Deleuze might say, *multiplicity.*

When introducing Bateson's system thinking in a study of systemic innovation in the making we thus arrive at a fundamentally different system concept compared with the one we find in innovation studies. In a batesonian perspective, change and transitions in how systems work and what explains their evolution has to do with the intensification of patterns of interactions (increasing competition, strengthening of dependencies, etc.) which are systemic in nature and where "agency" is a relational effect that might change and take multiple directions of evolution simultaneously. In a batesonian perspective, the innovation systems framework commits the error of overdetermining patterns of interaction by means of introducing a functional delineation of agency as a parts-to-whole element in the overall "innovation system". In contrast to this, Bateson opens up for a more open-ended and dynamic understanding of how agency is relationally constituted over time through its intertwinement with varying system dynamics. In an innovation systems perspective this complexity gets lost due to its commitment to a belief in a higher order system structure which informs agency functions and their possible interactions. In a study of systemic innovation in the making it seems to be significantly more productive to explore a batesonian system perspective on processes of changing interaction patterns due to its complexity embracing framing of how systems work and how they undergo change.

Having introduced some of the basic elements of Bateson's system theory (a full introduction would go far beyond the scope of this study), I will in the following focus on his notion of complex systems of presuppositions and his ideas about responses to what he calls transcontextual complexity as a way to develop an understanding of cartographies as systematized habitual patterns of problem-response conventions which – when confronting a new complexity – becomes "stressed" and undergo change in order to solve a variety of relational problems and establish new interaction patterns.

5.3. Systems of presupposition and transcontextual complexity

In *Mind and Nature – A Necessary Unity* (2002), Bateson points to how the evolution of social systems implies the relative stabilization of what he calls *complex systems of presuppositions.* Upon having studied the organization of an Australian tribe, Bateson observes how *"(t)heir ideas about nature, however fantastic, are supported by their social system; conversely, the social system is supported by their ideas of nature. It thus becomes very difficult for the people, so doubly guided, to change their view either of nature or of the social system. For the benefits of stability, they pay the price of rigidity, living, as all human beings must, in an enormously complex network of mutually supporting presuppositions. The converse of this statement is that change will require various sorts of relaxation or contradiction within the system of presuppositions."* (Bateson 2002: 134). When systems of presuppositions undergo change, the otherwise familiar and taken-for-granted presumptions guiding human actions become problematic and open-ended. They *intensify* and open up for a variety of new problem-response constellations, new interaction potential and relational dynamics.

Bateson's observation of an Australian tribe is useful for framing the analysis of the organizing forces at work in sustainable energy research and processes of systemic innovation in this area. Here too we find systems of presuppositions which help coordinate whole communities of research and research-society relationships. The empirical manifestation of such systems of presuppositions can be found in multiple parts of knowledge systems – for example in the cartographic operations introduced in chapter 3 whereby coordination is being pursued in the midst of complex system transition processes. In the construction of technology road maps, the evolvement of a given technological field is being projected on the basis of established ways of center-staging technological development as a key driver of energy transition processes and innovation at large. The center-staging of technology helps reveal a process landscape where a movement from A to B is envisaged to become realized by means of investments and priorities that reflect the technologically defined maturing of e.g. photovoltaic technology or off-shore wind turbines. Road maps are part of the anticipatory machinery which helps establish coordination within established systems of presuppositions while systematically excluding – intended or not – a vast complexity and numerous problematic questions regarding for example complexity of implementation and the multiple cross-system interactions and balancing acts this entails.

In consequence, the pursuit of "systemic innovation" in energy research is embedded in a complex set of systemic presuppositions and conventions pre-selecting certain problem-response constellations while excluding others setting a variety of demarcations between relevance and irrelevance with direct effects on how problems are posed and approached and which actor constellations are taking shape. This implies that processes of organizing systemic innovation are to some extent held captive in established cartographies reflecting past accomplishments and existing orders which have hitherto successfully functioned as a means to coordinate and perform energy research towards specific ends, in response to specific problems. Thus, when analyzing cartographies in transition during processes of systemic innovation, we analyze processes where systemic patterns of problem-response conventions and habits of thought undergo change (Bateson 2000: 274).

Conceptualizing such patterns as cartographies means that we recognize how processes of systemic innovation challenges very well-established, "hard programmed" ways of posing problems and constructing solutions. To analyze cartographic processes therefore involves a recognition of well-established systems of presuppositions and a special attention to how such systems open up for change when their taken-for-granted ways of organizing knowledge production begin to encounter a new complexity they cannot absorb without transforming in the process.

As Bateson observed, change appear through "relaxations or contradictions" within systems of presuppositions creating new relational problems and potentials at different levels. The energy system transition agenda in Europe constitutes an example of how tensions in well-established energy research cartographies evolve and transform how research is being pursued, how questions of relevance are no longer self-evident, etc. SEEIT is a case which illustrates how energy system transitions and the wide range of new relational problems these open up for travel into the organization of knowledge production. When constructing and responding to new relational problems, SEEIT as a process of interaction in the making unfolds in-between established systems of pre-suppositions and the new interaction potentiality emerging from its system transition cooperation efforts.

When new actor formations are being formed in response to new relational problems and potentials, the living multiplicity of transition trajectories manifests itself in a complexity of diverging demands and competing agendas. Organizing and coordinating joint strategic efforts are tasks which are constantly being molded relationally in response to a variety of often conflicting coordination problems. As we shall see in the case of SEEIT, the efforts unfolded here to define problems to be solved by the partnership pull the partnership in multiple directions simultaneously. For example: Are system transition objectives best formulated and pursued by defining and solving technological problems? Should we systematize our way out of the labyrinth introducing innovation management systems? Do we need to move into a new 'paradigm of systemic approaches' in energy research where cross-disciplinarity and cross-sectorial cooperation reign?

Bateson suggests us to consider the *transcontextuality* of such processes where systemically constituted habits of thinking and organizing are confronted with relational problems they cannot solve without going through transformative learning processes (Bateson 2000: 271pp). "Transcontextual syndromes", Bateson explains, appear when habitual first-order problem-responses encounter a *context of context* that demands a different course of action than the first-order problem-response patterns produce. Transcontextual complexity, then, offers a good expression of the nature of system transition complexity and the nature of the learning processes and obstacles facing energy research when engaging in systemic innovation: For energy research to become responsive to the multiple new relational problems opening up in context of system transition processes, it must learn to learn new problem-response patterns along the process of innovating the organization of knowledge production Where systematized and institutionalized habitual patterns of problem-responses may provide an immediate response capacity, energy research faces a greater and open-ended set of contexts of context (the "system transition") which render first-order habitual problem-responses (established cartographies) problematic and in some situations ineffective or even contra-productive for solving problems at hand. The transcontextual complexity of system transition processes produces a syndrome of *cartographic stress* which manifest itself in a variety of struggles and creative responses to the challenge of constructing and responding effectively to relational problems such as how to best organize cooperation across disciplines and sectors to support complex system transformations.

Thus, as we begin to consider energy research as guided by complex systems of presuppositions which stabilize problem-response patterns, we arrive at a concept of cartography which has to do with the habitual reproduction of problem-response constellations guiding action and efforts of organizing in the field. When established cartographies are stressed they undergo change as new problem-response constellations are constructed and learned. This entails, as Bateson also points to, often a bad economy of trial and error, as SEEIT is also an expression of, but at the same time the pressure on established cartographies may open up for creative responses and learning processes which help probe and actualize new relational potentials and interactions. In other words, if we are to follow a batesonian understanding of systemic innovation we must inquire processes where cartographies come under pressure and where we find a struggle to learn how to respond to a new context of context which makes habitual patterns of action problematic and ineffective. Rather than reproducing patterns of organizing, energy research – during processes of systemic innovation – is learning how to respond constructively to the transcontextual complexity system transitions open up for. Thus, the difference between "a bad economy of trial and error" and creative learning in processes of systemic innovation becomes of great value to understand and analyze. For this purpose, I will in the following introduce a key distinction from the works of Gilles Deleuze (and Felix Guattari), between the virtual-actual and the possible-real which helps me arrive at a synthesis of Bateson and Deleuze in the analytical strategy devoted to inquire processes of *cartographizing*.

5.4. The virtual and the actual

The concept of the *virtual* is highly complex and related to a web of other concepts in the philosophical works of Gilles Deleuze including his collaboration with Felix Guattari. I will not attempt to go through the philosophical project underlying the concept but only introduce some main lines of argumentation that I find to be productive for the purpose of further refining our understanding of the organizing forces of cartographic operations and their intensification.

The work of Deleuze and Guattari has already entered organization studies (see e.g. Wood 2002, Fuglsang and Sørensen (eds) 2006, Thanem and Linstead 2006, Linstead and Thanem 2007, Hjorth 2012, Steyaert 2012), but has not been explored much in relation to innovation studies, although this is exactly a problem-field where the thinking of Deleuze seems to have a particular strong relevance (see Styhre 2008 as one example hereof). The introduction of Deleuzian thinking offered here might contribute to further linking Deleuze to innovation studies, and in particular help produce a cross-disciplinary linkage between organization and innovation studies, as the theory of organization (Linstead and Thanem 2007) and organization of knowledge production (Wood 2002) we might derive from Deleuze, is exactly, I will argue a theory with a high relevance for understanding the complexities and organizing divergences involved in processes of systemic innovation.

Deleuze invests much attention to the concept of the virtual – partly in his reading of Henry Bergson (Deleuze 1988) and in one of his main philosophical publications *Difference and Repetition* (Deleuze 1994). The question he pursues in these, and many other works including those co-authored with Felix Guattari, is the question concerning the conditions of the new (Smith 2007). How might we understand the emergence of genuine novelty? What is the relation between an existing order and processes of becoming? In the development of the concept of the virtual, Deleuze distinguishes between two ways of understanding this relation: the real-possible and the actual-virtual.

According to Deleuze, the possible is determined by means of identity, or resemblance. We find something to be possible because it resembles what we already know. Thus, what is seen as "possible" tends to stay confined within the horizon carved out by dogma in all its manifold versions stretching from everyday habits of thought and movement to advanced, reified systems of knowledge production and batesonian systems of presuppositions. As such, "the possible" poses no danger to conventional ways of knowing and pursuing solutions. When developing an analytical strategy for studying processes of systemic innovation, the possible-real model therefore needs an alternative if we are to grasp how novelty beyond known state of affairs comes into being. Otherwise, we cannot hope to be able to grasp how processes of systemic innovation are driven by constructing relational problems and probing interaction potentials beyond the scope of what is taken for granted as 'proper' problems and approaches (Wood 2002, Thanem and Linstead 2006). The need for such an alternative is what the conceptualization of the relation between the virtual and the actual provides.

It is crucial to distinguish, Deleuze argues, between the virtual and the possible because they form fundamentally different conditions of novelty. As he writes, *"the virtual could be confused with the possible. The possible is opposed to the real; the process undergone by the possible is therefore a 'realisation'. By contrast, the virtual is not opposed to the real; it possesses a full reality of itself. The process it undergoes is that of actualisation."* (Deleuze 1994: 211). The reality of the virtual is the perpetual unresolvedness of actual state of affairs – the yet unresolved problems which force upon the actual a divergent and open-ended potentiality for becoming irreducible to conventional and habitual patterns of organizing and knowing.

With the concept of the virtual, Deleuze therefore challenges conventional thinking in relation to organization and innovation. As Thanem and Linstead (2006) formulate it: *"Conventional thinking progresses from the real (a real state of affairs) towards the realization of the possible. (...). Deleuzian thinking moves in the opposite direction, from the virtual to the actual."* (op.cit: 51). When Deleuze specifies the nature of the virtual and its relation to the actual he stresses that the virtual is not – like the possible – negatively defined against the real. The possible-real distinction and the process of realization suggest that the possible is un-real, yet to be realized. Contrary to this, the virtual possesses a reality of its own: *"The virtual possesses the reality of a task to be performed or a problem to be solved: it is the problem which orientates, conditions and engenders solutions, but these do not resemble the conditions of the problem."* (Deleuze 1994: 212). This means that the virtual remains problematic and continues to force upon the actual state of affairs an unresolvedness and a multiplicity of potential for becoming.

Thus, where a conventional understanding of organization might suggest that organization provides the means of coordination to obtain desired outcomes in a cost-efficient manner, a deleuzian understanding of organization suggests that organizational solutions are actualizations (differentiations) of a divergent open-endedness of potentiality residing in the midst of the actual yet transcending its logics and structures. The virtual-actual axis is therefore an organization process engine which is never put to rest, but continues to multiply potentiality from within.

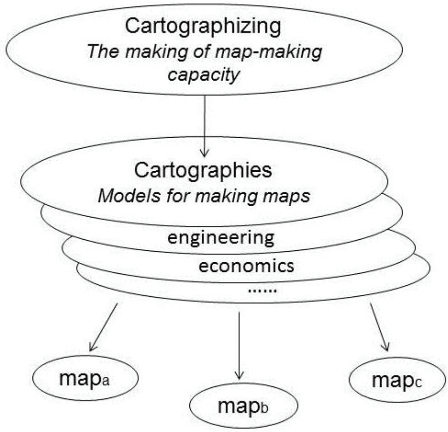
Therefore, rather than thinking about the process of innovation as a yet non-existing possibility that needs organization in order to become real (e.g. "improve innovation systems in order to gain more innovation"), Deleuze invites us to turn the image of organization and its relation to innovation upside down: Organization should not be treated as a given, nor as a formal condition of the new, but as a process of actualization of a real yet to come, of an yet unresolved or yet *undifferentiated* problem. As Deleuze formulates it: *"In this regard, four terms are synonymous: actualise, differentiate, integrate and solve. For the nature of the virtual is such that, for it, to be actualised is to be differenciated. Each differenciation is a local integration or a local solution which then connects with others in the overall solution or global integration."* (Deleuze 1994: 211).

The theory of organization and its relation to novelty which emerges from the virtual-actual axis is therefore, that organization evolves in a charged field of diverging forces in-between an actual state of affairs and a virtual real of yet unresolved problems. In this way, a deleuzian concept of organization and its relation to innovation takes as a point of departure a living multiplicity of relational forces pulling in the actual state of affairs. Divergency, crisis, distortion, struggles, and creativity become of key interest to a deleuzian organization and innovation analysis (Wood 2002). This corresponds with Bateson's interest in understanding the relational dynamics of systems of presuppositions, their uneasy balancing between patterns of competition and dependency, and the cartographic crisis organizational ‘trembling’ this opens up for (Linstead and Thanem 2007).

Deleuze emphasizes that the process of actualization is an *event* which marks a discontinuity. An event, in this context, is more than an everyday organized social gathering. Events of actualization unfold when a potentiality is differentiated and a new relational order is becoming manifest. The eventuality of actualization underlines its “involuntary” nature – it is not planned and executed, but remains on the verge of the virtual. With reference to Stoic philosophy, Deleuze (2004) formulates the idea of “becoming worthy of the event” as a way to express the eventual nature of actualizations. This is not unlike Bateson’s notion of system wisdom in the sense that Bateson too points at the inevitable reliance on already actualized forms and representations in our way of pursuing goals. Like Deleuze, Bateson points to the divergent lines of relational forces which the human mind cannot conceive of fully nor integrate in a collective, organizational effort. A system is always in a state of an uneasy balance between divergent forces. But the notion of becoming worthy of the event, and to have system wisdom suggest certain openings for modes of engaging with this multiplicity of forces in a constructive way. “Flexibility” and “balancing” of system dynamics are some of the key concepts Bateson points to, but neither Deleuze nor Bateson engage in further defining any “how to…” solutions, except, perhaps in the case of Deleuze and Guattari in their in(ter)ventive mode of experimenting with writing and thinking in e.g. *A Thousand Plateaus* (Deleuze and Guattari 2002). Pursuing this further will pull the line of argumentation too far off track. However, I should like to note, that an attention – not only analytically but also in practice – towards cartographic divergences, and the potentiality this opens up for, may offer some good indications of how to “make events work” (Sørensen 2004) and thus to practice a mode of analyzing and organizing which affirms the multiple and the divergent, rather than trying to silence these in the name of 'rigor' or coherency and manageability as a condition for action and movement.

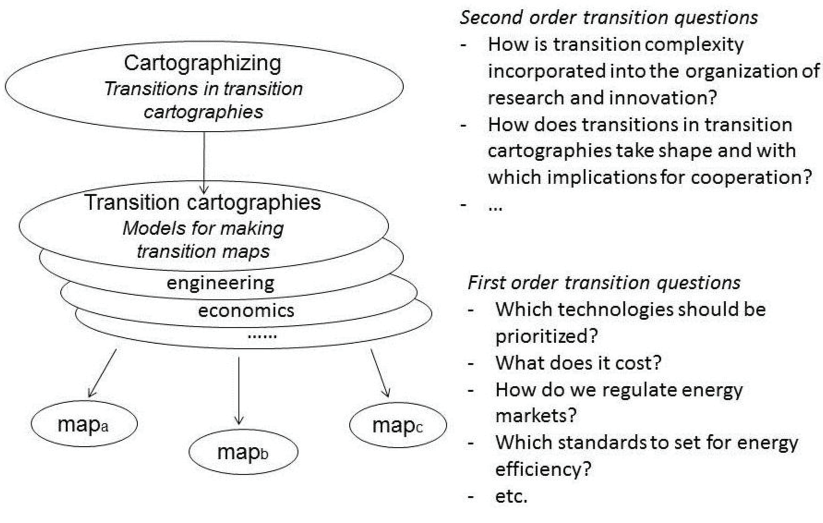
5.5. Synthesizing the cartographic approach as analytical strategy

To sum up the previous pages, the coupling of Bateson with Deleuze and Guattari opens up for an analytical strategy focused on systemic innovation in the making - that is, processes whereby interaction potentiality take shape and become actualized (and destroyed) along the divergent lines of becoming which open up as knowledge production confronts a new, open complexity of system transitions. On the basis of the empirical sensitivity this affords us, the analytical strategy aims at capturing how cartographic operations and their intensification become (or do not become) socially productive. That is, how *processes of cartographizing* construct and actualize a new potentiality for interaction where established systems of presuppositions are inadequate for a productive response to system transition complexity. In a diagrammatic form, we might illustrate this in the following manner:



An analytical strategy devoted to studying processes of cartographizing thus installs a form of *second order perspective* on ongoing map making efforts to resolve relational problems and it does so by giving emphasis to the struggles, the divergence of map making efforts, the politics and negotiations of setting boundaries for coordination and cooperation, and the unusual alliances and unfamiliar combinations arising from such processes transgressing conventional cartographic operations. However messy this might be, it is exactly tensions such as these which comprise the core empirical material for an analysis of systemic innovation in the making where we have not yet arrived at a productive state of cooperation, but where we are still in the process of probing potentials for interaction. During such processes we find diagnostical rivalries, multiple simultaneous directions, contradictory approaches, and coordination efforts to sustain a cooperation process. This is truly a “messy” set of processes (Law 2004) which are nevertheless interesting and important to become sensitive to analytically and organizationally if we are to understand and act constructively upon the challenges of making steps of systemic innovation.

Where first order map making efforts aspire to stabilize a certain problem-response constellation in theory or practice, a second order analysis hereof focuses on how such efforts become or does not become socially productive – whether they help actualize new relational potentials or whether they disintegrate and reduce the connective capacity of organizing processes. In a cartographic approach, the problem is therefore not how to produce a map. Map making per se is not the problem. The problem is rather how the multiple cartographic operations involved in constructing and responding to relational problems of systemic innovation transform and reach a state of becoming socially productive. This distinction between different kinds of transition questions is tentatively captured in the following diagram:



Given that multiple map making efforts are already taking place, the problem for a cartographic analysis becomes to diagnose these and offer a way to understand such efforts' role in establishing coordinates across actors where known coordinates have become insufficient. This seems to be of high relevance for the field of energy research where the sustainability transition agendas and scenarios call for new compositions of competencies and cooperative frameworks. In this context, ongoing map making efforts, which express established systems of presuppositions, may easily reproduce unproductive boundaries for energy research and knowledge production at large in relation to energy technology development and system transition processes. Boundary setting is one key feature of cartographic operations which has a bearing on how problems are constructed, diagnosed and approached and thus which domains of knowledge, which actors are seen as relevant, and how they might be activated in knowledge production processes. Arguably, providing an analysis of such processes may help expand the managerial and organizational repertoire of understanding and addressing the challenges of turning complex cooperative endeavors like the SEEIT partnership into a socially productive process. The strategy of analysis thus seeks to arrive at a point where we can distinguish between different forms of map making efforts with regard to their social productivity.

This is in line with the understanding of research as a productive and performative practice as introduced in chapter 4 where I introduced the in(ter)ventive aspect of the cartographic approach. Thus, a second order analytical strategy constitutes a deliberate attempt to affirm and open up for new potentials of understanding and acting upon processes of systemic innovation and does therefore not first and foremost seek to provide a representation of the SEEIT partnership efforts. The cartographic approach makes a decisive cut through the material in order to perform an analysis which opens up and helps potentialize systemic innovation (Haraway 1988, Hosking and Hjorth 2004, Steyaert 2011).

In which way does this offer an alternative to established innovation systems research? As pointed to in chapter 2, innovation research focusing on the systemic nature of innovation and system transition processes are not engaging directly with studying processes whereby relational agency formations take shape and undergo change during the course of innovation processes. The functional delimitation of agency embedded in an ideal parts-to-whole structure (innovation systems) builds on a theoretical and methodological foundation where agency is treated entitatively providing an orderly imagery of how interactions drive innovation processes and how these interactions may be governed at different levels "within" the innovation system. The system conceptualization follows the logic of romantic holism which implies the existence of emergent higher order entities which add structure to and in-form the parts they are presumed to emerge from. The task of the system analyst then becomes to compose a coherent and representational model which captures the essence of this greater whole and derive models for how interaction may be arranged optimally given their functions in the system they are part of.

A batesonian and deleuzian system ontology pulls away the foundation for such a system conceptualization. Systems are in state of becoming as they incorporate a multiplicity of forces and patterns of interaction that need to be continuously balanced in order to sustain e.g. organizational efficiency and a capacity of solve problems without creating worse problems in the process. The batesonian and deleuzian system concept is therefore a living 'baroque multiplicity' with no emergent higher order promising an optimal structure – only everlasting efforts to construct and respond creatively to relational problems that put established systems of presuppositions in a state of crisis and intensification. Transcontextual complexity is what organizers of systemic innovation and cooperation must constantly endure and respond to. The question is how such responses unfold and what we might learn from studying such processes? The proposition here is to become empirically and analytically sensitive to the incoherent, the transitional and the diverging forces whereby interaction in the making takes shape. This is how we might better grasp and learn to act constructively upon the challenges of organizing processes of systemic innovation and affirm the many new potentials opening up when cartographies are out of bound.

Thus, the combination of Bateson and Deleuze offers an alternative framework for studying innovation in the making. If we take into account the arguments developed in chapter 4 relating to the in(ter)ventive practice of doing innovation process research, the composition of the cartographic approach might be juxtaposed with innovation systems theory in the following way.

	Innovation Systems	*Cartographic Approach*
System concept	Romantic holism	Baroque multiplicity
Agency constitution	Functional (parts-to-whole)	Relational
Spatial frame	Euclidian	Topological
Form of knowledge	Representational	In(ter)ventive
Analytical focus	Patterns of interaction	Processes of cartographizing

In a cartographic approach we are interested in understanding the multiplicity of *relational forces* and their organizing effects *including* the relational forces at work in-between our own research practice and the field of inquiry. Thus, it is not only 'processes out there' but also the relational dynamic between the practice I unfold as a researcher and the practices I connect with in the field. In this way, the cartographic approach integrates a performative and in(ter)ventive research practice with a batesonian and deleuzian system ontology of diverging forces at work in the processes of actualization of interaction potentiality. The cartographic approach seeks to become an affirmative strategy for studying processes of cartographizing performatively.

After the analysis, I will further discuss the implications of a cartographic approach vis á vis established innovation systems research and system transition studies as well as follow up on the question of how to conduct organization process research without sustaining the ontological opposition between being and becoming and the tendency in process studies to sustain a representational form of knowledge as observed in chapter 2. Before we move on to the analysis chapter, I will briefly touch upon a few important questions about how the cartographic approach differs from other perspectives that could have been chosen as analytical frameworks. In particular, I will provide a brief argument for why I do not use the theory of sense-making by Karl Weick and why I consider the cartographic analysis as different from actor-network theory even though the approach taken here has many overlaps with ANT. Also, I will elaborate what it implies to do cartographic analysis in terms of the role of individuals and the status their actions have in the analysis pursued here.

5.6. What about individuals, sense-making and ANT?

SEEIT is a partnership that gathers individuals, we might say. These individuals are researchers, research advisors, university managers, deans, people from industry, and students. What happened with all these people, their thoughts and reflexions in the cartographic approach? Are they not the pivotal ingredient in understanding what goes on in the SEEIT partnership? The cartographic approach does not take its point of departure in individuals per se. To put it boldly, in the perspective of the cartographic approach it is cartographies which operate and intensify, not individuals or groups of individuals. However, the cartographic analysis uses statements and inquires processes where individuals and their voices are clearly present. Indeed, the SEEIT partnership is populated by individuals who in many cases have comprehensive research and leadership experiences. Their statements, their power points, their diagrams are all part of the empirical material – so why not focus on what they think and how they reflect about their own work and the processes in the SEEIT partnership?

In a cartographic analysis individuals and their actions matter, but they are not center-staged as self-interested entities unfolding actions according to inherent interests, cognitive constructs, or any other entitative agency perspective. Rather, individuals participating in the SEEIT partnership are interesting because their actions and utterances express the systemic intertwinedness of knowledge production and the social manifestations of struggles to come to terms with a new transcontextual complexity. Thus, an individual participant in the SEEIT partnership might speak about how to approach cooperation in the partnership, and this is interesting in a cartographic approach. However, what is interesting about it is not what this person actually meant or how it expresses his or her cognitive translation of some problem to be solved. Rather, we are more interested in the interaction processes the statement is part of, especially when these processes intensify in some way because it is during such processes interaction in the making becomes socially manifest.

This status of individuals confirms that cartographic processes and their eventual intensification are processes of relation-creation. Thus, map making efforts unfold as a process of creating and stabilizing certain relational realities (Hosking and Hjorth 2004). This is not productive to reduce to individuals' cognitive constructs *of* reality. A cartographic process study therefore focuses on the relational construction of realities in the form of cartographic operations and their (dis)organizing effects. Such a study involves analyzing individuals' acts, statements, re-actions, etc. but these are seen as an expression of a relational order in-progress irreducible to an entitative understanding of individuals and group formations. A cartographic intensification process takes shape as a relational dynamic where individuals interact to build up and sustain a shared process which potentialize certain interaction possibilities while excluding or neglecting others. This is how the cartographic approach is oriented towards inquiring collective, or relational, agency in progress. This is an important aspect of how the cartographic approach builds on a systemic understanding of organizing processes – the “systemic” is not only far-reaching institutionalized webs of presuppositions but also concrete ways in which practices of organizing are being ordered relationally. The relation-creation processes take shape locally, e.g. in a partnership process, and they are entangled with wider cartographic efforts whereby a field constructs its problematic context to respond to.

The relational focus of a cartographic analysis leads us into answering why Karl Weick’s concept of sense-making (Weick 1995) is not used as an analytical solution to studying processes of changing map making capacities. This could have been an obvious choice, given the widespread use of Weick’s sense-making concept and the linkages it suggests between sense-making and organization. Jay (2013) provides a recent example of sense-making theory put to use in a study of ‘paradoxes in hybrid organizations’ combining Weick with institutional theory. So why not consider map making as a process of sense-making and then get on with it? The problem with sense-making is that it tends to sustain a constructivist view of individuals making sense of reality rather than viewing reality as relationally constituted. This makes a big difference analytically and methodologically because it affects how we in analysis may treat individuals and explain their actions.

In sense-making we are invited to pay special attention to how individuals make sense of reality and how this sense-making feeds into actions and organization. This attention towards the cognitive operations of individuals’ minds lead into a framework of analysis that treats individuals and their sense-making entitatively rather than relationally which is the purpose of the cartographic approach. Furthermore, where sense-making analysis tends to recover sense (a cognitive category) as a condition for action, the cartographic analysis posits that cartographies are irreducible to individual sense-making processes even though cartographies resonate through the utterances and speech acts of individuals. In a cartographic approach, we inquire how map making efforts unfold relationally, which wider cartographic dramas are at stake in a specific organizational process, and how cartographic processes intensify and reach the point of becoming socially productive. In this way, the cartographic analysis seeks to capture organizing processes that are irreducible to cognition and sense-making processes.

Finally, the cognitive orientation in sense-making analysis has a limitation in its lack of attention towards the politics of organization and the power relations involved in processes of systemic innovation where there is much more at stake than a local sense-making process among a specific group of people. Thus, when a partnership like SEEIT engages in organizing cross-disciplinary cooperation in response to complex system transition challenges, the partnership activates and mixtures a variety of systemic cartographies which are inherently political and institutional rather than merely cognitive constructs. This is typically not included in sense-making analysis but remains a core part of the cartographic analysis.

What sets the cartographic approach apart from a sense-making analysis is also its post-structuralist features. Such features include the de-centering of entitative thinking (Deleuze and Guattari 2002, Law 2002, Hosking and Hjorth 2004) in favor of centering relational processes which are local and situated but at the same time interwoven with wider systemic apparatuses of, in this case, knowledge production and innovation policies. A post-structuralist analysis does not seek to settle the question of what a cartography is and how it should be constructed in order to solve a specific coordination problem. It does not say what a cartography is as an entity. Rather, by means of analysis it seeks to show how cartographic processes evolve in relational interactions and how they might become socially productive. The purpose hereof is therefore not to fix our understanding of cartographies' organizing effects, but open up a second order level of understanding that allows us to consider how different map making efforts perform relational realities and how these potentialize and help actualize interaction across otherwise well-established boundaries. The purpose is therefore to open up rather than nailing down the notion of cartography and processes of cartographic intensifications as inherent aspects of organizing systemic innovation.

Many of the arguments pursued in the cartographic approach comes close to those already provided since the 1980s in actor network theory (Latour 1987, Latour 1993, Akrich, Callon and Latour 2002a, Latour 2005). So why not "simply" frame the analysis of SEEIT using actor network theory (ANT)? The main reason for not doing an ANT analysis has to do with the virtual-actual axis of becoming introduced above. With the risk of oversimplifying, one could argue that ANT has traditionally concentrated on questions about how the actual came to be actual (Latour 1987, Latour 1991) and less on what goes on when we do not yet know what will be actualized. One could easily argue that this is indeed an important aspect of the ANT tradition (see e.g. Akrich, Callon and Latour 2002a and 2002b for an example hereof). However, I would argue that ANT has engaged predominantly in deconstructing how facts came to be facts, and how technologies came to obtain a certain stability as solution to some problem, and so forth. Compared to such an orientation, the empirical material behind my analysis is characterized by offering no clear stabilization of actor-networks, but rather an ongoing effort to render complex cooperative processes productive in the midst of changing actor-networks.

Therefore, compared to ANT, the focus established in the cartographic approach puts emphasis on yet unresolved actualizations of the virtual within the virtual-actual axis. This focus does not stand in opposition in any way to the arguments and insights produced in ANT, but it invests in a question which rarely receives attention in ANT analysis due to its traditional inquiries into how specific examples of actor-networks came to be stabilized. The focus established here is rather how the actual potentializes, intensifies and opens up towards resolving a yet undifferentiated problem of energy system transitions.

5.7. Sum up of cartographic approach

In the preceding two chapters, I set out to develop a cartographic approach to studying systemic innovation in the making. The point of departure was a problematization of innovation systems research and organization process studies, and an empirically anchored observation of map making as a key aspect of how energy research and system transition efforts currently seek to create a momentum of and new coordination frameworks for cooperation. The argument here was that these cartographic processes play an important role in systemic innovation where we no longer focus primarily on single technologies, products and commercialization efforts in a traditional sense. Instead we focus on the processes whereby new means of interaction and coordination take shape in response to a new transcontextual complexity and the multiple relational problems this opens up for in practice. The cartographic processes in the empirical field are then seen as symptomatic for a cartographic crisis and transition process *within* the organization of knowledge production in the field.

In the method chapter, I pursued the question of how to study systemic innovation in the making and suggested a performative, in(ter)ventionist research practice. On the basis of explaining the participatory research process, I thus suggested an innovation research practice focusing on adding actively to cartographic intensifications by means of problematization and conceptual creativity. This approach situates innovation research in the midst of ongoing processes of cooperation and commits to perform knowledge that adds to such processes, and the risks of failure this entails, rather than sustaining a detached position which distances innovation research artificially from the challenges facing those involved systemic innovation. The core message of the in(ter)ventive research practice argument was to embrace rather than ignore the relational forces at work not only in the field, but also in-between the research practice and the field it connects with.

In the current chapter, I have introduced elements from Gregory Bateson's system theory and Gilles Deleuze's conceptualization of the virtual-actual axis of becoming as a basis for constructing the analytical strategy. I arrived at a focus on *processes of cartographizing* which constitutes a second order analytical strategy for studying how map making efforts unfold in the midst of system transition, and how divergence, multiplicity of forces and their relational dynamics are key processual aspects of systemic innovation. The main challenge taken up with this analytical strategy is to diagnose the capacity of map making efforts to become socially productive beyond the established, conventional ways of organizing knowledge production and innovation.

In the chapter on implications following the analysis of SEEIT, I will return to the questions of how the cartographic approach offers an alternative to established innovation systems research, and which insights of relevance to practice the cartographic analysis of SEEIT opens up for.

6. Analysis: Formation and stagnation

In order to explore and demonstrate the relevance of the cartographic approach to studying systemic innovation in the making, I will in this and the following chapter zoom in on three examples from the SEEIT partnership which in different ways illustrate the importance of cartographic intensifications for making the partnership process productive. Two of the examples show different versions of how cartographic crisis and divergence may turn into a productive tension for the partnership whereas one example illustrates what happens when crisis and divergence are 'put to rest' by orderly implementation efforts.

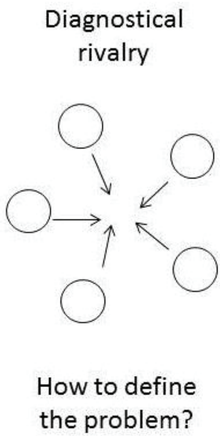
The analysis of the three examples is structured according to their chronological evolvement in the SEEIT partnership process from 2009 to 2012. The first example is the formation of SEEIT as a KIC proposing partnership in the Summer of 2009. This example will, among other things, show how energy transition agendas and the politics of innovation stir a cartographic crisis driven by problem-diagnostical rivalries and cartographic negotiations. The second example illustrates the fragmentation problems arising when the cartographic process loose intensity. Thus, in the "post-KIC" phase of SEEIT, the cartographic intensity imploded in fragmentation reducing the capacity of the partnership to connect partners in cross-cutting cooperative projects. The third example illustrates how the partnership regained a connective capacity through a new process of cartographic intensification which was of a different kind than the initial one in 2009. The third example thus shows how a recovery of system transition complexity, combined with a deliberate composition of heterogeneity and divergence in a series of workshops in 2011-2012, which opens up for a cartographic transition in how the partnership organizes itself with a direct impact on the connective capacity of SEEIT.

On the basis of the three examples I will in the end the analysis in chapter 7 by elaborating how we might consider the SEEIT partnership process as a process of cartographizing, and how this relate to the problem of organizing systemic innovation.

The three examples are not intended to be a comprehensive analysis of the SEEIT partnership. There are many steps and interesting examples which are left out. Thus the main purpose of the analysis is not to exhaust but rather to demonstrate the cartographic approach to studying systemic innovation in the making. The composition of examples has been made with that specific purpose in mind along with the in(ter)ventive rationale of opening up for new ways of understanding and acting upon a problem as an alternative to constructing yet another “more accurate” (representationalist) model of innovation. Put differently, the analysis pursued here and the condensation of findings I will try to develop form an attempt to compose a cartography *for* systemic innovation in the case of SEEIT, not *of* the SEEIT process.

Accordingly, the selection and composition of examples support the attention to cartographic intensifications where “the problem to be solved” is no longer to be taken for granted and where divergent problem-diagnostics and solution orientations enter into processes of rivalizing, negotiating, compromising and mixturing their heterogeneous map making principles. Here we find divergence, strange alliances, and all kinds of balancing efforts to be central process ingredients. This is therefore not yet another “positive sum” story about synergies in strategic partnerships and cooperation-based innovation and knowledge production. Rather, we will encounter a variety of struggles to come to terms with the system transition complexity the partnership seeks to respond to and the many fragmentation challenges as well as creative processes this opens up for.

6.1. Example 1: Formation and incorporation of divergence



*"This is **not** about technology – it's about innovation!"*

[The voice of a frustrated participant during the Munich SEEIT KIC workshop, June 2009]

The formation of SEEIT as a KIC proposing partnership in the Summer of 2009 was a process with many tensions. These tensions had to do with competing problem-diagnostical framings (which problems was the KIC supposed to respond to? And how?) and controversies over the meaning and implication of constructing a partnership devoted to innovation in the field of sustainable energy. Was this not merely a question of doing more and better coordinated technology development? Educating more and better energy engineers? No, others would say, this is about *innovation*, not technology! The formation phase of SEEIT is, as we shall see, symptomatic for a cartographic crisis which is not isolated to SEEIT, but becomes manifest in how SEEIT is constructed as a KIC proposing partnership.

The point of departure for the majority of SEEIT partners was not immediately one of cartographic crisis. Several of the university and research center partners were already deeply engaged in constructing and implementing the SET plan coordinated by the EU Commission's General Directorate for Energy. The SET plan process generated a European cartography for energy systems transformation and was from the outset a key cartographic reference framework for the construction of SEEIT. Thus, SEEIT was from the beginning constructed as a strategic partnership that would help realize key SET plan objectives unfolding a rationale of solving a wide range of fragmentation problems (relational problems inherent to system transitions) and for exploiting the potentials for coupling resources this implies. This reasoning was echoed in the final KIC proposal text:

> ***"Systemic complexity and fragmentation within and across technology areas.*** *While the energy sector is characterised by systemic complexity and technological interdependency, the European R&D activities in sustainable energy technologies are disciplinarily, geographically, and financially fragmented. This results in a widespread lack of critical mass, which cannot be solved by single institutions alone but needs to be addressed in a joint strategic effort. The fragmentation also results in a lack of systematic cross-fertilisation between the different sustainable energy technologies and industries. For instance, the developments in solar energy are largely decoupled from advances in the bioenergy area, leaving potential opportunities for integration unexploited."* (SEEIT KIC proposal 2009: 4).

Sustainable energy technology R&D activities and their fragmentation was seen as a key relational problem for the SEEIT KIC to respond to and this response should follow the SET plan goals and coordination approach so as to avoid ‘making a mess of things’ by introducing new coordination references. So, while the above quote could be seen as evidence of a cartographic crisis in the organization of European sustainable energy R&D activities, this crisis is contained by framing the response by means to the SET plan cartography which provides an orderly structure and technology development goals to secure a coordinated, coherent and comprehensive response. We have before us a crisis, but we know how to deal with it.

In what sense did a cartographic crisis affect the formation of SEEIT? The cartographic crisis arrived not first and foremost from a complex system transition agenda, “contained” as it was by the SET plan cartography, but from the KIC call and the innovation rationale it carried with it. Thus, the call for Knowledge and Innovation Communities from the, at the time barely operational, EIT did not first and foremost contextualize the energy KIC with reference to system transitions and the SET plan cartography. Rather, the KIC framework was composed quite differently in that it had no clear cartographic reference framework – the relational problem it constructed for the KICs to become a response to was one of complete dissolution of any preconfigured ontologization of innovation (e.g. innovation = technology development and diffusion, or innovation = systematization of innovation management, etc.). Thus, with the advent of the KIC call, the cartography for SEEIT could no longer merely be taken for granted – it became problematic: Which relational problem should the partnership construct for itself to respond to? And who was to determine this. This was not an expression of lack of expert competence or management competence for that matter. It was rather an expression of a set of presuppositions and systemically intertwined habitual patterns of problem-response conventions encountering a new, open complexity they could not respond to frictionless.

In order to specify in what sense the KIC call produces a cartographic crisis, let us zoom a bit out from the SEEIT process and visit the composition of the KIC call.

6.1.1. KIC: A de-centering of innovation

The KIC framework played an important role in creating a diagnostical tension with regard to how to construct a problematic context for the partnership to respond to. This had to do with the KIC framework being completely new to the EU policy landscape (already there a source of noise), but it also had to do with the specific way in which the KIC call was composed as a highly open-ended and almost empty framework which effectively de-centered any established cartographic category in relation to organizing knowledge production towards innovation:

> *The delivery of the EIT's strategy is centered around Europe's most exciting "innovation experiments", the Knowledge and Innovation Communities, KICs. KICs are bringing together the key actors in the knowledge triangle: research, education, innovation, entrepreneurship and business; co-locating people from diverse backgrounds (industry, SMEs, academia, nationality, gender, discipline ...) to work together across the innovation chain from education through to economic impact. KICs will be testbeds where we will address some of the critical questions for Europe's future success in the knowledge economy: "what makes people and teams innovative?"; "can we train entrepreneurs?"; "what makes an innovative place?"; "can open innovation work for an advanced manufacturing industry?"; "how can we measure innovation?"."*
>
> [European Institute of Innovation and Technology, EIT 2009a: 4]

> *"A KIC is a collaborative partnership, a legally and financially structured and managed entity of internationally distributed but thematically convergent partners"*
>
> [Schuurmanns 2009, Chair of EIT board]

The KIC framework aspired to become a catalyst for innovation-centered interaction. The language it speaks is very idealistic using sweeping and vague categories like "knowledge triangles" or "innovation chains" refraining from any stabilization of the concept of or approach to innovation. At the same time it wants the future KICs to become an "legally and financially structured and managed entity", as the chair of the EIT board Martin Schuurmanns describes it, with a business-like approach, focused priorities and rigorous methods. It suggests "co-location" as one key idea that might offer some sense of "KIC ontology": Thus by financing the setup of co-location centers spread across Europe, the KICs should intensify interaction and thereby accomplish better results with regard to commercialization of research and breeding of "new generations of entrepreneurial people". The KICs were therefore explicitly not about funding for technology research. This was emphasized by the use of the "knowledge triangle" as a framing device. The knowledge triangle implied that a KIC should focus on *integrating* research, education and innovation.

If we consider the "knowledge triangle" cartographically, its main feature is to avoid any stabilization of what a KIC actually is or should be according to established categories – it sustains an in-between position that does not have a name of its one, but is framed as an "integration" of activities. This means that the KIC framework opens up for a variety of diagnostical framings to be promoted – what does it entail to "integrate" education, research and innovation? What is the constitutive problem this integration solves? By means of which methods and processes? And who are to determine this?

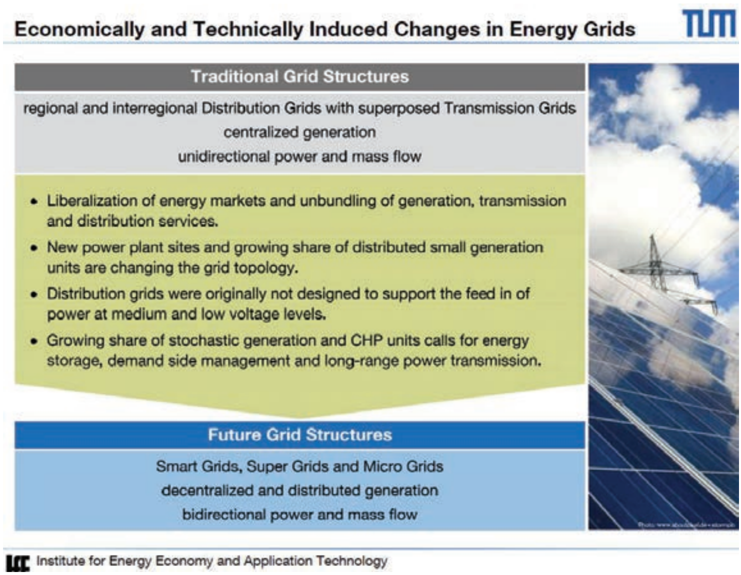
Cartographically viewed, the knowledge triangle and the KIC framework thus produces cartographic stress because it refrains from delivering a frame. Instead it de-centers all of its main categories that might have carried with them a degree of denotative familiarity. Rather than specifying what it entails to construct a KIC partnership in terms of main activities to be funded, rationale, and so forth, the KIC framework delivers an open-ended set of ambitions regarding "boosting entrepreneurship" and intensifying interaction through co-location and the mixing up of all conceivable actors involved in innovation processes. In the world of the KIC framework, no single cartography for innovation can legitimately be claimed to have the power to define what a KIC is and how it should be constructed. This was left open to proposing partnerships to develop.

The KIC framework thus persistently points to the middle of everything in order to express its rationale: A KIC comprises research, education and business creation, but cannot be reduced to either of these. It wants to mobilize "world class researchers", but insists on measuring the impact of KICs in terms of business creation. It wants to avoid reproducing technology-centered research, but continues to speak to a frame where commercialization of technology is the very definition of innovation. The KIC framework thus produces an overflow of transcontextual complexity, as Bateson calls this, in relation to organizing cooperation for innovation implied that established cartographic conventions of defining and approaching the organization of research and innovation can no longer legitimately be taken for granted as a self-evident and authoritative way of posing problems and promote solutions. A cartographic crisis, in other words.

Thus, while the SET plan cartography laid out a relatively orderly set of coordinates for a joint movement to take place, the KIC framework produce a distortion of this, and opens up for competing problem-diagnostical frameworks to enter the scene.

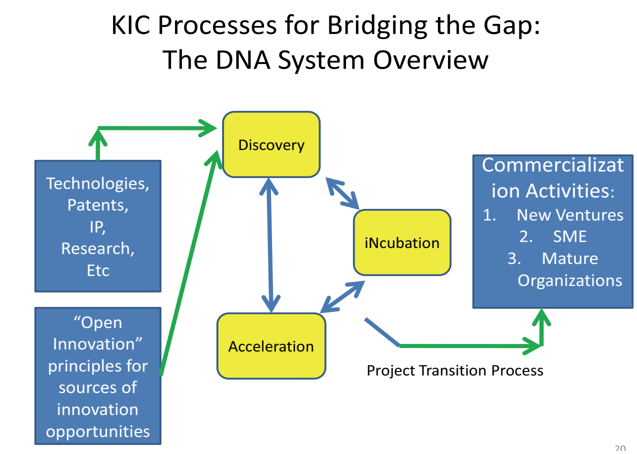
6.1.2. Diagnostical rivalries

Already during the first SEEIT KIC workshop in Munich, June 2009, the cartographic tensions emerged in a discussion about how to define the core activities of a sustainable energy KIC. Specifically, two fundamentally different problem-diagnostical frameworks clashed: On the one hand, a technology-centered cartography giving emphasis to organizing and legitimizing the KIC framework using the SET plan technology road maps as a diagnostical and structuring tool and, on the other hand, an innovation process systematization framework called the "DNA model" (Discovery, iNcubation and Acceleration) which provided a generic innovation management framework for structuring and systematizing the organization of innovation processes regardless of the technology in question. At the 2009 Munich workshop, the problem-diagnostical rivalry was rather unrefined. A brief juxtaposition may serve as illustration of the divergence at work. First a slide from a presentation by an energy systems professor from TU Munich seeking to frame the overall problem of transforming energy systems through a transition between different system topology compositions:



[Wagner 2009: Future Energy Grids, SEEIT KIC workshop]

Then, a thoroughly structured "DNA-model" of managing innovation:



[Leifer 2009: DNA System diagram as suggested to the SEEIT group]

Clearly, these framings suggest fundamentally different ways of setting the problem of energy transition and innovation. The system topology frame gives priority to the materiality and technical problems of energy systems and their transition. Here, energy technology innovation and sustainability transitions have a gravity of their own which the engineering disciplines and their respective problem-response conventions are in an position to deal with. The DNA model, on the other hand, suggests a different cartography all together: Innovation management, in this version, is a matter of interaction process systematization and management. This builds on a generic view on innovation processes and may, as argued persistently by the promoters of the DNA model, be applied to literally any innovation process regardless of technological field in question. The energy field has no gravity of its own with a bearing on the DNA approach. Only the proper setup of an innovation management system matters. For this we need the expertise of innovation management research and in particular the systematization school within this. The problem for the KIC to respond to is, in the DNA diagnosis, one of constructing a comprehensive and coherent system for innovation interaction. The underlying assumption of this is that the organization of innovation processes must solve problems so as to reduce the risk of investing in commercialization of new products, processes and organizational arrangements. The Discovery-iNcubation-Acceleration process was proposed as the framework that would provide the optimal control with systematizing risk reduction from "idea to commercialized product". Not surprisingly, in context of a partnering process dominated by engineering maps, this framing was hard to swallow – *"Where is the substance?"*, or *"This is not how innovation happens!?"* were some of the skeptical reactions voiced in the informal discussions between agenda points.

What is characteristic for both these cartographies is that they unfold a cartography of domains. Not to be understood as a pure repetition of some engineering or economist structural and entitative "Profession", but more dynamically as two cartographically similar versions of how professional mappings involve an erection of a problem to be solved by means their proper methods and angle of attack (Abbott 1995). For the engineering cartographies (there are multiple) the main lines of demarcation were already made by forming SEEIT as a competitor to the InnoEnergy consortium thus promoting a consequent focus on renewable energy as opposed to InnoEnergy which comprises renewables as well as fossil fuels such as "clean coal" from its Polish partners. With this demarcation in place, the SET plan cartography could do the residual work of structuring focus areas and setting up technology development objectives. The DNA model and its proponents saw the KIC framework as an opening into a domain which otherwise tend to be preoccupied by energy engineers – their stake was therefore different compared to the technology experts for whom the KIC framework was to be constructed by a continuation of well-established problem-response conventions within the various fields of energy engineering.

Thus, the diagnostical rivalry did not unfold on the same terms. The technology-centered cartographies, however ontologically distortive the KIC call might be, remained relatively stable whereas the DNA-model proponents had to invest considerable efforts in persuading the partners to take on the DNA framework. The rivalry, therefore did not manifest itself only in explicit disagreements, but also in polite silence and hesitation (what do they mean by "DNA"…?) along with more outspoken critiques and frustrations regarding the lack of 'a coherent rationale', clear focus, and so forth. The diagnostical rivalry is an illustration of how the KIC call opened up for a variety of possible problematizations of how to define and approach energy innovation and construct cooperative frameworks for cross-fertilizing innovation processes with education and research.

6.1.3. Constructing barriers, negotiating boundaries

The process of stabilizing a common response to the KIC call was a process balancing the problem-diagnostical divergence introduced above, but the final KIC proposal never reached a point where this divergence was creatively transformed into a new complementarity. Rather, the divergence translated into a kind of territorial compromise that afforded both cartographies a place on the KIC map but without transforming the domain-structure they invested in sustaining or gaining. If we revisit the thinking of Bateson, this is not surprising, nor is it a sign of poor coordination. The balancing of competing cartographies of domain that (aspire to) assume the power of defining the problem to be responded to may very well imply a territorial division between the rivalizing cartographies. In the SEEIT KIC proposal this manifested itself in the construction and negotiation of "barriers to innovation" for the KIC to overcome. This was an important move, because it allowed the divergent problem-diagnostical forces within the partnership to construct a typology of barriers (a set of key relational problems to solve) which would offer the rivalizing cartographies a place of their own in the KIC framework. In the final KIC proposal this translated into the following construction of barriers for the KIC to overcome:

> *"**Barriers to Innovation and SEEIT Programmes.** In order to meet the ambitious educational and complex innovation objectives, barriers need to be identified and overcome. Barriers can be identified in three main domains:*
>
> *1. Generic energy sector barriers (e.g. systemic nature of industry, regulatory influence);*

2. Specific technology and industry related barriers (e.g., energy efficiency: a fragmented and conservative construction industry; wind energy: a lack of communication protocols between emerging industry partners) and

3. Generic innovation barriers (e.g. restrictions for innovation initiatives, mismatch of innovation uncertainty and investment calculi, critical mass problems, difficulties of technology transfer between university and research laboratories and businesses due to conflicting cultural values and metrics of success).“

(SEEIT KIC proposal 2009: 4).

In this way, a form of territorial compromise was reached. The term "DNA model" was not used in the final proposal but the underlying terminology and thinking informed the structuring of the "innovation tools" sections in the proposal whereas the SET plan framework and terminology structured the elaboration of the "technological barriers and objectives" including the structure of the most important KIC component namely the co-location centers which were framed in accordance with the five technological focus areas (wind, solar, bio-energy, energy efficiency and energy systems). In this sense, the compromise favored the SET plan and technology-centered cartography but afforded a clear place for innovation management in the composition of "innovation tools" and programs to be implemented. This, on the other hand, implied an inherent fragmentation in the KIC proposal because it combined a technology-centered structuring of the co-location centers while listing a variety of innovation tools and programs which were staged according to a logic of addressing "generic innovation problems".

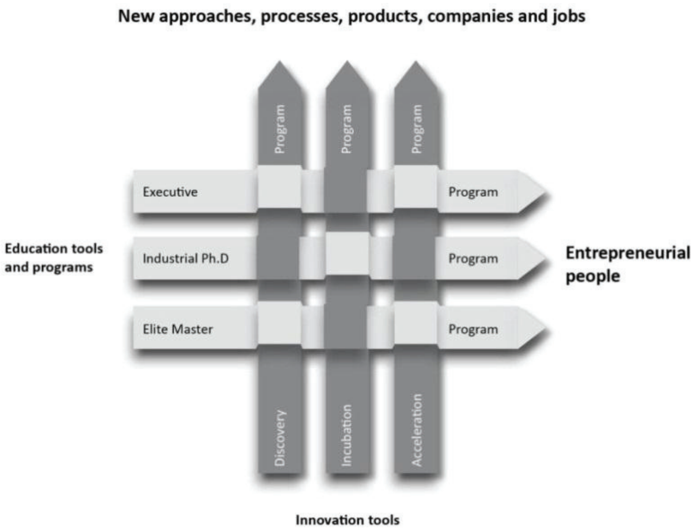
The construction of barriers is an example of how cartographic operations, even those defined by a relation of "territorial battles", may arrive at a point of boundary negotiations and compromises that implies a relative incorporation of otherwise divergent problem-responses. This means that the barrier construction and the resulting negotiation of boundaries was important for turning the cartographic divergence into a process of composing a joint proposal. However, the barrier construction and boundary negotiation also shows how a political process of strategic partnership formation stimulates cartographic operations of domains more than they stimulate integrative and creative processes of going beyond known cartographies. What the SEEIT KIC process did accomplish was a composition where very diverse ways of diagnosing and approaching relational problems to be solved were if not integrated then at least combined with the prospective of pursuing more integrative methods in future partnership cooperation.

6.1.4. In search for a dynamic, integrative principle

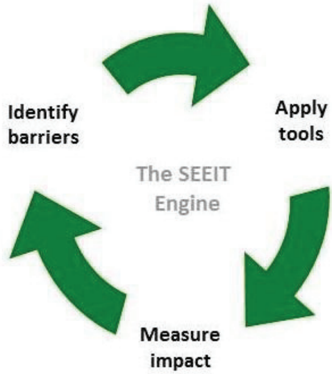
The diagnostical rivalry was one important formative line of divergence which was balanced and negotiated in a variety of ways as explained above. Simultaneous to this was another formative divergence line which was not about different expert professions seeking to domesticate the KIC but rather about balancing between developing the KIC as a new entity operating beyond the defined boundaries of individual partner institutions and the KIC as comprised by a range of individually strong and well-established institutions and industrial partners with a need for being represented as such. In other words, a line of divergence between a cartography for integration and a cartography of representation. A few diagrams developed during the formation process illustrate this.

For example, the coordinator suggested a braiding diagram as a way to articulate a “strong fabric” of interconnectedness of the planned SEEIT activities in education and innovation. This became part of the final KIC proposal (“The Braiding of Programmes

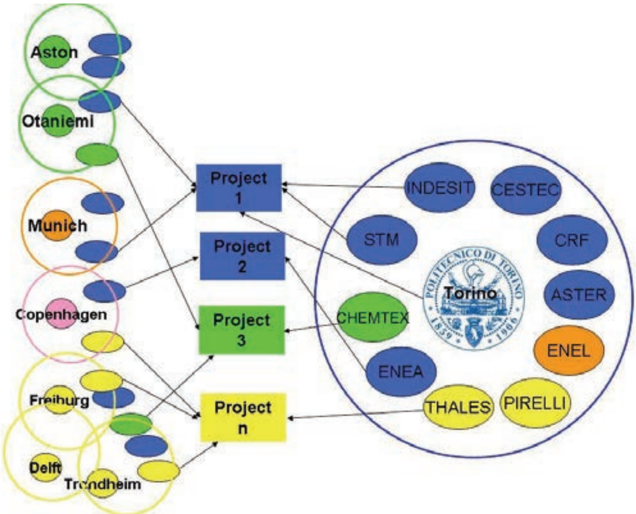
Creates a Strong “Fabric” of Learning and Innovation Processes”, SEEIT KIC proposal p12):



Another example of a diagram intended to express an integrative principle was the “SEEIT engine” diagram showing the rationale of continuous improvement of the SEEIT tools in education and innovation. The diagram obviously resonates with widely used performance management systems and does not in itself suggest a particularly original idea or way of conceptualizing an organization as capable of sustaining a dynamic momentum in its activities. What the diagram does illustrate is the image of SEEIT as “frontier actor” constantly constructing and responding to barriers thus sustaining a learning cycle with regard to how it operationalizes its integrative efforts.



A third example is a diagram developed by Polito research advisors seeking to illustrate a rationale of using co-location centers as a place for making cross-technological connections and industrial participation to better solve complex innovation problems. The diagram was constructed rather early in the formation process, but did not enter the final proposal. Rather, it was used in the final round of evaluation of competing proposals during the hearing in Budapest in December 2009 as a way to respond to a critique from the proposal evaluators pointing to the risk of fragmentation and "silo thinking" due to the technology-based structure of co-location centers in the SEEIT KIC proposal.



Even though this was not included in the written KIC proposal, the Polito diagram is an example of map that was socially sanctioned in the process as a good way of showing the SEEIT framework: It assigns the "core partners" (the technical universities and research laboratories) and their respective, local industrial partners a clear position while showing the project-based cooperation and referring to the five technological focus areas by means of a color coding. Each partner "ecology" thus sustains a strategic, institutional integrity while connecting on a project to project basis with other ecologies in the partnership.

This line of divergence was important because it informed key structural decisions in the composition of the KIC proposal, for example the conceptualization and structure of the co-location centers. Thus, the co-location centers and their techno-thematic structure (wind, solar, bio-energy, energy efficiency and energy systems) was partially an echo of the thematic structure of the SET plan and a representational staging of the constituent partners and their 'core capabilities' within the respective thematic fields.

This was also another manifestation of a cartography of domains which guided formation phase. The divergence between the institutional, representational domains of constituent partners and the search for an integrative principle that would bind together partners in a KIC framework did not unfold as a rivalry in the same way as we saw it between the technological and the DNA-model approaches. It was more a balancing between framing the KIC as a composition of strong institutions (who are we, what have we accomplished) and the KIC as a novel add-on, a piece of organizational innovation, that would transgress the institutional arrangements it connected and thus open up for a new relational order across the constituent partners.

The strong investments made in sustaining the institutional landscape of strong partners with core competences (which they, according to the logic, have built due to their institutional accomplishments and integrity) illustrate the power of systems of presuppositions when encountering a distortive "agent" like the KIC framework. Thus, even though the KIC call de-centered the ontology innovation, as introduced earlier, the cartography of domains of technological excellence and institutional integrity was sustained and defined key parts of the KIC proposal. At the same time, the proposal did indeed accomplish to bring such strong institutions onto the same map of a future KIC framework and to introduce a variety of cooperation 'tools' in innovation and education which would in effect open up for a topology of connected domains (as the polito diagram also suggests) which is, given the political and strategic nature of the KIC proposal already an important cartographic accomplishment.

6.1.5. Coordination as postponement of stabilization

How did coordination perform its role as the "care taker" of pulling the partners together and resolve territorial battles and divergences? The coordination effort was a balancing act between acknowledging disciplinary and institutional domains and the strategic integrity of partners while stimulating a process of partnering that transgresses these boundaries. We have already seen how the construction of a barrier typology helped carve out a terrain for the partnership which incorporated the diverging problem-diagnostics. And we have seen how coordination was in search for an integrative principle. However, an important coordination response was a postponement of proposal stabilization, or rather a stretching out of the process of stabilizing the KIC proposal starting with an agreement on future hosts of co-location centers (to take the heat out of a potentially destructive rivalry on this key point) and then gradually adding elements to the KIC conceptualization. Thus, up until the last workshop two weeks prior to the deadline, the draft proposal was still messy and pointed in many directions. This stirred frustration and critique among some partners (was the coordination team actually capable of pulling this off?!) which during the opening of the last workshop became so outspoken that it froze the otherwise good atmosphere at the partner assembly. The postponement was however a response to the domains that was still being nurtured and promoted and a balancing solution which gradually pulled the "domain cartographers" towards a shared agenda.

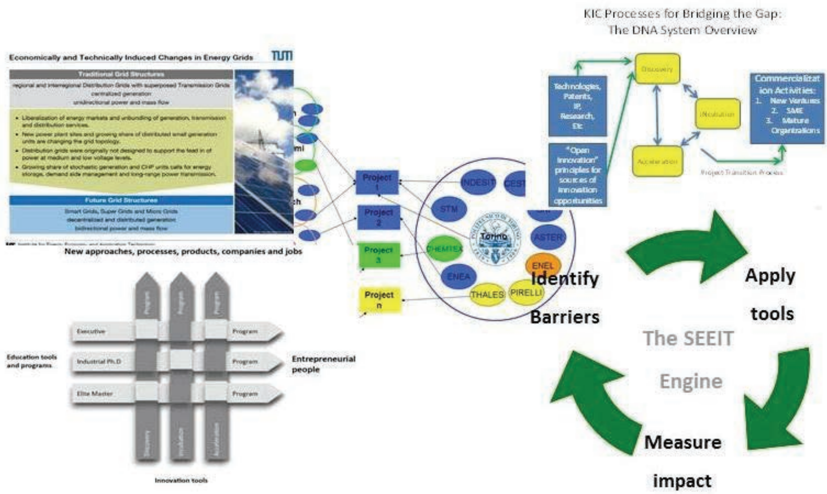
In general, what characterizes coordination in this phase was its way of responding to the various manifestations of a cartography of domains and the territorial battles this implies. Thus, coordination refrained from becoming a part in the domain dynamics by postponing the point of culmination of the KIC process until the very last moment where the pressure got so intense that it was no longer legitimate to exclusively play a game of domestication (not that this disappeared entirely from the process). It seems plausible to suspect that had coordination invested in these domain dynamics with a domain cartography of its own, it would have lost the capacity to pull partners together. It had to stay neutral with respect to the diverging domains, but at the same time continue to point towards an empty in-between of domains (where the KIC should grow from) where no single partner could legitimately claim a superior position. This is an example where how coordination accomplishes its tasks not by fixing coordinates, but by acting like the “blank domino” (Serres 2007) with no particular value but an eminent connective, game-changing capacity. We shall encounter more examples of such a coordination performances in subsequent examples. By associating itself with the blank spot of the KIC framework, coordination accomplished to avoid becoming mixed up in territorial dynamics while gradually pulling the partners towards a shared problem of constructing a KIC proposal that pointed beyond the scope of domain-specific interests.

6.1.6. Sum up: Formation along divergent lines

[“SEEIT family photo”, August 2009]

Example one shows how the formation of SEEIT was a process that evolved along divergent lines of diagnostical rivalries and a tension between self-conserving institutions and an effort to conceive of a new relational order that would transgress established institutional and disciplinary boundaries. The KIC call was an important ingredient in this because of its 'cartographic distortion' and the resulting diagnostical battles and negotiations. The de-centering performance of the KIC in combination with its strategic and political status teased out a cartography of domains and the partnering process was generated in response to the divergent lines this opened up for. This is a clear example of how the formation of the partnership is an inherently systemic effect where multiple dynamics pull in the partnership.

In this sense, the cartographic crisis introduced never really took hold of the partnership at this stage. Probably because of the high political stakes of the KIC proposal which stimulated a cartography of domains, and a set of divergent lines fueled by the territorial tensions, competition and negotiations this kind of cartography performs. Thus, the cartographic crisis was contained and balanced through a balancing act of affirming domains of expertise and institutional integrity while searching for a set of integrative principles that would express a new relational order instigated by the KIC. The SET plan framework which had been evolving for some years clearly served as a legitimate coordination reference framework which informed the main technology development targets pointed to in the KIC proposal. The competing DNA framework invested in an alternative problematization of what the KIC was supposed to respond to, and succeeded in being incorporated in the KIC framework but only through a construction of a 'division of labor' between the domain of technological expertise and innovation management expertise. Again, the cartographic distortion of the KIC opened up for the possibility of challenging a technology-centered ontology of innovation, but the potential cartographic crisis hereof never reached a point where it could truly challenge and alter the cartographies of domains which populated and defined the formation phase.



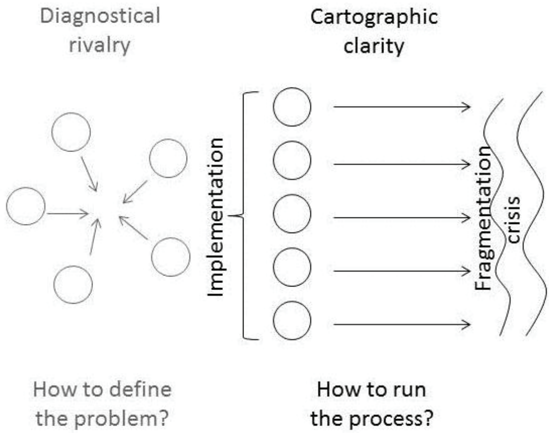
[Divergency incorporated]

These divergent cartographic operations and the tensions they generated within SEEIT were formative for the KIC proposal because the charged field of diagnostical rivalry and negotiation of boundaries they instigated produced the main relational problems for the partnership to resolve in order to arrive at a jointly conceived and collectively sanctioned, competitive KIC proposal. As the analysis shows, a key aspect of arriving at such a proposal was to construct an innovation barrier typology which incorporated the diverging problem-constructs and afforded these a place of their own in the KIC proposal. The barrier typology construction was a boundary-setting operation and negotiation that sustained a divergence while avoiding its potentially destructive consequences for the proposal and overall partnership cohesion.

This is an important example for a study of systemic innovation in the making because it illustrates how established systems of presuppositions respond when their habitual and taken for granted ways of defining problems and solution approaches no longer perform coordinates for joint movement smoothly, but becomes a matter of problematization and diagnostical rivalry. The example illustrates a conservatism in the encounter between well-established institutions and a call for a new, open-ended relation order which transgresses the institutional cartography of domains at work in the formation of SEEIT. Thus, the cartographic distortion of the KIC call never reached a point of cartographic crisis that altered substantially the cartography of domains in favor of a new relational order – however, it did open up a number of 'cracks' where it became possible to problematize the organization of the KIC from an innovation management domain of expertise.

The political and strategic nature of the KIC proposal made it a scene for different versions of territorial demarcations and rivalries, and an effort from the coordination team to constantly strike a balance between constructing SEEIT as an engine for cross-cutting activities, while acknowledging and affirming the institutional and strategic integrity of the partners. *Sustaining and balancing divergent forces* was therefore a constitutive relational dynamic in the formation of SEEIT. As such the partnership demonstrated at an early stage a capacity to hold diverging forces together without collapsing their heterogeneity into one overarching principle. As we shall see, this capacity of the partnership was reinvigorated on a later stage, in an renewed form.
With this first example of cartographic intensification and divergence incorporation as drivers of partnership formation, I will now move on to the second example which is a more brief observation of what happened with the partnering effort after the SEEIT consortium lost the KIC competition to InnoEnergy and choose to carry on with a cooperation process.

6.2. Example 2: Implementation and fragmentation



As we might recall from the introduction to SEEIT in chapter 3, the KIC proposal was not elected by the EIT board. The KIC was granted to the competitor "InnoEnergy". This was a big disappointment for the partners. All the potential collective energy that was created in the formation phase made the partners consider how to sustain the partnership and harvest from the many ideas and relations that had been created. For this purpose, the partnership developed a Letter of Commitment during the Spring of 2010 and made a special effort to ensure that SEEIT despite the failed KIC proposal was recognized by the EU Commission as an important strategic actor for the implementation of the SET plan goals. This was accomplished when Jørgen Kjems as the coordinator of SEEIT was invited to participate in a meeting in May 2010 in the Commission where the various emerging strategic alliances in the field were also present. After the meeting the coordinator could announce to the partners the recognition of SEEIT by the EU Commission:

> *"Dear SEEIT colleagues.*
> *Attached please find my preliminary report from the meeting in Brussels yesterday concerning education and training in relation to the SET Plan.*
> *The meeting was organised by DG RTD and chaired by director Rafaele Liberali. Participants were representatives for EIT KIC InnoEnergy, eseia (Graz), SEEIT, EERA, DG RTD and DG EAC.*
> *The result was very encouraging for SEEIT. We are invited to participate on equal footing with the EIT KIC, EERA, EUA and other interested constellations in a new effort to establish a road map for education and training in relation to the SET Plan. DG RTD will provide a descriptive note within 15 days and the aim is to create a forum like the Technology Platforms that will produce common objectives and a road map for SET Plan related education and training within 2-3 months.*
> *I am looking forward to discussing the prospects of this at our meeting in Helsinki next week."*

[Email to partners from the coordinator, May 27, 2010]

The recognition of SEEIT as a European actor was needed in order to secure a legitimatizing narrative at the strategic level of the partnership. The possibility of participating in road map constructions and thus engage in EU level coordination efforts was of key importance for sustaining the partnership, especially for the university and research center partners. In this way, SEEIT could become a platform for promoting a research and education perspective on the negotiation and translation of SET plan goals. However, there was also a clear limit to how far SEEIT could move in this direction of becoming a policy ‘spokesperson’ for the partners in the EU system. Thus, the Italian research laboratory partner, ENEA, refused to consolidate SEEIT in this particular way because this would be in conflict with their own EU policy office in Brussels – again, when the partnership enters a game of domains, it gets into trouble. The recognition of SEEIT as a partner for the EU Commission’s work on the SET plan process was a strategic stabilization of SEEIT as a European partnership and as such an important element in the transition from the KIC process to the ‘post-KIC’ process of turning SEEIT into a performing partnership.

6.2.1. Ideals of cartographic clarity as a basis for effective implementation

The transition from the formation phase charged by diagnostical rivalries and problem negotiations to an operational phase was also a transition from a cartographic intensity to a cartographic ideal of clarity as a basis for implementation and coordinated movement: *Get the coordinates right, and then move on*. While strategic and cartographic clarity served the partnership well in its efforts to put SEEIT on a European map of “key actors in the SET plan”, the cartographic clarity suffered from taking the heat out of the generative tensions that helped potentialize SEEIT during its early initiation. Thus, cartographic clarity helped the partnership re-construct and sustain itself strategically immediately after the KIC rejection, but this came with a cost of stabilizing a vision for the partnership and a division of technological focus areas (as conceived also in the KIC proposal) that did not incorporate a productive conflict or unresolvedness for a cooperation process to feed on.

Given the analysis suggested in example one, this is not surprising: If the partnering process feeds on divergent lines of demarcation and the cracks and in-between opportunities these produce, then a ‘relaxation’ of the cartographic intensify must become counterproductive, despite its orderly proposition and easy to grasp division of labor. This marks also a difference between the strategic gaze and the process of movement (de Certeau 1992). Where the strategic gaze might perform a terrain of order with clarity in purpose and means, the process of movement and interaction feed on generative differences and divergence which the strategic gaze does not connect with. This was at least the case in the post-KIC phase of SEEIT and expressed in the Letter of Commitment which was signed in June 2010.

> ***“1. Mission statement and objectives***
> *Within and across the initial five focus areas of:*
>
> - *Solar Energy,*
> - *Bio Energy,*
> - *Wind Energy,*
> - *Energy Systems,*
> - *Energy Efficiency,*
>
> *the main objectives for the SEEIT Alliance are to:*
>
> - *Become a global leader in accommodating the fast growing demand for adequately skilled experts in the area of sustainable energy by educating and training students and academic staff at an unprecedented scale,*
> - *Accelerate the development and promotion of sustainable energy technologies by conceiving and implementing Joint Programmes of education, innovation and research in support of e.g. the SET-Plan,*
> - *(...)*
>
> *The main objectives of the Alliance are achieved by developing, operating and expanding Joint Programmes and activities based on education and innovation*

tools, examples of which are outlined in Annex A to this Letter of Commitment. Joint Programmes and activities may include:

- *Aligned or common educational programmes, e.g. using known instruments such as Erasmus Mundus, Double Degree Programmes etc.,*
- *Opportunity recognition activities, which should result in agreements between at least three partners to engage in a joint project proposal for developing and implementing innovation and/or education tools,*
- *Pooling and integrating activities and resources, combining national and Community sources of funding and maximising complementarities and synergies, including non-European international partners,*
- *(...)*
- *Organising sustainable energy innovation camps, i.e. summer schools gathering students, researchers and industry in a joint effort for discussing innovation opportunities as presented by researchers and companies."*

[Excerpt from the SEEIT Letter of Commitment of June 16, 2010]

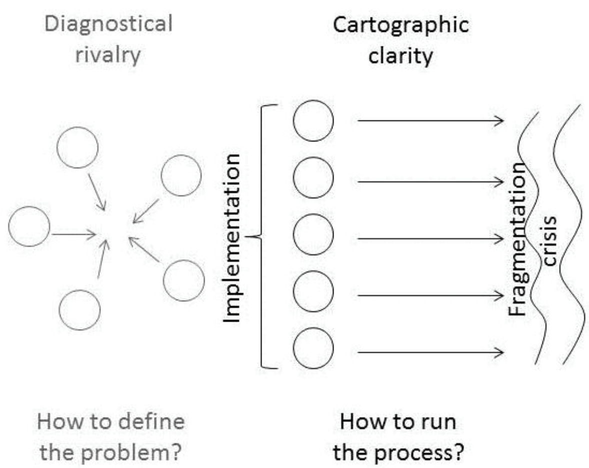
The "Letter of Commitment" only provides an abstract framework which everyone can agree to, but more importantly it produces a problematic context for the partnership to respond to which does not activate any tensions within the partnership. Rather, the majority of innovation management experts slowly migrated away from the partnership activities and most of the partnership gatherings in the period from Summer 2010 to Autumn 2011 were devoted to assemble technological experts on the basis of the five technological domains of expertise.

At a partnership level, therefore, the cartographic intensity was more or less dissolved during this period. Several project developments and spin-offs were generated, as described in chapter 3, but the composition of the partnership process was strategically stabilized in a way that echoed the SET plan cartography – not only discursively, but also organizationally with the five technological focus areas as the main illustration hereof. With the advent of cartographic clarity that pre-figures and divisionalizes the field for SEEIT to enter, the partnership enters a process where the complexity of system transitions is no longer working for the partnership process because it has been replaced with a strategically conceived and well-ordered cartography dominated by the SET plan framework and an affirmation of cartographic domains as the basis for cooperation (rather than the tension in-between these, as in example 1). One of the processual implications of this move came to be that SEEIT in the subsequent time period persistently struggled with turning the partnership into a productive cooperation, which is illustrated in an example from the Rome workshop in April 2011 where the partnership reached a cartographic low-point of intensity.

6.2.2. Cartographic stagnation and fragmentation frustrations

The thematic point of departure for the SEEIT workshop in Rome 2011 was a potentially very rich and relevant field for a partnership like SEEIT to explore. The main theme was energy efficiency in buildings (40% of total energy consumption happens in buildings) and given the variety of technologies and domains of expertise involved in knowing and developing new solutions in the building and construction sector, this particular theme seems particularly potent for stimulating cross-cutting cooperation. However, the Rome workshop was a tour de force in experiencing the agony of a motionless and unproblematized cartography of knowledge production. The workshop comprised a series of presentations most of which were predominantly reports on already completed research. There was no problematic outside calling for a new approach. The many difficulties of realizing energy efficiency targets (despite a very well-established and long-standing technical knowledge) where never problematized in a way that would potentialize the partnership. Rather, the workshop became one long journey through conventional research reports, detailed information about local projects with upgrading energy efficiency standards in local communities, and so on and so forth. The time stood still. This was felt even more intensely as the venue of the workshop was located in a ENEA research laboratory outside Rome which was also a laboratory for nuclear energy with 'airport-like' security control at the entrance. The architecture of the workshop space was some residual of a 1970s 'cutting-edge' use of new colors, forms and furniture design, which made a slow and frustrating workshop even more stagnant and painful. A little piece of evidence hereof was the frustration of the coordinator who after a break choose to escape the far-away venue in a taxi to Rome…

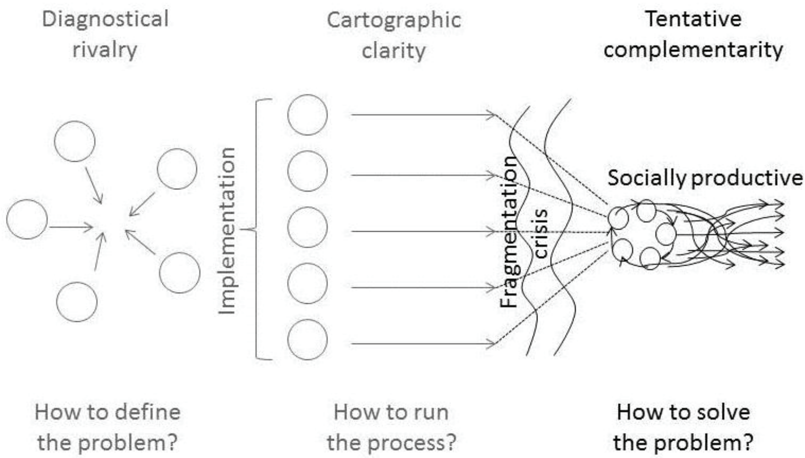
6.2.3. Sum up: Symptoms of a lost intensity



A lack of “charged fields of potentiality” – this is the price sticking to cartographic clarity. The structure of the strategic gaze – however effective it is in securing strategic legitimacy – cannot generate the processes which potentialize interaction creatively. Thus, while cartographic clarity resonates well with established ways of defining relational problems and organizing towards solving these, the very same resonance with the familiar is what makes it inherently counterproductive in relation to potentializing interaction which transgresses the familiar and the habitual ways of posing problems. This is indicated in the diagram above where the ‘positions’ are no longer related to each other in a charged field of potentialization as they were in the formation phase. Instead they are ‘implemented’ in an orderly way on the basis of a cartographic operation which constructs a set of problems to respond to in accordance with the SET plan cartography and the strategic outlook this offers. However, the limitation of using the SET plan as a coordination reference framework is that it remains a political-strategic process with a predominance of cartographic reproduction of positions and means-ends logics of technological development and implementation. Also, given the political nature of the SET plan framework it remains a territorial compromise rather than an actual engine of innovation. This is important when striving to translate wider system transition agendas into a specific process of partnering and cooperation because in such a context, for systemic innovation to take shape, a cartographic tension is needed in order to keep the process going and enable connections which actualize new interaction patterns where systems of presuppositions are yet to become effective.

The post-KIC process and the Rome workshop example also illustrate the relevance of distinguishing between the real-possible and the virtual-actual as proposed by Deleuze. When cooperation efforts get caught up in taken-for-granted cartographic conventions, they are also caught up in a real-possible framework where no problematic contexts is being created and where cooperation efforts implode into actual state of affairs. This is a good example of how difficult systemic innovation is because it relates to even the most trivial and everyday processes of doing things like for example organizing a workshop around energy efficiency research. In Rome this became a venue for the actual to repeat its many conventions and assumptions frictionless making the SEEIT partnership process fragment until the point of unbearable frustration.

7. Analysis: Cartographic transition – a new potentiality



7.1. Example 3: Recharging the process

While the Rome workshop was a low-point in the SEEIT process, the following two workshops illustrate a new cartographic high-point of intensity. The process taking shape in Munich and the following workshop in Copenhagen was the first time since the formation of SEEIT where a problematization of energy system transitions was intensely and jointly worked on. In particular, the Munich-Copenhagen process took shape through a *recovery of system transition complexity* as irreducible to any single or otherwise specific set of domains of expertise, opening up for a *flat composition* of a cooperation process. A flat composition means that no unifying principle is reified that would have subordinated the diverse range of research specialties to the same transcendent set of coordinates. Rather, the recovery of system transition complexity means exactly that such a unifying principle is avoided in favor of a heterogeneous composition where complementarity is being tentatively developed without collapsing differences across the involved research specialties. This opened up for a cooperation process on the basis of coordinates for joint movement that was constructed along the process of cooperation.

The point of departure is the systems analysis workshop organized by the Technical University of Munich in October 2011. The workshop stirs a cartographic controversy resulting in a productive recovery of system transition complexity and an opening towards a workshop in Copenhagen in March 2012 that came to be the most successful SEEIT gathering since its formation in 2009. As a cartographic process, the Munich-Copenhagen workshops increased the connective capacity of the SEEIT partnership considerably compared to previous efforts.

7.1.1. Munich 2011: Recovering system transition complexity

You can't model political will.

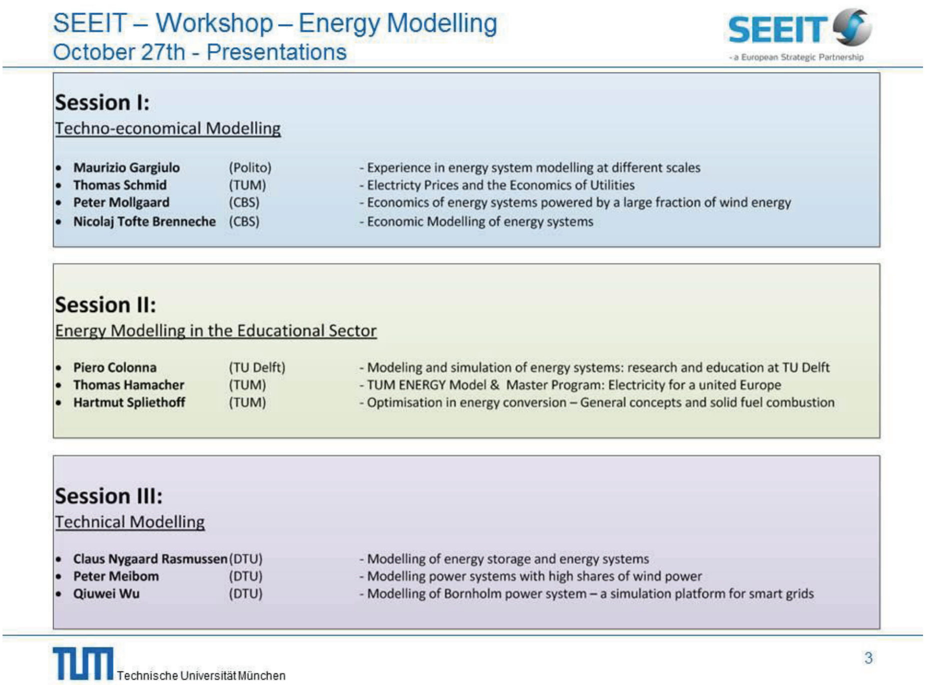
[Professor from the Technical University of Munich]

We cannot separate these issues. There will not be a technical fix nor a market fix. The problem is much more complex!

[Professor from the Technical University of Denmark]

The focus of the Munich workshop was how to model the dynamics of future energy systems integrating large fractions of renewable energy from e.g. wind and solar. This was approached from a technical as well as economics-based modeling perspective and brought together a variety of researchers working with system modeling in particular from TU Munich, the Technical University of Denmark, TU Delft, Polito and CBS.

Already in the composition of the workshop, we thus find an opening towards a problematization of knowing and organizing energy system transitions which did not merely reproduce fix problem-response constellations, but held an opportunity for recovering a complexity of system transition processes.



Modeling energy systems is a discipline which is often used to support decision-making in relation to infrastructural investments or new regulatory frameworks with infrastructural and economic effects in the energy sector. It helps qualify all sorts of questions regarding consequences of changing how systems are assembled and how to optimize the mix of investments made to support overall system transition processes. In turn, this means that within this discipline, the experience of system transition complexity is well-established. As a professor from TU Munich expressed in his presentation, *“you can’t model political will”*. Thus, while the modeling experts advance the view that a rational use of good models yields more optimal results when making decisions regarding changes in energy systems, they recognize the political dynamics and complexity this entails. For these modeling experts, the question was therefore not only how to technically construct good models, but also how modeling may gain impact on various levels of decision making in relation to energy investments – at a regional level as well as at an urban and household level of modeling energy dynamics.

Already during the first session of “techno-economic modeling” a cartographic intensification opened up. This was stirred by a presentation of an economics-based approach to modeling energy market dynamics of electricity systems dominated by wind power. The scene was in many ways predictable: On the one hand an economics-based approach to modeling (energy) market dynamics, and on the other hand a technical and mathematics-based approach to modeling the multiple energy dynamics in systems incorporating volatile energy sources. The clash was two-fold. First, a controversy regarding how to capture “energy system dynamics” in a model: The economist focused on an aggregated level of changing supply-demand equilibria and the resulting volatility of energy prices. Opposed to this, the technical and mathematics-based system models focused on capturing the multiple energy dynamics of energy systems integrating large fractions of wind and solar energy using a more differentiated language for “dynamics” compared to the economics-based model. Second, there was a diagnostical clash between the conclusions derived from the market modeling and the energy dynamics modeling. Not surprisingly their different presuppositions about the nature of dynamics in an energy system translated into very different diagnoses of the problem to be responded to when addressing complex system transition processes.

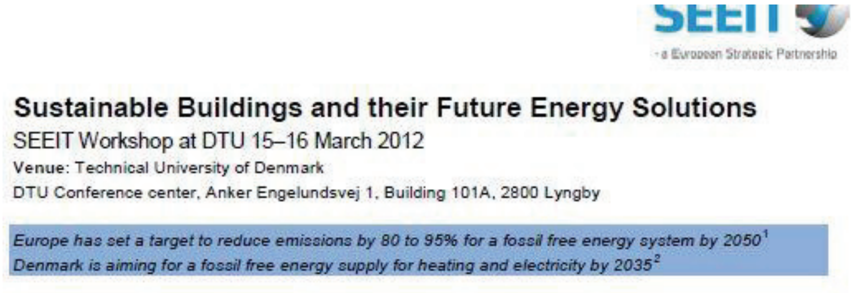
The cartographic controversy was quite outspoken. As one somewhat frustrated technical modeling researcher expressed it during a break: *"I have two problems with economists: First of all, they don't understand dynamics. Secondly, their analytical level is static and doesn't capture the variety of dynamics taking shape across spatial levels and across time in energy systems. We engineers think too much in terms of structures and components and we lack knowledge regarding business models and a language for articulating economic solutions. We need to cooperate more. We cannot move ahead by saying "the engineers should solve this and this problem" and "the economists should solve this and this". We cannot separate these issues. There will not be a technical fix nor a market fix. The problem is much more complex."*

This frustration was ignited partly by a concluding remark made by the economics professor pointing out that *"if only you engineers could invent some nice, big batteries, then we can integrate much more wind energy, balance out the supply-demand disequilibria and make these future smart grids work".* While this remark was obviously made knowing that the issue at hand was more complex, it still provoked the engineers because it portrayed the problem to be solved in a way that obviously did not recognize the variety of profound technological challenges "the engineers" seek to deal with and it reproduced a "technical fix" narrative in relation to how complex system transitions evolve.

However, a fundamental cartographic controversy is also a crack of potentiality. The frustration they affect may become an advantageous point for a different cartographic process to take shape. This is what happened when the image of dancing was so explicitly embraced as a relevant metaphor for "what needed to be done" (as introduced in chapter 4). Despite its stereotypical clumsiness, the dancing image becomes an image of a process rather than an image of how to solve a given problem. The image of dancing is an image of a continuous creation of a space for joint movement (Steyaert 2012). It also provides a simple image of cooperation as a process which *sustains* the constitutive differences the process feeds on. As explained in the method chapter, the dancing image was part of an attempt to problematize the relation between system transition processes and the organization of energy research pointing to a transition process *within* energy research rather than repeating cartographic operation seeking to stabilize yet another a version of energy system transitions and technology development challenges "outside" energy research.

The outcome of the cartographic controversy was an affirmation of the need to 'start dancing' – this affected the focus of the workshop to become increasingly oriented towards searching for a productive integration of energy efficiency in buildings and energy system modeling. The energy efficiency workshop in Rome had decided a follow-up in Munich which was scheduled for the second day of the workshop. However only one researcher from the Rome workshop turned up and the planned energy efficiency follow up was turned into a discussion about to connect the energy system modeling domains with the problem of making radical improvements of buildings' energy consumption – improvements that were anticipated to change the interface between wider energy systems and the building itself. The outcome of Munich was therefore a agreement to take the tentative composition of knowledges which had emerged as a basis for the following workshop the Technical University of Denmark in March 2012.

7.1.2. Copenhagen 2012: Mixturing domains – multiplying perspectives


SEEIT
- a European Strategic Partnership

Sustainable Buildings and their Future Energy Solutions

SEEIT Workshop at DTU 15–16 March 2012

Venue: Technical University of Denmark

DTU Conference center, Anker Engelundsvej 1, Building 101A, 2800 Lyngby

Europe has set a target to reduce emissions by 80 to 95% for a fossil free energy system by 2050[1]

Denmark is aiming for a fossil free energy supply for heating and electricity by 2035[2]

It is in the transition chaos emerges.

[Professor from the Technical University of Denmark]

We have to mix things up to avoid silos.

[Professor from Copenhagen Business School]

"It is in the transition chaos emerges". These were the words of a senior buildings engineering professor during a CBS-DTU meeting where preparations were made for the coming SEEIT workshop at DTU in March 2012. He referred to the transition of energy systems in society and the risk of making bad infrastructural investment decisions with vast technical and economic consequences – such as overinvesting in expensive off-shore wind parks without considering the gains in energy efficiency over the course of future system transitions. However, this remark regarding chaos in transition came to be more relevant than anticipated by the professor, only not chaos in future energy transition, but in the mobilization and 'baroque' mixturing of perspectives that the subsequent workshop was about to stimulate.

For the first time since the formation of SEEIT, there was a sense of having 'discovered' a promising in-between for the partnership to problematize and target in a joint research effort. This was stimulated by the recovery of system transition complexity as an irreducible and open-ended process that challenged all actors involved, including the SEEIT partners, to 'start dancing' in new cooperative constellations. The Copenhagen workshop was to be held at the Technical University of Denmark, but was co-organized with CBS. This came to be an important decision because it implied a small in(ter)vention from the side of the CBS team of making as mess out of the boundaries which are normally used to design workshop agendas – thus rather than categorizing and subsequently allocating presentations in a proper order reflecting disciplinary domains, the workshop was deliberately designed to mix up such domains – often without any specific guiding idea, in some cases with a tentative thematic link. In any case, the workshop design was a deliberate attempt to avoid separating technical from social science domains of expertise and thus challenge pre-established cartographic categories as a means to arrive at new mixtures of cross-cutting thinking. This is illustrated in the following excerpt from the workshop programme:

Friday 16 March 2012 – Presentations

Session 3: Integration of technical, economic and organizational aspects

The interface between technical science and social science perspectives provides substantial growth potential. Social sciences provide understanding of government, organizational regulation and entrepreneurship, which is essential for the success of systemic innovation of complex sustainable energy systems.

- *Governing distributed processes of systemic innovation – the quest for bridging actors to advance systemic innovation.*
- *Co-evolution of technologies, markets and institutions*
- *Integration of systemic innovation through economic means*

Keynote presentations

"From optimisation models to the business case: finding the missing link in the heating sector"	Thomas Hamacher, TUM
"How do we understand dynamic energy systems with technical, economic and organizational aspects?"	Lars Heide, CBS

Short talks

"Corporate strategies for nano-enabled energy efficient windows"	Maj Munch Andersen, DTU
"Co-Creation Dynamics in Collaborative Networks. The Role of the R&D and Manufacturing Interface in Cross Boundary Innovation. Case Study: Cleantech Industry"	Pedro Parraguez Ruiz, DTU
"Why do markets not pre-exist when we live in a market economy?"	Peter Karnøe, IOA, CBS

[Excerpt from workshop agenda – making a mess by design]

In the preparation of the workshop the CBS inputs were guided by an idea of mixturing otherwise separated domains, and to construct problems that would force upon the workshop discussions an integrative orientation. This is also reflected in appendix 2 which was written to the SEEIT Steering Group meeting in Copenhagen, as introduced in the method chapter. This small document illustrates how the language at the time was beginning to gravitate towards emphasizing 'systemic innovation' and 'catalyzation of cross-disciplinary collaboration' as a contrast to previous ways of framing SEEIT using the SET plan thematic structure as the 'higher order' coordination reference. Also, the language begins to point towards the at the time still very early signals arriving from the EU Commission regarding the next EU framework for research and innovation, the so-called Horizon 2020 which was anticipated to prioritize strategic partnerships and cross-disciplinary cooperation much more than the

FP7 framework. For example, as captured in the written summary from the SG meeting in Copenhagen:

SEEIT

- a European Strategic Partnership

Agenda item 5. SEEIT and Horizon 2020

The discussion identified a need to reinvent SEEIT but also the benefits of staying together as a partnership:

- The partnership offers added visibility on European scene and provides important political visibility.
- Education and training are important elements in achieving the SET-Plan goals and we can use SEEIT to gain political influence.
- SEEIT holds unique capability as a catalyzer for a holistic approach to identifying more interdisciplinary research projets and to solving Europe's energy related challenges.
- The SEEIT partnership will collaborate to obtain funding for joint projects and to achieve synergy in nationally funded projects.

[Excerpt from summary of SG meeting, SEEIT 2012]

The optimism that shines through these formulations was fueled by the Munich and Copenhagen workshops which at the time of the referred SG meeting had just been finalized. The Copenhagen workshop had successfully mobilized 47 participants from a broad range of disciplines and comprised 18 presentation ranging from sweeping key notes such as "Denmark's Energy Future" to specific technological project presentations such as "Heat load forecasting for single-family house" to include also social science based presentations such as "How do we understand dynamic energy systems with technical, economic and organizational aspects" and "Why do markets not pre-exists when we live in a market economy?".

7.1.3. A cartographic transition

The mixturing and multiplication of the diverse range of presentations mark a transition from a cartography of domain towards a cartography for a *symmetric* *perspectivism*. This is what the recovery of system transition complexity in Munich opened up for in its affirmation of the need for ‘dancing’ and for new practices of knowledge production. The transition from a cartography of disciplinary and technological domains to a ‘baroque’ cartography of symmetric perspectives is a remarkable event because it transforms the capacity of SEEIT to catalyze new mixtures of expertise that had hitherto been notoriously difficult for the partnership to accomplish.

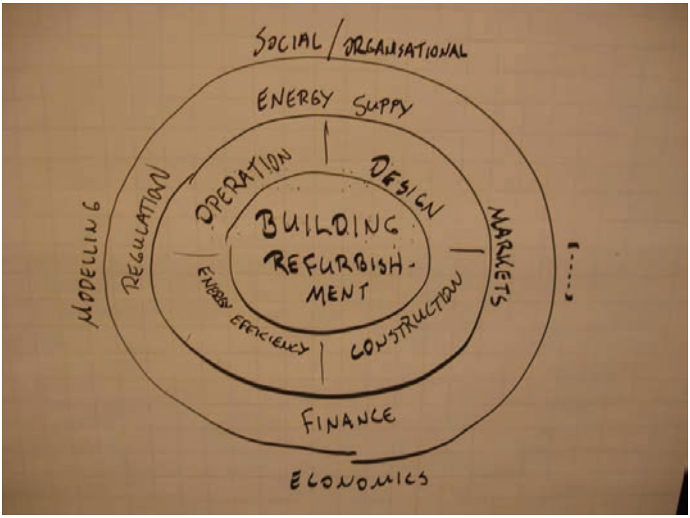
Obviously there were still traces of conventional ways of distinguishing between levels of analysis and the implied professional and disciplinary hierarchies of who can legitimately speak to the general overview and who should speak to more partial issues (e.g. “Denmark’s Energy Future” versus “Heat load forecasting for single-family house”, the former offered by a leading system analyst, the former offered by a phd-student).

Regardless of these orderings, the workshop as such performed a cartography for a symmetric perspectivism more than it performed a cartography of domains. The difference between these is clear if we for instance compare the Munich and the Copenhagen workshop designs (as they have appeared above). Where the Munich workshop sustains clear lines of demarcation between domains, with only cautious mixtures such as “techno-economical modeling”, the Copenhagen workshop makes a true mess of things and domains of expertise – not to ridicule this, but to turn the cartography of domains and their prefigured boundaries into a mix of symmetric perspectives where expertise in system analysis and modeling is put together with expertise in the historical and social construction of technological systems, along with expertise in cooperative innovation in the energy sector, and so on and so forth. Thus, we find here a cartographic transition from a habitual pattern of organizing knowledge according to proper standards and well-established disciplinary boundaries to an unfamiliar composition which helps perform knowledge and – more importantly – potentiality for interaction completely different.

Compared to the formation phase analyzed in example 1, where we saw how a cartographic crisis stirred a multiplication of ways of problematizing energy innovation challenges for the KIC to respond to, the Munich-Copenhagen process offers a different example of how a cartographic crisis can become socially productive. Thus, in example 1, we saw a diagnostical rivalry unfold which gave rise to a divergence that was rendered productive through a construction of a barrier typology that allowed for the different domains to sustain their proper ways of staging and approached problems to be solved. A territorial compromise between domain-centered interests, we might say. In contrast to this, we find in the Munich-Copenhagen process not a diagnostical rivalry (even though this was present in the Munich workshop) but rather a *multiplication of problematizations* without entering into a zero-sum game of problem apprehension. We might say that the cartographic crisis in the form of a recovered system transition complexity was responded to through an affirmation of the crisis (we cannot make *the* map so we might as well multiply our capacity of seeing), and a multiplication of problematizations, or perspectives without reference to any form of higher order or any other form of externally given coordination system. The coordinates for joint movement were produced along the way and in multiple directions simultaneously.

This is also a form of cartographic divergence, but a kind of divergence which becomes an affirmation of a cartographic crisis rather than a regression into an even more strong cartography of domain, which was a tendency at work in the formation phase of SEEIT, even though it was skillfully balanced out through different coordination maneuvers.

7.1.4. The “SBDSTFSHIRBE flagship project”



[Reconstruction of diagram made by the SEEIT coordinator at the DTU workshop, March 2012]

What happened with the chaos released at the Copenhagen workshop? The coordinator was working hard to arrive at some form of conclusion which could translate the multiple problematizations and perspectives into a shared frame:

*SBDSTFSHIRBE Flagship Project

- "Science Based Decision Support Tools For StakeHolders for Refurbishment in the Built Environment"

It was now late and everyone were exhausted by the rich and ever-increasing complexity that the workshop had opened up for. When the coordinator took the stage to propose a condensation of the outcome of the workshop and wrote this strange acronym, a laughter spread among some of the participants – a laughter that seemed to balance between skepticism and hope?

The impossible acronym provides a good expression of the underlying process and the outcome of the workshop. The SBDSTFSHIRBE is on the one hand an awkward enunciation of something we are unfamiliar with, that we have not yet learned to speak to using a conventional language. We are forced to construct expressions, however weird or impossible they may sound or look, which escape the normal way of communicating. This is a symptom of a cartographic transition at work where habitual ways of setting problems and stage solution approaches become inadequate and where new staging of problems are being constructed in a struggling and uneasy way. On the other hand, SBDSTFSHIRBE is also an act of differentiation of the potentiality generated in the workshop. It is as if this acronym and the joint project aspiration it seeks to express was constructed right at the high-point of potentialization with all the many perspectives added, one by one, to the still more rich, incoherent and open-ended material. The cartographic transition allowed for system transition complexity to flood the workshop with a multiplicity of perspectives and problematization that loaded the present with potential energy to be released somehow in a future joint project. The SBDSTFSHIRBE was an attempt to differentiate this dense potentiality and its chaotic tendencies (give the monster a name…) without collapsing the potentiality into known categories and problem-settings. The potentiality had to survive the differentiation.

Obviously, the project title which the acronym referred to ("Science Based Decision Support Tools For StakeHolders for Refurbishment in the Built Environment") sounds more familiar – something to hook on to in the midst of cartographic pluralism and open-endedness. But it is acronym itself that gives us a taste of how cartographic transitions opens up for new symmetries and combinations of perspectives (system analysis *and* social construction of markets *and* single-family houses' energy systems *and* ...) which hitherto were dissociated in a cartography of domain but which now becomes associated, at least tentatively, in a cartography for symmetric perspectivism. This does not form a new, coherent ordering of knowledge production. As SBDSTFSHIRBE illustrates, it remains on the verge of the unfamiliar, non-sense, chaos, pure potentiality. But only on the verge hereof because the new-born "SBDSTFSHIRBE flagship project", as it was also called, provided a common plane for the multiple perspectives and problematizations to relate to. This common plane – the new map – was still a living multiplicity that pointed in many directions simultaneously but added a minimum of structure to the otherwise incomprehensible potentiality that was accumulated over the course of the Munich and Copenhagen workshops.

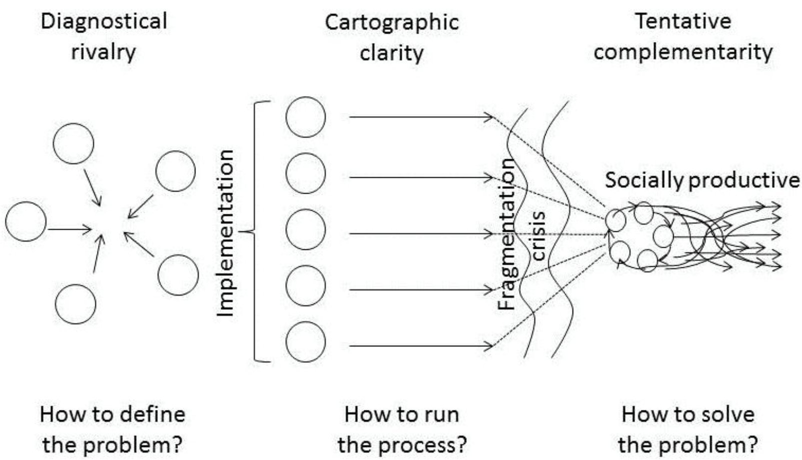
7.1.5. Sum up – example 3

The Munich-Copenhagen workshop series marks a cartographic transition in the SEEIT partnership process. A critical moment of this transition was the recovery of system transition complexity during the Munich workshop, which broke any sense of a rigid system transition ontology (e.g. a technical or regulatory fix) in favor of 'dancing' as an emblematic expression of what needed to be done. The subsequent process of the Copenhagen workshop became an affirmation of the cartographic crisis inherent to system transition complexity – an affirmation that took shape as a multiplication of perspectives assembled in a flat composition that allowed for associating very heterogeneous fields of expertise and ways of problematizing energy transitions thus actively breaking with the cartography of domain which had hitherto continued to dominate the SEEIT cooperation efforts.

The example thus shows how a cartographic crisis becomes socially productive and how coordination efforts might act upon a cartographic crisis affirmatively rather than adding a 'super structure' or a cartography of domains as a means to 'handle' transition complexity and the cartographic complications and frustrations this opens up for. In a certain sense, the Munich-Copenhagen process entailed a *multiplication* of the cartographic crisis by means of a transition from domain-centered approaches to a multiplication of transition perspectives put onto the same cartographic plane without reference to a higher order of organization. Reaching such a common plane, even if it is only tentatively, as in the SEEIT example, opens up for an interaction potentiality that allows for unlikely connections and associations to be explored beyond the domain-centered logic of organization. The *relational order changes* and generates a new range of openings and cross-cutting lines of demarctions driven by a problem-solving interest.

The cartographic transition from domain to symmetric perspectivism constitutes an example of a process of *cartographizing* which I suggest to consider as a core aspect of systemic innovation in the making. It is a process where systems of presuppositions and their habitual ways of posing problems and construct solutions enter a process of transition that opens up for new kinds of problematizations, unfamiliar combinations, and yet undifferentiated problems to be solved. It is, in this sense, a transition from a cartographic order of past accomplishments towards a cartographic order of progressive differentiation of a problem to be solved. Thus, SEEIT turned into a problem-solving engine for systemic innovation. In the following, I will investigate the concept of cartographizing and relate it to a reconfiguration of the "SEEIT Engine" that was proposed already in the formation phase.

7.2. SEEIT – an engine for systemic innovation?



Assembled in a process diagram, the three examples form a basis for understanding the relational dynamics involved in the making of the SEEIT partnership and its capacity to become a socially productive process of constructing and responding to relational problems jointly. In example one, we saw a process shaped by diagnostical rivalries and boundary negotiations stimulated by the KIC and its cartographic distortion. The political nature of the KIC process made the response of diagnostical rivalry inevitable and limited the capacity of the partnership to engage more creatively in mixturing the different fields of expertise and actors involved in the formation process. Nonetheless, the cartographic divergence present in the partnership were charging up the process of partnering and illustrates the potential social productivity of cartographic crisis. The social productivity during the formation phase was not merely ‘spontaneously emerging’ from a soup of cartographic divergence. The coordination capacity was a key aspect hereof as it helped provide a form of arrangement for the divergence to unfold – not by silencing it through e.g. a top-down decisionism, nor by leaving it to its own devices.

The coordination responded to the diagnostical rivalries and the variety of strategic framings of the cooperation by becoming a “blank domino”, as Michel Serres calls it (Serres 2007) with no prescribed value, but with an eminent connective capacity – not only in the sense of being able to connect to any other value, but more importantly to become *the connective body* for divergent and separate series to form an association. Thus, coordination became complexity sensitive by avoiding to form its own specific cartography for the KIC that would have become yet another competing problem-response alongside the other ones at work in the formation phase. Rather, coordination placed itself in-between these but exactly so that it would pull them together, for example by composing a KIC proposal on the basis of a barrier typology which incorporated the diverging cartographies for the KIC.

In this way we see how the process of partnering and the process of becoming socially productive is tied in to what Bateson would have called system wisdom and flexibility where divergent forces are balanced and sustained as divergent at the same time. This allows for a multiplicity of interests and investments to take shape as well as the formation of novel interaction potentials that would otherwise be squeezed in run-away competition patterns of zero-sum games of influence (e.g. between the SET plan cartography and a DNA model of innovation process systematization). The capacity of coordination is therefore not the power of “the General” or the great Cartographer who once and for all draws *the* map for others to follow and adhere to. Rather, the power of coordination is that of the eminently flexible tactician moving *in-between* strategic agendas (which the tactician must know intimately) in order to formulate the problem that no single strategic cartography can legitimately claim as its exclusive domain (de Certeau 1992, Chia and Holt 2009, Hjorth 2012b) – the irreducible problem to which only a divergent association of interests and expertise can speak to. This is how, in the example of the formation of SEEIT, coordination became responsive to a complexity of alliance formation in the midst of system transition and cartographic divergence. It indicates an important relation between system transition complexity and the nature of the coordination capacity needed to become responsive to the multiplicity of relational problems this complexity produces. I shall return to this question in the chapter on implications following the analysis.

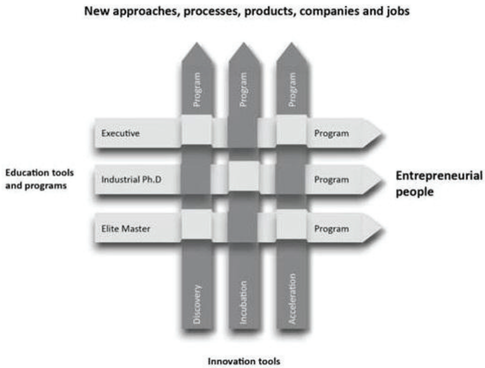
In example two, we saw how the decreasing cartographic intensity of the "post-KIC" process paved the way for fragmentation problems culminating in Rome 2011. Here we saw an implosion into known states of affairs and the fragmentation frustration this generates. In Rome, the fragmentation crisis became almost unbearable because it generated no potentiality for the partnership to work towards. The generative divergence characterizing the formation process was not sustained in the post-KIC process and thus the engine of the partnering process was no longer in place.

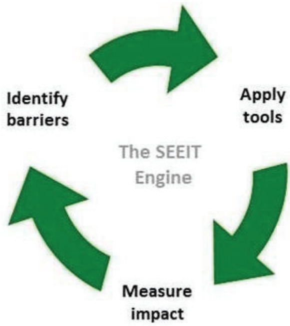
In example three, the cartographic intensity was recharged and evolved to become the most productive process since the formation in 2009. The Munich problematizations opened up a crack in-between fields of expertise constructing a relational problem to respond to in the subsequent workshop in Copenhagen. This workshop was co-constructed so as to mixture "the silos of specialization". This ignited a baroque overflow of mixtures of perspectives which generated a potentiality for interaction that was tentatively grasped by the construction of the "SBDSTFSHIRBE Flagship project". The organizing power of this process and the 'flagship project' it arrived to was build up, similarly to what we saw in example 1, through an affirmative incorporation of divergent problem-diagnostics across fields of expertise. We saw a tentative complementarity being constructed in the 'flagship project' while the divergent elements it strived to incorporate remained divergent – it became a *flat composition* of heterogeneous and divergent problem-diagnostics, methodologies and expertise conventions.

The three examples show in different ways the importance of cartographic intensifications in the shaping of the partnership and its capacity to associate divergent fields of expertise and problem-response conventions. Thus, the analysis suggests that irreducible divergence, diagnostical rivalry, fragmentation problems and transcontextual complexity of system transitions all feed into a generative process of partnering. The wide range of open-ended relational problems inherent to system transition processes produce an overflow of complexity which the partnership strives to incorporate in different ways. This is in line with the batesonian and deleuzian understanding of how divergent forces and the open-ended potential for new associations and interactions they open up for are inherent to organization and coordination. Thus, when striking a productive response to complexity, coordination efforts do so by affirming divergence rather than putting them to rest in a well-ordered cartography for joint movement. This suggests an interesting dynamic between complexity and coordination which I would like to pursue a bit further in the following section.

7.2.1. The "SEEIT engine" revisited

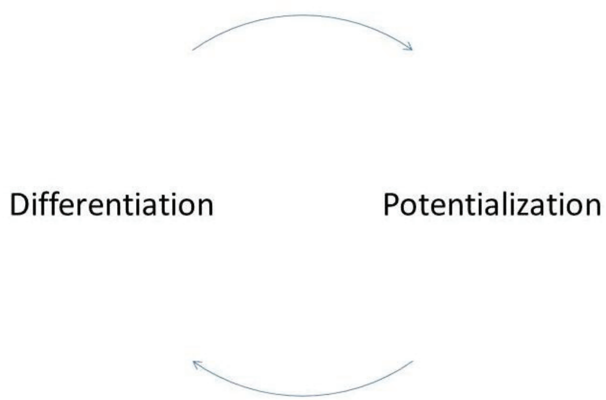
As introduced in example 1, the coordinator of SEEIT constructed two diagrams ("braiding of tools" and "the SEEIT engine") in an attempt to capture the integrative and dynamic principle of the partnership – what made it a responsive and dynamic cooperation framework.





The SEEIT engine works by keeping the problem-response processes going, it keeps the partnership on the move. While the diagrams communicates an apparently simple means-ends logic, they do open up for a temporality figure which is interesting to elaborate on while integrating the findings from the three analysis examples. Thus, the cartographic approach to studying the partnership process opens up, I will argue, for a strengthening or radicalization of the idea of a "SEEIT engine" anticipated in the diagrams above. In order to arrive at a synthesis of the analysis performed so far, and the cartographic analytical strategy, I will in the following propose a reconfiguration of the SEEIT engine diagram in order to develop a more condensed argument for why and how we might consider the cartographic intensifications we find in the SEEIT process as an example of a *process engine for systemic innovation.* The diagrammatization of this process engine is intended to capture the process of cartographizing which is proposed as exactly the dynamic and integrative principle which makes SEEIT work (or disintegrate), as we have seen in the three examples.

The diagram is an attempt to capture the dynamics involved in processes of *cartographizing,* i.e. processes of systemic innovation whereby a new potentiality for interaction is being actualized (*differentiated*) following the line of reasoning developed in the analytical strategy in chapter 5:



[The *SEEIT engine* reconfigured]

To begin with *potentialization* (there is no necessary order of succession between the two), the idea is to express how the process of cartographizing involves some version of a cartographic crisis where conventional, taken-for-granted ways of posing and approaching problems no longer perform effectively in the organization of knowledge production. For example, when the force of a transcontextual complexity of open-ended system transitions puts pressure on established orders in the organization and politics of energy research. The cartographic crises emerging from this become manifest in e.g. problem-diagnostical rivalries as we saw in example 1 and 3. Such rivalries are symptoms of a cartographic crisis in the sense that “the problem to be solved” can no longer be treated legitimally as self-evident. The denotative power of e.g. technological problem-response conventions is no longer necessarily as powerful as it might have been perceived to be. Similarly, the construction, negotiation and translation of system transition scenarios into agenda-points, priorities and problem-constructs no longer proceed merely according to taken-for-granted conventions in the field. The relational problems to respond to are “out of joint” with the effect of a multiplication of potentials for novel associations and combinations of otherwise separated fields of expertise, actors from within and beyond the energy sector, and so forth.

Potentialization thus relates closely to the growth of fragmentation problems inherent to system transition processes because it is in the midst of the crisis of fragmentation potentialization prospers. System transition fragmentation implies a multiplication of relational problems confronting research and innovation, and the scene for staging the future as pregnant with this or that ‘next solution’ opens up for novel actor constellations. As one professor from DTU formulated it in the planning of the Copenhagen workshop in 2012, “it is in the transition chaos emerges…” In context of such chaotic forces, potentialization becomes an important aspect of actualizing new interactions, new alliances and mixtures between heterogeneous actors.

What is important to hold on to here is exactly that potentialization opens up for *a virtuality* which remains open-ended and therefore irreducible to habitual problem-response conventions. This is crucial for the process engine diagram to capture the irreducible complexity of system transitions and the transformative effects these carry with them with regard to the organization of knowledge creation in the field. Accordingly, when we understand potentiality as a virtuality we arrive at an understanding of potentialization which does not pre-determine the outcome of actualization (differentiation). This is consistent with the distinction between the virtual-actual and the possible-real introduced in chapter 5. What is possible remains governed by what is real. Novelty is conceivable only if it does not challenge what we already know and how we know this to be true. In contrast to this, a virtuality is a yet undifferentiated problem the actualization of which brings novel interactions and organizational responses into the actual, beyond what is conceivable as 'possible'. *Potentialization,* therefore, is a constitutive aspect of cartographizing where problem-response conventions exactly are 'out of joint' and in-transition, and where we do not yet know how future energy solutions and their topology will stabilize.

Potentializations have many sources – they are composed by *"aggregates of intensities"* (Deleuze and Guattari 2002: 15), like a batesonian plateau, and cannot be 'put to use' in a strategic and instrumental way. Potentializations grow from the midst of fragmentation and cartographic crisis, but as the analysis of SEEIT also suggests, it is possible for coordination efforts to affirm potentiality rather than confining cooperation efforts to a closed set of possibilities. As I shall also elaborate in the implication chapter, we might indeed consider the ongoing build-up of strategic alliances and partnerships like SEEIT in the field of energy research and innovation to be a symptom of an evolution of organizational responses with a capacity to affirm, incorporate and feed on a potentiality of system transitions (see also Andersen 2008 for a similar point building on a study of Danish cases of public-private partnerships).

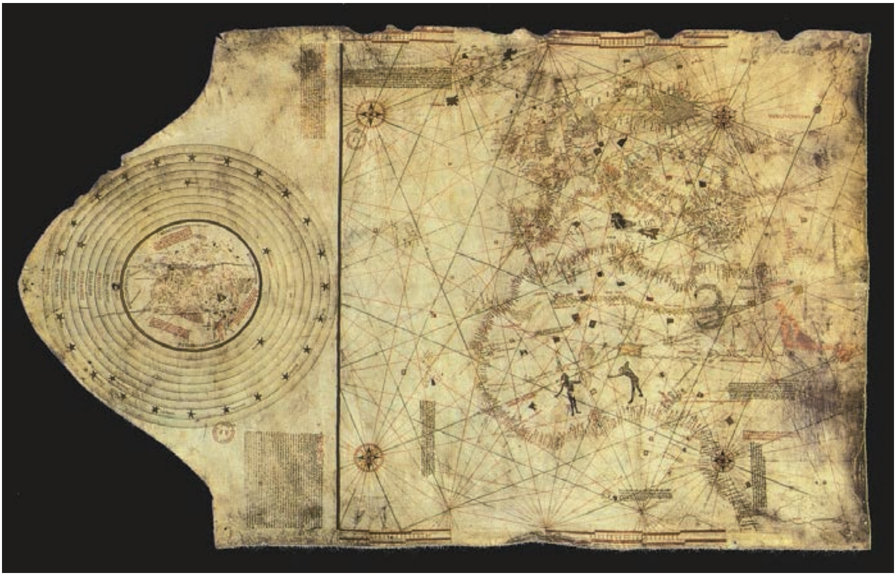
As the analysis of SEEIT illustrates, potentiality affirmations are only one side of the process of cartographizing. The other side is that of *differentiation.* Differentiation is the process that generates divisions, charged fields of oppositions, and incorporations of a transcontextual complexity of diverging system transition trajectories. The analysis of SEEIT suggests several instances of differentiation – some more profound and transformative than others. Thus, the Munich-Copenhagen process is an example of a process whereby a potentiality (the outcome of the Rome-Munich fragmentation) was progressively differentiated over the course of designing and unfolding the Copenhagen workshop. The notion of *flat compositions* used to describe the associations made across heterogeneous fields of expertise, methodologies and problem-response conventions is a good expression of how differentiation works.

The formulation of the 'SBDSTFSHIRBE flagship project' thus illustrates an instance of differentiation. The formulation of the flagship project was a structuring moment on a high-point of cartographic intensity where the Copenhagen workshop was loaded with potentiality, on the verge of being chaotic. The flagship project may thus be seen as an attempt to add a minimum of structure and lines of demarcation for a future pursuit of cooperation. Thus, the construct of the flagship project was a differentiating moment of cartographizing because it introduced a set of distinctions and a tentative, relational order that afforded the various themes and perspectives involved a place 'on the map' without collapsing the heterogeneity of these elements in one unifying principle.

Consequently, while the 'flagship project' construction introduces a common frame and lines of division and boundary setting, the construction did exactly not implode into habitual problem-response conventions – at least not at this stage. It remained in-between an open potentiality and a conventional cooperation project framing.

Therefore, the ‘flagship project’ remained monstrous in how it assembled a diverse range of fields of expertise, methodologies and so forth. It was a mess and it was chaotic, but it was also condensed in a way that added a minimum of direction and a tentative relational order. No surprise, then, that the participants at the DTU workshop laughed for a moment (a laughter somewhere in-between skepticism and hope) when the coordinator offered his way of condensing the chaos that had been released during the workshop. The ‘flagship’ was indeed providing a sense of direction, but at the same time it sustained a connection with an “unknown world”, a virtuality beyond the immediate grasp of the workshop and its participants.

In this sense the metaphor of ‘flagship project’ was well chosen: As a ‘flagship’ it provides a sense of direction and mutuality while at the same time pointing into a radical unknown transition process the pursuit of which entails profound risks and potentials for those embarking on the journey. It is not entirely different from the process of “discovering a new world” such as those worlds that was simultaneously invented and discovered by renaissance cartographers. Here too, the invention of a new cartography which exactly does not ‘represent’ the new world but rather installs by means of its lines of demarcation and mystical potentials of wealth and danger an intensification with the power of assembling vast resources for the actualization of highly “impossible” journeys. To associate contemporary efforts to transform energy systems with renaissance world discoveries is obviously a bold proposition, but the similarity resides in the cartographizing process engines such endeavors necessitate which can over the course of many years to come persistently sustain a transition momentum without yet knowing where transition processes will take us.



[Cartographizing as the simultaneous potentialization and differentiation of a reality yet to come. Christopher Columbus' first map, approx. 1490 – Source: Wikipedia Commons]

It is in this sense, we can diagrammatize the process of cartographizing as an engine for systemic innovation in the making. This engine – when its dynamics are catalyzed – simultaneously potentializes and differentiates as it produces intensifying lines of demarcation and 'force fields'. This is a machinic feature of organizing systemic innovation which we find instances of in the coordination of SEEIT, but which is irreducible to individual participants' properties and competencies. The cartographizing process engine is a relational effect and relational multiplier rather than an isolated map making 'competence'. However, leadership or entrepreneurship, or what we might call this, may or may not make itself available for these process dynamics to unfold. I shall come back to the implications for managing and organizing partnerships in the next chapter.

As in Columbus' first map, the process of cartographizing potentializes and progressively differentiates a real yet to come, staging a yet undifferentiated problem as a tangent to 'our world', within our grasp and yet irreducible to the safe zone of the square of the 'old world'. Processes of systemic innovation feed on such cartographic operations which seek to establish a 'cutting edge' on the verge of the virtual through a progressive potentialization-differentiation process. This might be how we can reconfigure a SEEIT engine so as to sharpen the expression of how processes of cartographizing play a key role in 'engineering' processes of systemic innovation without falling back into conventional ways of staging problems and pursuing solutions, and without disintegrating completely into a chaotic outside with no lines of demarcation or division to hold on to as a new potentiality for interaction is being composed.

7.3. Conclusion of analysis

A central aspiration constituting the initiation and continuation of the SEEIT partnership was to create an enhanced connective capacity integrating energy research, education and innovation. The partnership wanted to become a response to a need for enhanced strategic alignment of energy innovation across Europe, while confronting system transition challenges beyond the known boundaries of energy technology research. The kind of alignment the partnership aspired to accomplish was therefore not merely about steering in a crude sense, but also about creating alignment where coordinates are not yet in place – that is, to somehow catalyze a new potentiality for interaction, and a new relational order of cooperation and coordination.

The three examples from the partnership process show how the capacity of the partnership to enact this purpose varies along with the cartographic intensifications (and the lack hereof) characterizing the journey made by the partnership since 2009. The analysis suggest an intimate relation between cartographic intensifications and the connective capacity and productivity of the partnership process.

The case of SEEIT is a good example of how systemic problem-response conventions encounter a new open complexity of system transformation which produces multiple “earthquakes” and cracks in the otherwise well-ordered landscape of energy technology research. This cartographic crisis arrives from open-ended system transitions, but also, in the case of SEEIT, from innovation policy making in the form of the EIT’s call for Knowledge and Innovation Communities, and the clash this generated between the SET plan cartography and a de-centered innovation agenda. The cartographic crisis is crucial because it opens up a variety of ‘cracks’ in a field with multiple well-established domains of expertise. These cracks become openings towards a potentiality for interaction and systemic innovation when the divergent problem-diagnostics and solution perspectives they stir are being incorporated and affirmed rather than silenced. The social productivity of the cartographic crisis resides in the capacity to multiply and affirm the crisis rather than ‘fixing’ it through an orderly cartography of domains. To organize for systemic innovation thus implies an incorporation and affirmation of system transition complexity.

The analysis suggests that partnerships like SEEIT has a capacity to incorporate the complexity of system transitions and the cartographic divergence they open up for. This capacity becomes increasingly important to understand and develop in practice due to the rising pressure on the overall energy research community to become responsive to the call for new modes of knowledge production and interaction-driven innovation as a means to contribute progressively to wider system transition efforts. It is a capacity which is connected to a batesonian system wisdom and flexibility because it involves an activation and incorporation of divergent system transition cartographies. This kind of coordination capacity is therefore not a centralized decision-making rationale of strategic coordination, but a form of coordination that opens up for and feeds on divergence and multiplicity which it progressively seeks to potentialize and differentiate during the course of rendering new interaction potential productive.

Thus, coordination may respond productively to transition complexity by 'inviting it in' through e.g. the construction of strategic partnerships incorporating divergent transition cartographies. However, the affirmation of the cartograpic crisis this entails, is not merely an open-ended affirmation of potentiality. It is also a differentation hereof which avoids falling back on established domain-centered ways of organizing research. For example, but inventing the 'flagship projet' a line of demarcation was constructed which potentialized a certain interaction possibility transgressing familiar ways of defining fields of expertise and their relational order. Potentialization and differentiation are inseparable in this process. The cartographic operation of the 'flagship project' is simultaneously a potentialization and differentation – an opening and a collectivizing operation which associates diverse domains of expertise without collapsing their generative differences into an overarching cooperation model.

In the case of SEEIT we saw how the social productivity of the partnership was associated with varying kinds of cartographic intensifications. We even saw how the partnership, after a process of increasing fragmentation, regained a momentum and went through what I suggest to consider to be a cartographic transition from a cartography of domains (and the resulting problem of connecting these) towards a cartography for symmetric perspectivism. This was a shift in the SEEIT cartographizing engine that activated a new potentiality for interaction beyond domain-centered cartographies. In this shift, a variety of connections and intersections flourished until the point of chaos. The shift indicates the organizing power of cartographizing where the very capacity for making maps is undergoing change. The cartographic transition is an example of systemic innovation in that it opens up for a new interaction potentiality that allows otherwise disconnected domains of knowledge to become associated in a variety of ways in an incoherent, flat composition where system transition perspectives unfold without a clear point of climax, and without a clear set of coordinates given in beforehand. They form their own plateau of intensity – an instance of systemic innovation in the making.

8. Implications

The purpose of this chapter is to follow up on the problematization developed in chapter 1 and 2 and point to how the cartographic approach and the analysis performed may translate into contributions of academic and practical value. Before elaborating this, I will summarize one of the main points developed during the dissertation.

At the outset of the dissertation, I formulated an ambition of developing an approach to studying systemic innovation in the making and I framed this with reference to ongoing European processes of (re)organizing energy research so as to become responsive to a new, open complexity of energy systems in transition. In particular, I pointed at the growing focus on strategic partnerships and alliances as interesting empirical symptoms of a research field in transition searching for ways of coordinating strategically across actors and develop new approaches to cooperation cutting across a variety of domains such as institutional boundaries, disciplinary boundaries, sectorial boundaries and so forth. On this background I formulated a general problem of coordination which goes beyond a steering function across known domains to involve a problem of transgressing established domains in order to arrive at new cooperation practices, new actor-alliances, actualizing a new potentiality for interaction.

I then characterized these efforts as processes of systemic innovation whereby new approaches to cooperation and coordination are taking shape, and pointed to how such processes pose a challenge for innovation research to inquire. Thus, systemic innovation in response to system transition complexity is a challenge not only for those directly involved in e.g. energy research but also the field of innovation studies. The reading of innovation systems literature gave rise to a critique regarding the construction of overarching concepts such as innovation systems from which agency and interaction assumptions are being derived and superimposed from a distance. As an alternative to this I pointed to the need for an approach to studying systemic innovation *in the making* where "interaction patterns" are yet to be determined and where effective responses to innovation and system transition challenges have not yet materialized. Along with a reading of organization process studies, which I shall return to below, this was the point of departure for suggesting a cartographic approach comprising a methodological and analytical strategy.

In the following, I will specify how the cartographic approach and the analysis performed may translate into academic and practice oriented contributions. I will begin with elaborating the cross-disciplinary nature of the academic contribution and then on the basis hereof elaborate how the dissertation contributes to innovation systems research, organization process studies and not the least to a practice context of organizing and coordinating processes of systemic innovation in the energy research area. I will close the chapter by pointing at some of the openings for further research I find to be interesting to pursue in the future.

8.1. Against disciplinary tendencies in innovation studies

In a recent article on *The evolution of science policy and innovation studies* (Martin 2012), one of the more influential scholars in innovation studies offers a reading of the broad field of policy oriented innovation research, including innovation systems, in an attempt to diagnose the status of the field and where it is headed. Martin observes how innovation studies tend to remain detached from other academic fields such as political science, sociology, science and technology studies, and psychology, and we could add philosophy, cultural theory, organization studies, and critical social theory to this non-exhaustive listing of ‘adjacent fields’. At the same time he points at how the field of innovation studies begins to display disciplinary features (dedicated doctoral schools, publication infrastructure, professionalization tendencies etc.) which he considers to be a positive development.

The nature of the contributions to be proposed here goes in a different direction. Rather than supporting a disciplinary tendency, the importance of cross-disciplinary research is sustained which Martin (2012) also points to as a key ingredient in the evolution of the field in e.g. the 1970’s and 1980’s. We could say that rather than beginning to form a disciplinary orientation on the basis of 40-50 years of innovation studies evolution, a new cross-disciplinary tension is needed in order to advance innovation studies and broaden the available repertoire of theoretical and methodological tools. This would, however, entail an inclusion of theories and methods which stands in fundamental ontological and epistemological contrast with the field of innovation studies as we know it today. For example, the connection with post-structuralist thinking and the development of concepts such as cartographizing and in(ter)ventive research practices suggest a step away from essentialist views on agency and innovation processes and distance-criteria for gaining objective knowledge. The study of innovation as inherently systemic, emergent and relationally constituted would thus be pursued on the basis of completely different assumptions about the nature of innovation processes and how to study such processes.

This is therefore the first overall aspect of the contribution to the field of innovation studies: A proposition to go against a disciplinary tendency and connect with post-structuralist thinking and organization process research in order to import, develop and experiment with new process theories, methods, and roles for innovation research. However foreign this might seem for a field that is not strong in cross-disciplinary research (according to Martin 2012), the methodological and theoretical openings such a move entails have a clear relevance for a renewed engagement with foundational questions within the field. For example, the question regarding the processual and dynamic constitution of interaction as a key element in innovation processes (Lundvall 2007, Kuhlmann, Shapira and Smits 2010). Or, the challenges for organizing innovation in the midst of open-ended system transitions (Geels and Schot 2007) where system transitions and transitions in actor formations go hand in hand. The question addressed are therefore not foreign to the field, but the approach to engage with these question is of course different as it builds upon a combination of post-structuralist theory, organization process theory, and performative research practices which are indeed foreign to the field of innovation studies.

A critical conditioning of these connections across fields is the shift in conception of innovation as inherently systemic from a romantic holism to a baroque complexity with no option of a higher order entity that guarantees a possibility of order and transcendent structure. The shift produces a different problematization of systemic innovation which opens up for a broader range of theories, method approaches and innovation research practices. On the following pages, I will elaborate how the cartographic approach contributes to studying systemic innovation processes – both as an analytical strategy and as an in(ter)ventive research practice.

8.2 Breaking with romantic holism

What are the implications of breaking with romantic holism as a dominant conception of "the systemic nature of innovation"? The consequences are rather profound because romantic holism secures a ground for the study of innovation systems as an emergent higher order which informs the basic assumptions about agency in relation to innovation. Romantic holism also stages innovation systems as a particular ideal object of study which positions innovation systems research in a privileged and modernistic cartographic position outside the innovation systems which, according to the romantic holism, are emergent higher orders which are positively given complex objects of study. This is convenient for innovation research as well as the users of innovation system concepts in practice because it stabilizes (black boxes) numerous aspects of innovation in a way that allows research to draw its maps of innovation systems and patterns of interaction as if they were given independently of our staging of them as objects for research, or objects of managerial planning and intervention.

To turn away from such a conception is therefore the same as turning away from the foundational assumptions informing innovation systems research' theories and methods as well as the possibility of contributing to e.g. policy making with "coherent and comprehensive" advices for how to setup and implement innovation policies. As a contrast to this, a baroque conception of the systemic nature of innovation takes us in a completely different direction with regard to analytical strategies, theories and methods. A baroque conception of innovation implies that there is no hope for a higher order which can inform us about the best way to organize innovation in society or at the level of institutions, firms, etc. In a baroque conception, the systemic nature of innovation means that there are multiple and divergent forces giving shape to innovation processes simultaneously. Agency is relationally constituted, but not in a parts-to-whole framework, but rather through a multiplicity of relations which does not form a coherent whole but remains fractional and transitional. Thus, to assign at the level of general assumptions certain actors with a functional agency becomes impossible in a study of systemic innovation.

Thus, breaking with romantic holism is a way of challenging dominant assumptions in innovation studies and open up for new methodological and theoretical resources. In the reading of innovation literature I emphasized two overall challenges which become pertinent when making a break with romantic holism:

1) A analytical challenge of studying systemic innovation as *interaction in the making* where agency is seen as a relational effect involving multiple, divergent and open-ended interaction dynamics. Agency can no longer be derived from a higher order system construct, but need to be inquired empirically and without any reference to an ideal agency structure.

2) A challenge of doing systemic innovation research when all possibilities for superimposing agency assumptions are dissolved leaving no privileged outside point of view for innovation research to position itself. If everything is a relational effect this would have to include the practice of studying innovation. This calls for a transgression of methodological conventions based on the assumption that there is a position outside "the system" for research to place itself.

8.3. A new analytical strategy

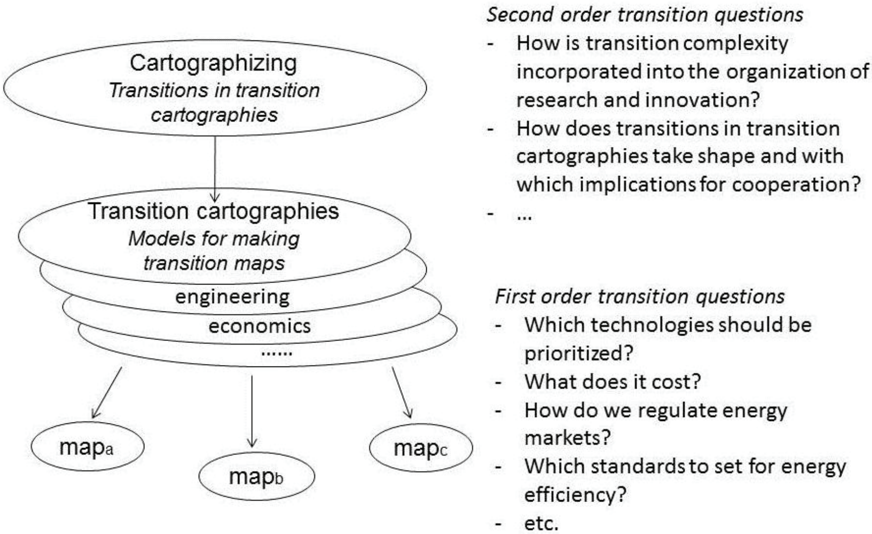
The implication for analyzing systemic innovation in the making as processes of *cartographizing* is that we begin to focus on the processual and relational constitution of cooperation and coordination. Processes of cartographizing unfold along divergent lines of potentialization and differentiation. They are interactions in the making where multiple and divergent problem-response conventions intersects, clashes, and form new alliances. There is no essential interaction pattern which can be distilled from this, but there are different interaction dynamics we can observe depending upon the response to – in the case of SEEIT – system transition complexity.

Thus, for systemic innovation research this implies a shift of attention from “patterns of interaction” between entitative actors to the processes whereby interaction is actualized which might yield a variety of “patterns” and actor-formations within the same interaction process. In the case of SEEIT we do not see one but multiple patterns of interaction as the partnership evolves over time. The partnership continues to be a relational effect – in terms of the relational dynamics in-between partners as well as in terms of the relational dynamics in-between the SEEIT process and the various contexts it associates itself with (the SET plan, KIC, Horizon 2020, specific system transition problems, etc.). This means that any actor we might want to better understand in terms of its role in innovation processes becomes de-centered and constituted according to the multiple relational dynamics it becomes associated with.

Look for divergent forces. Problematization and diagnostical rivalries. Understand the specific ways in which boundaries are made and re-made during the course of a cooperation process. Analyze how different boundary settings and cartographic operations potentialize interaction differently. Follow the shifts in interaction intensity – they are symptoms of a process of cartographizing where a new potentiality is being actualized. It is no longer the job of innovation research to nail down the most effective model of innovation, but rather to operate with a second-order analytical strategy under the assumption that there are always several “optimal solutions” and that what is optimal changes according to the relational dynamics interaction processes evolve through.

The second order analytical strategy invites us to focus on the specific ways in which “transition to transition” is being problematized and pursued in practice without superimposing any transcendent model of innovation or transition trajectory typology as a “framework” of analysis or interpretation. If interaction in the making evolves through shifting relational dynamics, there is no externally given structure or set of coordinates such processes can or should reach – e.g. a “function” or a “pattern of interaction” according to an innovation systems model. Rather, the “optimal point” is being determined relationally and without any reference to a higher order or externally given point of climax. Interaction in the making establishes its own intensities and potentialities for interaction along the process of cooperation. To superimpose sweeping higher order models onto such processes is the same as silencing the complexity of organizing cooperation across domains which those involved in such processes face continuously, as the case of SEEIT also illustrates.

Thus, moving from constructing, superimposing and mapping higher order entities as a basis for analyzing interaction patterns in innovation processes towards a second order analytical strategy for studying the complexity of making interaction productive opens up for a different range of questions and a different empirical sensitivity regarding complexity, agency-in-progress, divergence and multiplicity and the relational and transitional constitution of organizational solutions.



Given these arguments, the study of systemic innovation in the making should therefore turn the attention to analyzing how potentiality for interaction is being build up and differentiated and which role coordination operations play during such processes.

This is one of the advantages of the cartographic approach compared to innovation systems and system transition concepts: Rather than making still more differentiated models to better capture and represent the complexity of systemic innovation, the cartographic approach allows for inquiring how complexity surfaces in processes of organizing cooperation for innovation and how the response to complexity changes actor compositions and interaction potentiality over time. There is no ambition then of producing “a better map of complexity” because such a map is at best an illusion, at worst a contributor to reproducing fragmentation with impact on policy making and other practices of innovation. Rather, the ambition is to produce a cartography *for* systemic innovation by performing analyses of how interaction in the making takes shape through processes of actualization where divergence and tensions are drivers of cooperative efforts and coordination operations.

Obviously, this does not offer fix solutions to neither innovation researchers nor innovation practitioners, but seeks to show how e.g. system transition complexity opens up for new organizational responses where potentiality for interaction is being constructed, explored, destroyed, and re-constituted. This is a challenge for innovation research in its traditional form because its evolution over many decades, as described by Martin (2012) has quite consistently avoided the simultaneous growth in critical social theory, post-structuralist theory, and so forth, in social science in general and e.g. organizational and cultural theory in particular. The analytical strategy proposed in this dissertation and the overall break with romantic holism as a foundational conception of innovation as inherently systemic it implies carries with it a potential for a significant expansion of available theories and research methods. This also means that the range of relevant empirical material expands to include for example cases such as the SEEIT partnership where processes of systemic innovation are unfolding and collapsing as the partnership evolves over time.

These processual and complexity sensitive studies offer a stronger point of departure for studying systemic innovation and interaction in the making and as such build contributions to the core questions of innovation studies regarding the dynamics of interaction, the emergence of interaction approaches to innovation, and the complexity of organizing systemic innovation. This also opens up for empirical studies of processes which are typically black boxed. This has a particular value for policy oriented research even though there might be a need for "complexity reduction" (which typically means a silencing of complexity) in order to interact with policy making and advice how to compose policy initiatives within innovation and science policy (Rip 2010). However, the case of SEEIT suggests that while the policy level discourses on innovation might tend to be rather “simplistic” and fixed onto means-ends ways of reasoning, the performativity of policy initiatives like e.g. the KIC framework is very far from being merely “instrumental” or simplistic. As the analysis of SEEIT suggests, policy initiatives might indeed expand complexity significant and, arguably, this is a key feature of how they work and how they affect processes of organizing in practice. To not shed light on such policy effects is the same as participating in keeping policy makers in the dark regarding the complexity of innovation and system transition processes. To refer as Rip (2010) does to an alleged “preference” among policy makers for simple models and rather clear means-ends logics does not take innovation researchers off the hook with regard to problematizing this and offering insight into the irreducibility – and productive responses to – complexity of systemic innovation.

8.4. An in(ter)ventive research practice

One of the key contributions from this dissertation towards innovation studies is the proposition to move into a performative and in(ter)ventive innovation research practice. This move is a response to the question of how to study ongoing processes of systemic innovation which is a question of high relevance for the field of innovation studies which has increasingly oriented itself towards a systemic understanding of innovation processes (Kuhlmann, Shapira, Smits 2010). The proposition we might derive from this dissertation is to move into an in(ter)ventive mode of doing innovation research performatively. This implies a move into a participatory and situated research process where experimentation, problematization and intensification of research-field relations are key features. The in(ter)ventive innovation research practice unfolds a situated and partial form of knowledge production committing itself to actively co-producing relational potential in and with the field which – when successful – add to processes of innovation rather than merely theorizing and studying processes from afar.

An in(ter)ventive research practice operates from within by situating itself in the midst of ongoing processes of systemic innovation wherever such processes take place. This might be in a partnership like SEEIT, a governmental agency, a research department, a company, a social movement, etc. Systemic innovation is a process that brings about new relational possibilities and potential for interaction and to study such processes implies that innovation research itself becomes relational (Hosking and Hjorth 2004). The in(ter)ventive move (Steyaert 2011) is a specific solution to this which commits innovation research to becoming an active and creative component in processes of systemic innovation. The invention-aspect hereof has to do with exploring and seeking to actualize research-field relations that brings about socially productive conceptualizations of the processes and problems shared with others in the field. For example, the conceptualization of the coordination challenge as a cartographic process as proposed here and the attempts made during the process of cooperation in SEEIT to problematize energy system transitions in a way that would directly potentialize and explore interaction in the partnership process.

The conceptual creativity is itself a relational effect, not a product of the detached "genius" of the innovation researcher. The conceptual inventiveness becomes a form of in(ter)vention because it grows out of a cooperative research practice searching for a productive hook into the field it explores. Intervening in normal ways of staging the problem for energy research to respond to became the hook for this research project, but this is not a universal key because the in(ter)ventive research practice always needs to repeat its process of becoming in(ter)ventive through a relational process of interaction in and with the field. This is how the in(ter)ventionist approach refrains from becoming a method in a traditional sense. It offers no outside position for innovation research to conduct its studies of the practice of others. The in(ter)ventive innovation research practice puts itself on the line and shares the risk of failure with the field it inquires.

For a future innovation research practice, the in(ter)ventive approach thus activates the production of knowledge in relation to innovation and challenges innovation research to become engaged in cross-disciplinary constellations outside its traditional academic sphere as well as its normal ways of staging its relationship with (policy) practice (Kuhlmann, Shapira, Smits 2010). The *performativity* of innovation research takes center stage and its role changes towards actively enhancing possibilities for interaction in practice and contribute to foster connections and associations between domains of expertise where disciplinary boundary-setting etc. tends to prevail. This is the “proper place” for an in(ter)ventive innovation research practice.

This form of research practice operates with a different ideal of knowledge compared to those we find in innovation studies where representational, objective knowledge remains a dominant figure. The in(ter)ventive innovation research practice operates with a performative, relational-constructionist understanding of situated knowledge (Haraway 1988, Law and Urry 2004, Hosking and Hjorth 2004, Steyaert 2011) that continues to be an outcome of relational dynamics, always part of a process, always part of the processes it seeks to inquire. As Haraway puts it, this kind of knowledge production is *partial* and oriented towards producing openings and possibilities for practice to move on. To repeat her words quoted also in the method chapter, the in(ter)ventive innovation research practice seeks partiality and situatedness *“not (...)*

for its own sake but, rather, for the sake of the connections and unexpected openings situated knowledges make possible. Situated knowledges are about communities, not about isolated individuals. The only way to find a larger vision is to be somewhere in particular." (Haraway 1988: 589-590).

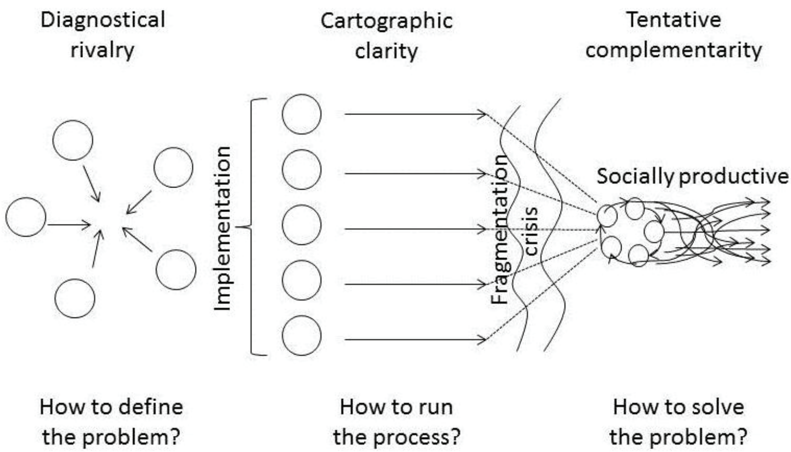
The in(ter)ventive practice of innovation research also adds to ongoing debates in organization studies on how to operationalize process thinking in empirical research. The agenda for a performative and experimental approach has already been pointed to (Beyes and Steyaert 2012, Steyaert 2012), but only few examples exist within organization studies of process thinking turned into a strategy for empirical research. As mentioned also in chapter 2 in the introduction to process thinking in organization studies, the import of process philosophy in organization studies has been devoted primarily to theoretical debates and conceptual work (Weik 2011, Steyaert 2012). The in(ter)ventive research practice pursued here offers one possible way of practicing empirical process research and theorizing processes relationally in and with the field of inquiry. The contribution also contains an illustration of how post-structuralist philosophy can be put to use in a participatory research process with relevance for the actual processes of organizing which are at stake in the field.

The proposition to go for in(ter)ventive practices of researching thus points into innovation studies as well as organization process studies. The in(ter)ventive approach offers a way to study ongoing processes of systemic innovation without introducing fix agency assumptions and innovation process models as means to study this from afar. It commits innovation research to take seriously its performative role in the fields it inquires and use this as a basis for active participation in innovation processes. This implies a different role for innovation research, including the policy oriented versions hereof. Rather than sustaining a "detached position" vis á vis innovation processes, systemic innovation research not only admits to but take advantage of its own role in constructing innovation as a problem to respond to in practice. The in(ter)ventive "solution" therefore also challenges the disciplinary form of expertise and problem-posing competence we find in many areas including innovation studies. Instead of supporting the development of a disciplinary capacity in innovation studies (Martin 2012), the in(ter)ventive approach stimulates genuine cross-disciplinary practices of engagement and puts innovation research on the spot as a contributor to actual processes of organizing.

8.5. A contribution to system transition studies

As elaborated in chapter two, the tendency within system transition research continues to be to construct system transition models and transition pathway typologies (Geels and Schot 2007). This prolongs a tradition within innovation studies to develop higher-order models with an aspiration to better represent the complexity of innovation and system transition processes. The problem here is, however, that the actual processes of organizing for systemic innovation remains black boxed in fix agency assumptions however complex these may be composed (see e.g. Geels and Schot 2007). Thus the "multi-level perspective" might seem to offer a more comprehensive mapping of system transitions and the multiple levels of engagement system transitions affect, but this remains of limited value because it sustains this artificial "as if reality" that invites to assume that we need such models in order to make sense of an otherwise too complex reality. It offers a complexity reduction we need in order to orient ourselves in the midst of highly complex system transition processes – just like a good map offers a useful simplification. This is taken to be true for the practice of researching system transitions as well as for the practice of organizing at different levels system transition efforts.

A critical response to this would be that transition pathway typologies and other kinds of transition process models of the kind we find in system transition research remain inherently incapable of grasping the relational and emergent constitution of agency due to its constant search for a more accurate transition process over-view model that builds on fix agency assumptions.



The suggested diagram for the variety of cartographic operations at work in the SEEIT process does not provide a better representation of system transition complexity because it refuses the possibility (and relevance) of such an ambition. Rather, the cartographic approach sustains that the transcontextual complexity of system transition processes remains open-ended and in-transition. This does not confront us with a negative limit but with an interesting challenge of inquiring and theorizing the ongoing constitution of agency as an inherent aspect of organizing processes of systemic innovation. Rather than trying to squeeze complexity of system transitions into a coherent overview model, the cartographic approach seeks to affirm the complexity of these processes and inquires how this is dealt with in practice. The diagram above is therefore not a model of something which is intended to be more accurate than e.g. transition trajectory models we saw in chapter 2 (Geels and Schot 2007), but an activist diagrammatization which seeks to problematize *cartographizing* as a key processual feature of systemic innovation processes and "the transition to transition" which is going on in the field of energy research and innovation.

The cartographic approach therefore offers an alternative analytical strategy for studying and contributing to ongoing processes of system transition. It does so by changing the focus from first order transition questions to second order transition questions. The system transition research field seeks of course to make a similar move in the sense of rendering system transition processes object for analysis and establish a kind of meta perspective of system transition processes. However, while this effort entails an ambition to develop grand coverage models in a representational ideal of knowledge, the cartographic approach turns the attention to questions regarding new interaction practices, new approaches to cooperation, transitions in transition cartographies, and so forth, which grow out of an effort to become responsive to system transition complexity in practice. It is therefore not the transition of energy systems per se, but the ongoing transitions in how energy research problematizes system transition complexity, how system transition complexity is being incorporated into new approaches to cooperation, and how these "transitions to transition" tendencies opens up for a new potentiality to be actualized.

Arguable, this kind of analysis is more in sync with the challenges facing those directly involved in system transition processes where creative responses to transcontextual complexity and enhanced flexibility in how cooperative associations are being made constitutes a major issue, as this dissertation has attempted to show.

8.6. Moving beyond the ontological divide in organization process studies?

In chapter 2, I pointed at the limitations of sustaining an ontological dichotomy in the "process-turn" in organization studies (Tsoukas and Chia 2002), with reference to a critique developed by Weik (2011). I took this as a point of departure for anticipating a contribution to organization process studies which does not rest on the assumption that 1) there are but two ontologies which 2) stand in a relation of opposition to each other and that 3) process researchers must choose to rely on the one or the other (Langley, Smallman, Tsoukas and Van de Ven 2013).

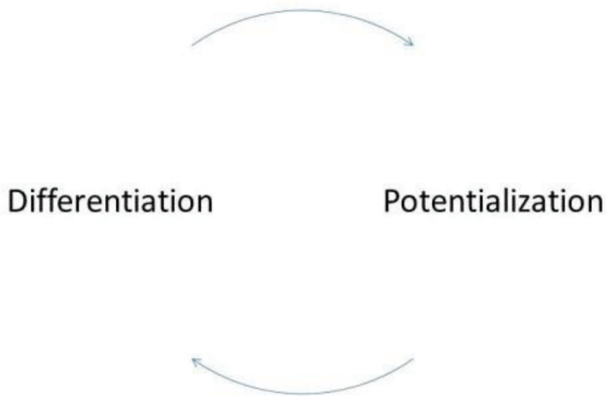
The ontological divide between being and becoming which I argued, following Weik, to be a threshold for the further advancement of organization process research, is of course by no means resolved in this dissertation. The dissertation does not offer distinctly philosophical contributions on the level of resolving questions regarding ontology of organization process studies. However, the ambition with developing the cartographic approach as analytical strategy was to avoid introducing an opposition or any other form of strict distinction between an ontology of becoming and an ontology of being. Thus, the concept of *cartographizing* as a process of actualization of a new potentiality for cooperation offers a way to understand processes of systemic innovation beyond an ontological divide between structure and process. The virtual and the actual as conceived by Deleuze (1994), and the process of actualization this implies, does not build on a distinction but rather a synthesis of being and becoming. However, not in the sense of repeating the credo in (parts of) organization process studies that the only thing that is (being) is change (becoming) and thus conclude that everything flows and is in a state of flux and transformation. Rather, the cartographic approach seeks to follow a Deleuzian synthesis project by theorizing processes of systemic innovation as organizing engines of potentialization and differentiation. Pure potentiality is undifferentiated chaos. Differentiation without potentiality is pure repetition without a difference. The process of actualization where potentialization and differentiation are mutually constitutive forces offers a way to avoid diving up one's thinking in terms of either becoming or being.

Thus, systemic innovation gains speed when a new potentiality for cooperation becomes active – this activation may be connected with a cartographic crisis as we saw in the case of SEEIT where competing problematizations and fragmentation problems gave rise to divergence and intensifications of problem-solving activities in the partnership. In the Munich-Copenhagen process, we saw how the deliberate composition of mixtures of expert domains stimulated a process of cartographic transition opening up for a new potentiality for cooperation and associations across domains. The transition between a cartography of domains to a cartography for symmetric perspectivism was not a shift from "being" to "becoming", but a shift in the configuration of potentiality-differentiation engine at work in the SEEIT process. Thus, when Weik (2011: 657) states a wish for the field of organization process studies *"to stop (...) revolving around the substance/process or being/becoming distinction and move on to more fruitful conceptual tools"*, the suggestion I develop here is to bypass these distinctions by means of the cartographic approach where we analyze processes of systemic innovation as unfolding through a differentiation/potentialization dynamic (cartographizing) which is a simultaneous affirmation of potentiality *and* production of organization. To separate these by means of a substance/process distinction would be like dismantling an organizing engine. This being said, the cartographic approach as an alternative to process/substance distinctions is only an opening and an initial attempt to contribute to a new process theory agenda and calls for more elaboration and development in the future, including a much more thorough theoretical development of the potentialization/differentiation dynamic vis á vis other process theories than achieved here.

8.7. Implications for practice

The cartographic analysis of SEEIT and its various responses to the transcontextual complexity of system transition processes carries with it several possible implications for practice. I will put focus on three aspect: First, I will discuss implications for policy making and its use of partnerships as “instrument” in the organization of energy research and European cooperation for innovation in the field. Second, I will discuss some implications for managing research cooperation in context of strategic partnerships – what are the challenges and possible learning outcomes we might derive from the SEEIT case? And third, I will try to connect the first two points by discussing whether and how we might consider strategic partnerships as engines for systemic innovation.

8.7.1. Strategic partnerships as engines for systemic innovation?



In what way is the SEEIT analysis relevant for policy making? Should we not have been focusing on policy instruments per se in order to derive policy relevant implications? The relevance of the SEEIT case towards policy making resides in the fact that the SEEIT partnership is partially a case of how actors respond to policy initiatives such as the KIC framework, the emerging Horizon 2020, the SET plan, and so forth. As such, the relational dynamics shaping SEEIT is associated with its interaction with policy frameworks. This makes SEEIT an interesting case for policy related research and practitioner learning because it provides an empirical basis for discussing the implications of calling for strategic partnerships to be formed in response to complex "societal challenges". This is a foundational aspect of the next EU framework for research and innovation, Horizon 2020 (EU COM 2011a), as well as the Danish national strategy for innovation "Denmark – a land of solutions" (Government of Denmark 2012) where "innovation partnerships" play a prominent role. As I shall elaborate below, calling for strategic partnerships intensifies transcontextual complexity which partnerships might actually become creative responses to. However, this in turn extends the complexity challenges back into the policy frameworks and funding systems which need to become fit for responding constructively to the new kinds of complexity affirming projects and cooperations emerging from partnering processes like those we find in SEEIT.

In the case of SEEIT we saw how the partnership strived to respond to system transition complexity in a variety of ways – some responses more productive than others in terms of bringing together the partners in a joint cooperative effort. If we now consider the interface between the partnership and the EU funding systems it tried to become relevant to (first the KIC framework and then primarily the FP7 programme) it was clear that while SEEIT at times became a process of gathering and combining otherwise disconnected fields of expertise from within engineering and social science, the funding apparatuses it targeted was not well designed for supporting such cross-disciplinary efforts. This was for example clear in the 2012 development of a FP7 proposal, the spin-off project of the Rome-Munich-Copenhagen workshop series. However, the discrepancy is even more fundamental. While strategic partnerships strive to become complexity incorporating organizational arrangements, the image of knowledge production guiding the setup of funding mechanisms tends to sustain a strictly contractual and functional understanding of knowledge production. Such an understanding implies that a "good" funding proposal is structured functionally according to a clear parts-to-whole logic where each element (e.g. the contributions from each discipline involved) are well-defined, individually comprehensive and collectively exhaustive. In order words, the predominant image of knowledge stands in contrast to a complexity affirming form of knowledge production where sustained heterogeneity, incoherency and flat compositions of disciplines are pivotal ingredients. Partnerships open up for a mess which affirms the transcontextual complexity they are supposed to incorporate and respond to, but the policy systems that evaluate proposals and performance of partnerships tend to sustain a complexity silencing formula by insisting on contractual clarity, coherency and "exhaustive" project designs. At least, this was a clear challenge in the case of SEEIT where the cross-disciplinary "mess" – and the creativity this opened up for – was difficult, if not impossible, to sustain in the translation process into an FP7 research proposal.

On the basis of the SEEIT case, we might therefore pose the question – which we cannot answer completely here – whether innovation policy systems have the stomach for responding constructively to the complexity their own 'instruments' open up for. For example, in the case of the coming EU framework programme, Horizon 2020, the call for cross-disciplinary cooperation and strategic partnerships have a much more prominent role compared with FP7. But the basic research project model seems to remain the same: A "good" research project can be contractually fixed in beforehand, and all contributing elements ("work packages") are assembled in a coherent and exhaustive project design. The risk here is that Horizon 2020 might reproduce a complexity silencing structure which stands in contrast with the complexity affirming ambitions the very same programme seeks to unfold. It is of course an empirical question how this discrepancy will play out in the implementation of Horizon 2020 (and other similar innovation policy programmes across Europe) which is beyond the scope of this dissertation to inquire.

The SEEIT analysis suggests that for policy makers, the opening of potentialization through e.g. the support of strategic partnerships is also an opening of a new complexity where failures and transcontextual learning are vital ingredients. To stimulate strategic partnerships as a complexity-incorporating form of organization necessitates therefore also a learning process in the various other policy frameworks, including the design of funding instruments by e.g. affording strategic partnerships funding on the basis of actual performance (ex-post) rather than merely on the basis of planned activities (ex-ante). If systemic learning and flexibility remains very restricted through e.g. contractual rigidity in EU funding systems, there is a risk of creating a destructive "double bind" situation of potentialization and contractual closure which is difficult, if not impossible, to respond to effectively. To paraphrase Bateson, the problem is systemic and so must the solution be.

8.7.2. Implications for managing partnerships

The main proposition of this dissertation has been to consider coordination as a relational, cartographic process which is not solely the task of the person(s) serving as coordinator(s), but which remains a collective challenge in a partnership and the field in which it operates. Cartographic processes are thus relational in that they help construct 'a common ground', a problematic context to respond to, and a distribution of roles and tasks to be carried out through collaboration. Still, the case analysis suggests that those who have the formal role of coordinating play an important part in prompting or instigating joint cartographic efforts. For example, in the case of SEEIT, we saw how coordination refrained from fixing "the map" but took on a balancing and flexibility enhancing role.

If we follow a batesonian systems thinking, coordination plays a role of securing flexibility as a means to build "system wisdom". System wisdom allows for a multiplicity of divergent problem-responses to take shape while framing these in a way that support mutualism and complementarity. The point is that coordination does something which stands in contrast to a strict and managerial approach to coordination which aligns collective efforts in accordance with one, overarching and unifying principle. The flexibility enhancing form of coordination might imply a cartographic operation which gathers collaborators on the same, common plane (which coordination processes help construct), but it might not enforce this as a fix solution to adhere to. Thus, coordination does not necessarily imply subordination even though this is the managerial ideal that often sticks to the notion of coordination. Rather, the capacity to coordinate effectively implies, if we follow the analysis of SEEIT, an ability to 'relax' the managerial aspect of coordination and operate more tentatively and flexible towards a collectively constructed common ground where there might be several problematic contexts to respond to and thus multiple possible outcomes and potentials for interaction.

Considering the transcontextuality of strategic partnerships organizing towards open-ended system transition scenarios, this kind of flexibility-enhancing coordination capacity seems to become highly relevant for research leaders to engage in. *Cartographizing* becomes a key task for coordination to engage with. This might involve an interference with established cartographies and their proper boundaries, as we saw in the Munich-Copenhagen process, and a relaxation of cartographic fixations of specific problem-response constellations. In this way, coordination responds to complexity by affirming it rather than trying to manage and reduce uncertainty as so many innovation management theories invites us to believe.

This role of coordination comes close to how Michel Serres describes the nature of the blank domino that has no fixed value but – when used at the right moment – has the capacity to connect otherwise disconnected series and become a game changing agent. This unique capacity resides in its blankness and the open-ended set of potentials for connecting (Serres 2007). This is similar to how coordination accomplishes to connect heterogeneous map making efforts – it points into the in-between of domains which can only become socially productive if no particular value is assigned. This is an important aspect of an effective form of coordination responding to a transcontextual complexity. It can only help sustain processes of interaction if it refrains from fixing itself to one specific transition cartography.

8.7.3. Responding to a systemic problem

As introduced in chapter 1, a key aspect of the coordination challenge in relation to innovation in context of open-ended system transition scenarios is that of establishing platforms and organizational solutions which can sustain processes of technological and system oriented knowledge production without fixating these onto one specific system scenario. The system transition efforts cannot rely on one single system transition scenario for many obvious reasons – for example that "the future energy systems" remain highly contested and dependent upon a variety of economic, political, cultural and technological developments which are impossible to organize around one single system transition plan or even one single plan-and-execute process. Thus, there is a need in the field to develop transition process engines which can support and sustain systemic innovation without committing to one specific system transition objective. Following Bateson, there is a need for a high degree of flexibility and transcontextual learning. The question is whether strategic partnerships might be one possible solution to this challenge. Certainly, the growing focus on strategic partnerships as catalysts for innovation suggests that this is a response being tested today in energy research and policies directed towards supporting system transition efforts broadly in the field.

If we take our point of departure in the SEEIT case, we find several possible answers to whether partnerships may be adequate responses to organizing processes of systemic innovation and transcontextual learning. On the one hand, the case illustrates the politics of setting up joint coordinates for strategic cooperation and alignment, and the conservative aspects hereof. Strategic partnerships like SEEIT may have a tendency to reproduce well-established technological boundaries and sustain technology-centered approaches to innovation in the field. The reason for this is that cartographizing, in the case of SEEIT and the field in which it operates, tends to be a rather elitist game where well-established research laboratories, technical universities and energy companies play dominant roles as those with the prerogative of posing the problem to be solved. European strategic partnerships like SEEIT might reinforce this considering the quite specialized and time consuming efforts the multiple cartographic processes entail.

On the other hand, the case also illustrates the interaction potentialization of strategic partnering and the social productivity this might open up for when partnerships engage in transcontextual learning and thus incorporate system transition complexity. In the case of SEEIT, this feature of partnering certainly emerges in the Rome-Munich-Copenhagen process. Here we saw how the partnership became an engine for systemic innovation in the sense of actualizing interaction potentials beyond established boundaries. It tentatively became a problem-solving process where cartographies no longer reproduced known boundary settings, but entered a process of co-construction that allowed for multiple knowledge disciplines to participate.

The case analysis suggests that the coordination rationale and the boundary settings this involved played an important role for the capacity of the partnership to become socially productive. When coordination turned into an exercise of subordination in accordance with a pre-established system of coordination (e.g. the SET plan), the capacity of the partnership to function as a connective force across the partners and fields of expertise involved decreased. This kind of coordination might be necessary as a means to secure legitimacy of the partnership vis á vis European policy discourses, but for the purpose of turning the partnership process itself into a creative response to system transition complexity, it offered very limited cartographic resources. It was when the partnership became a process of cartographizing involving a construction of joint and open-ended coordinates (the "systemic and holistic approach") that it demonstrated its capacity to actualize interaction potentials.

The different "answers" we get from looking at the SEEIT process are important because they illustrate the complexity of organizing processes of systemic innovation. For example, strategic partnerships cannot be seen as isolated "tools" that solves one specific problem in the overall landscape of innovation policy frameworks. The priority given to setting up strategic partnerships should be supported by e.g. funding systems which can cope with the creative responses to complexity partnerships might produce. As mentioned also earlier, there is a risk of creating a destructive "double bind" situation where energy research is asked to potentialize itself through e.g. partnerships while at the same time demanding complexity silencing research projects with are designed in a risk-minimizing manner and controlled according to contractual logics which squeeze out the kind of transcontextual learning systemic innovation implies (see also Andersen 2008 for a similar warning). The same goes for the use of strategic partnerships seen from a partner perspective: The cartographic stress occurring when heterogeneous partners seek to align and couple their efforts might become counter-productive if the eventual creative responses in partnerships are expected to fit into a narrow contractual arrangement defining the partnership. In the case of SEEIT such a contractual arrangement was never effectuated, and this might be one reason for why we can now study the SEEIT process as a multi-facetted story of constituting and re-constituting the cooperation process.

To get back to the main question of whether strategic partnerships might be adequate organizational responses to cooperation in context of system transition complexity, the answers we may derive from the SEEIT analysis is affirmative as well as skeptical. Strategic partnerships might indeed incorporate the complexity that opens up when multiple partners engage in processes of systemic innovation. This was at least one important feature of the more successful aspects of the SEEIT process. At the same time, strategic partnerships might turn into elitist gatherings and serve as a means of scaffolding strategic interests of well-established energy research and energy sector actors with the risk of reproducing modes of knowledge production that sustains specializations and institutional arrangements reflecting the system solutions and accomplishments of the past.

8.8. Further research

It seems that the cartographic approach and the analysis performed opens up for more questions than it answers. A few steps have been made in this dissertation into a cross-disciplinary zone in-between innovation studies, organization process studies, and post-structuralist theory. A major aspect of the ambition behind the project has been to open up for such a cross-disciplinary zone and this of course produce more openings than closures.

First, the in(ter)ventive research practice evolved as a learning process during the course of the research process and leaves many questions open for further exploration and refinement. For example, expanding and conceptualizing varieties of modes of in(ter)vention might be one interesting direction to go in. I made some attempts to practice problematization and conceptual creativity as a way to produce in(ter)ventions and enact a processual approach to organization and innovation research. However, there are many other ways in which a performative, in(ter)ventive research practice might unfold (Steyaert 2011) and the steps made here only provides an opening in relation to an in(ter)ventive innovation research practice that calls for further exploration.

The concept of *cartographizing* is part of the outcome of the dissertation and remains as such open for further elaboration and maturing. It helps problematize systemic innovation as a process of actualizing new potentiality for interaction and the analysis of SEEIT offers empirical examples of how such processes unfold. However, it would be interesting to inquire addition cases of cooperation for system transition where the range of partners include more active industrial and/or public sector actors. SEEIT is first and foremost a partnership among universities and research laboratories. This has a bearing on the nature of cooperation aspirations perceived to be relevant and the nature of cooperation challenges confronted in the partnership. It would be interesting to refine the cartographic approach on the basis of additional cases with an even more extreme “partner geometry”.

A theme which I have tried to keep out of the dissertation, but which has often come to my attention in the process, is a theme I would call system transition entrepreneurship, or something along those lines. Such a theme would feed into the overall topic of systemic innovation and the creation of new cooperative approaches but with an emphasis on processes of systemic innovation as inherently entrepreneurial in the sense of entrepreneurship as organizational creativity (Hjorth ed. 2012). The topic of entrepreneurship tends to be squeezed in the analysis of system transitions as well as in the policy efforts in this area probably because of the tendency to opt for grand overview models in research and policy making and because of the normal association of entrepreneurship with firm start-ups. However, entrepreneurship in the form of creating the organizational solutions needed for system transitions to gain speed is exactly a core problem and calls for being further inquired and problematized.

Along these lines of reasoning, one could frame the SEEIT partnership as a case for system transition entrepreneurship within the sphere of energy research and education. However, other cases might prove more significant on this particular theme such as the many public-private partnership arrangements which are taking shape in the energy area. Here we find interesting intersections between sectors, institutions and strategic interests and thus a perfect point of departure for studying transition entrepreneurship as a relational and collective process where we might find, as mentioned above, the cartographic crisis we need for in(ter)vention to become productive and for cartographizing to take shape. To center stage system transition entrepreneurship as a driver of systemic innovation might prove promising for a further advancement of system transition studies, and its intersections with systemic innovation analysis as well as studies of organizational creativity.

These were but a few possible openings this dissertation produce. In the next chapter, I will conclude the dissertation by reconnecting with the opening and provide an outline of the main steps made and conclusions offered in the previous chapters.

9. Conclusion

"We need a theory of complexity to handle this!"
[The SEEIT coordinator]

Did we get any closer to responding to this plea formulated by the SEEIT coordinator during the Copenhagen workshop at DTU in March 2012?

To ask for a theory of complexity in the context of a SEEIT workshop is of course not merely an expression of intellectual curiosity, but also an expression of a need for new concepts, new ways of reasoning, and new ways of organizing. The workshop was a small opening towards system transition complexity resulting in a veritable flooding of perspectives and a shift in potentiality for interaction. No wonder the coordinator was on the look for a way to grasp this.

The plea for a theory of complexity is a good point of departure for summing up the main points offered by this dissertation because it indicates a need for coming to terms with a new situation – not only for those involved in some aspect of system transition processes, but also for those of us involved in studying such processes.

Systemic innovation offers no innocent outside. The complexity it opens up for offers no convenient position from where we can theorize it as if we were standing outside 'it'. Thus, the first element of responding to the plea for a theory of complexity would be to say that such a theory would have sustain complexity as an irreducible virtuality that cannot be silenced or fixed but that we have to be able to affirm and pass through. There is no escaping. System transition complexity is the inherently open-ended passage for systemic innovation and system transformations to pass through. A theory of complexity should not try to 'fix' this, but sustain complexity as an irreducible open-endedness of system transitions and as a source for systemic innovation and new interaction potentiality.

Let us reconnect with the research questions in order to further elaborate how we arrive to this kind of respond to the plea for a complexity approach. In the introduction chapter I presented three questions:

> 1) What are the methodological and analytical challenges for innovation research studying systemic innovation in the making?
>
> 2) In the case of the SEEIT partnership, how is system transition complexity constructed as a problem to respond to and with what effects for the partnership's capacity to organize cooperation across the domains it spans?
>
> 3) Given the cartographic approach and the analysis of SEEIT, what are the practical implications of organizing systemic innovation through strategic partnerships?

The first step of engagement with these questions was a problematization of established innovation systems research and system transition studies where we find attempts to conceive of innovation as inherently systemic and driven by interaction across multiple actors. I found that this literature responds to the complexity of innovation (i.e. the systemic nature of innovation) by assuming that above and beyond processes of innovation we can detect patterns and a higher order of "innovation systems" which in turn allows us to derive a variety of functions and interaction mechanisms that need to be in place for innovation to prosper. I criticized this line of reasoning for introducing sweeping agency assumptions on the basis of an innovation systems construct which, regardless of the persistent observation in innovation systems literature that interaction around innovation is dynamic and continuously in progress, results in a functionalistic perspective of agency embedded in a parts-to-whole structure. Thus, innovation systems theory may put strong emphasis on complex interaction processes as the main driver of innovation, but its way of theorizing and researching this builds on functionalistic agency assumptions which black boxes the interaction dynamics and the relational constitution of agency. Thus, this line of innovation research offers no framework for studying systemic innovation *in the making* where 'agency' is yet to be established and where interaction has not yet become effective. This is a critical limitation in context of a research project where system transition complexity exactly creates an "agency crisis" and where we need to develop an empirical and analytical sensitivity towards this particular problem in order to produce knowledge of relevance for understanding and acting upon transition complexity.

At this point, I already made the first steps of responding to the plea for a complexity theory by drawing a line of demarcation between on the one hand translating complexity into a higher order complex whole we can conceive of and derive structures from and, on the other hand, translating complexity into an irreducible open-endedness where multiplicity and divergent relational dynamics reign. A response to a plea for complexity theory must decide between going for the ideal of a higher order entity (the innovation system) or going for a complexity affirming approach where multiplicity and divergence of relational dynamics are sustained as irreducible to any fix innovation or cooperation model.

As a consequence of going for the latter version, I then connected with recent developments in organization process studies in order to introduce a processual and relational understanding of agency as a more productive point of departure for developing a framework for studying systemic innovation in the making. I pointed at some limitations and potentials for further advancing this field, but invited the basic argument from this area into the dissertation in order to bridge between innovation and organization process research and develop a cross-disciplinary contribution.

The problematization chapter along with the introduction of the empirical field served as the springboard for developing a cartographic approach comprising a methodology of in(ter)vention and an analytical strategy.

Thus, in chapter 4, I introduced the research process and developed on the basis hereof a proposition for an in(ter)ventive innovation research practice as a means of studying ongoing processes of systemic innovation performatively. Rather than studying and theorizing processes of interaction from afar, this approach implies a research practice where participation and experimentation are key modes of researching. Thus, a situated and "partial perspective" as Haraway puts it. This is in line with the critique of innovation systems research as being largely detached from the processes it conceptualizes into transcendent models of innovation systems. The in(ter)ventive move suggested here, implies a commitment to actively engage in enacting knowledge that makes a difference for actual processes in the field of study. For example, processes of cooperation in the SEEIT partnership. This implies a repositioning of innovation research vis á vis practice and processes of innovation.

Similarly, the in(ter)ventive approach illustrate a possible way forward with regard to turning organization process research processual in its mode of knowledge production.

An important element in the argument was to show how post-structuralist thinking (e.g. performing knowledge through problematizing and creating concepts in interaction with existing concepts at work in the field) can form the core of an in(ter)ventionist, participatory research practice. This demonstrates how post-structuralist theory on performativity of knowledge and the social productivity of concepts can be put to use in actual processes of researching performatively adding to ongoing processes and creating potential for interaction in and with the field.

In chapter 5, I developed a strategy for analyzing processes of systemic innovation by introducing elements from Bateson's system theory and Deleuze's concepts of the virtual and the actual. The chapter arrived at an analytical focus on how cartographies potentialize interaction, and how the capacity for potentializing interaction undergo change when facing system transition complexity. Bateson's concept of systems of presuppositions and transcontextuality were key concepts for developing a systemic perspective alternative to the systems of innovation theory. Along with Deleuze's concept of the virtual and the actual, this laid the foundation for an analysis focused on how systemic problem-response conventions and habits in energy research intensify and undergo transformation when encountering a new system transition complexity they cannot come to terms with. The resulting cartographic crisis where coordination problems multiplies becomes of key importance for studying processes of systemic innovation because it is during such processes we opportunities for in(ter)vention and for studying how cartographic transitions help actualize a new potentiality for interaction beyond established domains, and beyond familiar ways of staging and approaching problems to be solved. The cartographic transitions were conceptualized as processes of *cartographizing* to stress the level of analysis pursued. Thus, the analytical strategy installed a second order perspective on map making efforts opening up for questions such as how transition cartographies potentialize interaction and how cartographies (as principles for making maps) undergo change when the conventions they comprise no longer perform coordination and potentialize interaction effectively. The cartographic analysis puts focus on cartographic crises, tensions and transitions and how such processes affect the potentialization and actualization of interaction across otherwise disconnected and heterogeneous fields of expertise.

This kind of analytical strategy is useful for a study of systemic innovation in the making – processes whereby new interaction potential is created and pursued, but where effective approaches to cooperation has not yet been established. The complexity of open-ended system transitions challenges conventional thinking and practices in relation to organizing knowledge production and innovation, and offers no clear-cut direction for how to proceed, where to go. Thus, organizers of e.g. research partnerships for sustainable energy face a fundamental challenge of transgressing established boundaries while introducing new lines of demarcation that creates new alliances and interaction potentials without having the 'security' of a clear external reference framework that secures effective coordination of new cooperative efforts.

The analysis of the SEEIT partnership process is an attempt to demonstrate what kind of analysis the cartographic approach opens up for. The analysis makes a particular cut through the empirical material focusing on symptoms of cartographic crisis (e.g. problem-diagnostical rivalries, fragmentation problems) and how the responses to these intensifications give shape to the partnership and its capacity to unfold its purpose of becoming a connective framework across the domains it spans. The analysis illustrates how the divergent forces, and the multiple relational problems the partnership constructs and responds to, are brought to the fore in the cartographic analysis. Consistent with the analytical strategy, the analysis of SEEIT thus focuses on how interaction potentiality is created, dissolved and reconstituted and how the partnership process is sustained by incorporating system transition complexity as a potentiality it constantly seeks to actualize but which remains unresolved – how the cartographizing process becomes an engine for the partnership to move on. During these processes, the cartography of SEEIT goes through different transitions the more remarkable being the one from a cartography of domains towards a cartography for symmetric perspectivism and the shift in potentiality for interaction this produced. This example is also remarkable because it illustrates the active role coordination might play in composing the intensities and divergent lines which the cartographic transitions, or processes of cartographizing, feed on.

The analysis suggests how strategic partnerships like SEEIT have a capacity to incorporate system transition complexity and make the cartographic crisis it opens up for productive for cooperation. Clearly, strategic partnerships are therefore not smooth instruments for an organization of systemic innovation. They are not managerial tools that secures a rational solution to coordination in a complex landscape of system transitions. If we follow the analysis provided here, partnerships are incoherent, messy, difficult to render productive, and likely to consume considerable efforts before they create tangible results. However, the analysis also suggests that the interaction processes partnerships may open up for is of unique value in a field where strong and well-established domains of expertise and therefore certain problem-response conventions prevail.

Cross-cutting partnerships like SEEIT might exactly help intensify the cartographic crisis which opens up for a variety of new unresolved relational problems that feed into processes of systemic innovation. Partnerships, in this perspective, helps generate problems for energy research to respond to and as such they might enhance the problem-posing capacity in the field beyond the conventions which are taken for granted as self-evident and which are part of the barriers to systemic innovation which need to be overcome.

Consistent with the in(ter)ventive approach, the cartographic analysis does not result in a better representation of systemic innovation processes in SEEIT. The analysis remains an in(ter)vention that seeks to show how actualization of potentiality for interaction in SEEIT unfolds without fixing this process in e.g. an interaction model. This offers an alternative analysis of systemic innovation that gives emphasis to the open-ended constitution of organization and how cooperation efforts feed on the problems they cannot fix. This unresolvedness of organization is sustained in the differentiation-potentialization diagram which the analysis arrives at as a way of reconfiguring the SEEIT engine. The diagram suggests a way to understand the process engine at work in SEEIT where cooperation gains speed when a potentialization beyond the cartography of domains and familiar problem-response conventions is opening up. Coordination plays an important role in potentializing cooperation – not merely by providing alignment and secure a clear division of work (such clarity might even produce fragmentation as we saw in the SEEIT), but rather by stepping into the blank spot in-between the domains it seeks to pull together, and from there work along the divergent lines of demarcation, boundary constructions, and problem negotiations this creates. This is why the analysis does not provide a 'fix model' that suggests which coordinates for cooperation are likely to enable successful partnering. The problem is not to determine coordinates for systemic innovation in theory or in a model, but to determine the process engines whereby coordinates are invented. The engine diagram proposed here places coordination in a highly challenging position of unfolding coordination efforts without "running back" to fixed domains and an externally given reference framework such as the SET plan, but rather use the cracks and fragmentation problems such strategic domain cartographies generate as the advantageous point of departure for cartographizing to begin.

From the perspective of this dissertation, the answer to the coordinator's plea for a theory of complexity is then to say that system transition complexity should be actively affirmed, not nailed down in a model of systemic innovation. The slogans we need to practice, drawing inspiration from a passage in Deleuze and Guattari (2002: 161), would sound something along the lines of: *Intensify your cartographic crisis. Avoid retreating to firm grounds, but compose new plots of land potentializing interaction. Continue to work along divergent lines. Place yourself in-between domains in whatever manifestations they arrive in. Use fragmentation problems as an advantageous point of departure for cartographic transitions to being. Invite a bit of transition chaos into the process. Make unlikely alliances. Multiply and assemble perspectives in flat compositions. In short: Go cartographize.*

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Appendices

Appendix 1:

"Dynamics of Systemic Innovation", Presentation delivered at SEEIT workshop in Munich, October 2011.

Appendix 2:

"SEEIT as a catalyst for future research and education partnerships – Input to SEEIT SG meeting, March 16 2012, DTU". An input written by myself to the discussions at the time about the future direction for SEEIT as a partnership.

APPENDIX 1

SEEIT

- a European Strategic Partnership for Sustainable Energy Education, Innovation and Technology

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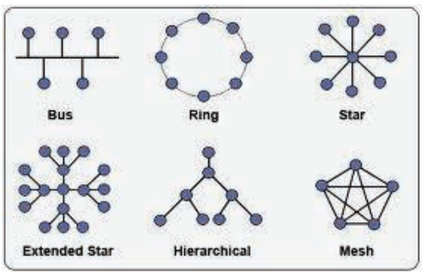
Dynamics of Systemic Innovation

Nicolaj Tofte Brenneche
Phd-student, CBS
Dept. of Management, Politics and Philosophy



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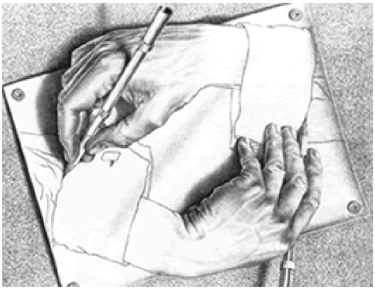
- Change of system topology affects multiple actors across levels. One system, many organisations and institutions.

APPENDIX 1

- No ”green field” innovation journey. Progress in-between existing and future energy solutions.

- No single ”grand coordinator” of systemic innovation.

APPENDIX 1



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- Systemic innovation journeys depend on partnerships and learning in collaboration.
- Actor are forced to relate to developments outside their usual ”core competence area”
- Technical and social/organisational creativity are mutually dependent

Platforms for systemic learning and innovation

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- *”Demonstratorium”* – a place for scaled experimental demonstration.
- Experimental demonstration – ”we dont know what happens when we materialize concepts such as smart grids”.
- *”Resursium”* – a place for experiments with different kinds of waste
- Vestforbrændingen – an energy provider turning waste into a resource for district heating. New platform: Resursium – opening of the existing value chain of biomass (particularly waste) in district heating
- Spaces for explorative demonstration of new systems or new components for existing systems where the technical and organisational learning goes hand in hand.

APPENDIX 1

Challenges for scientific research

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- Where does (processes and decisions on) systemic innovation take place?
- The separation of technical and economic modelling from political and organisational learning processes seems unproductive.
- Potential for better combination of competences in different scientific fields.

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060312

APPENDIX 2

→ NTNU /Arne very positive

SEEIT as catalyst for future research and education partnerships

Input to SEEIT SG meeting, March 16 2012, DTU.

If we think about future energy systems, and the research and educational efforts needed to underpin the transformation of energy systems, in terms of an emerging landscape we may characterize SEEIT as a cartographic actor.

Cartography is needed when we face challenges where existing maps tend to be insufficient. It is not surprising that the field of energy research, and increasingly also energy-related education, is crowded with cartographic work. The SET plan is an example. But also activities in smaller scale such as the SEEIT partnership workshops are emblematic examples of the need for new maps in order to catalyze partner relations and new research and educational (R&E) activities.

The catalytic potential of new cartographies is important for SEEIT partners to explore and develop. There are many reasons for this. One reason is the anticipated change in EU research policy from a project-based (FP7) to a partnership-based (Horizon 2020) funding regime including cross-disciplinary instruments. Another, and perhaps even more, important reason is the on-going and long-term topological transformation of energy systems. Future energy systems integrate a mix of energy technologies for which we do not yet have well-functioning topological solutions. We often talk about "transition" in relation to energy systems. But we might consider the term "transformation" in order to underline the foundational level we anticipate must change, namely, the transformation of energy topologies. "Transition" suggests that we move from A to B where the movement is a matter of implementation of B. However, we do not yet know the topological solutions of future energy systems. This constitutes a fundamental cartographic challenge which transcends existing ways of framing energy R&E.

Hans Larsen
We should pay special attention to the combination of tech.

Together, Horizon 2020 and the topological transformations of energy systems are good examples of why we urgently need to develop new energy R&E cartographies. We need to develop new maps which enable us to catalyze partner relations and R&E activities not "only" at the incremental boundaries of individual energy technologies, but also at the topological and systemic boundaries of energy solutions where technology, policy, management and culture intersect. Indeed, we need cartographic work that embraces the complexity of energy innovation rather than reducing the complexity with a sub-optimal perspective.

In order to make sense of the raison d'être of SEEIT we might think of this partnership as a cartographic journey which takes place at several levels including EU policy development and partnering processes through e.g. creative approaches to designing partnership workshops. Today, SEEIT also builds on an aspiration to catalyze FP7 projects but has so far not been very successful in this regard. I think this is due to the fact that the cartographic potential for SEEIT goes beyond FP7. Maybe our priorities should reflect this more than today?

- EU voice
- Training and edu into SET PLAN
- catalytic processes
- bevgrate / recent projects

If we consider the recent development of SEEIT workshops (München 2011 and Copenhagen 2012), it seems that we can attract a variety of researchers if we use a workshop design that plays with the boundaries of how researcher workshops are configured and thus how problems of energy research are staged and approached. The recent workshops are "systems-oriented" but not exclusively designed for system engineering or systems analysis as discipline. They combine different areas of expertise and have an explicit purpose to recast how we think

J. Yjems → It's maybe time to shift platform from the early days of SEEIT (Knowledge Triangle) to A process oriented ~~tion~~ machine*

Aalto Bio-economy as cartography

about energy technologies embedded in systems and how we approach knowledge and competence creation through our R&E activities.

Operating as a "cartographic catalyst partnership" is a challenging job. The process to results is bumpy and messy. However, SEEIT is already becoming an established voice in EU policy making within energy R&E, and the recent development of workshop designs and researcher participation indicate that we are on the right track at this level as well.

Given the ongoing development of Horizon 2020, and the overall challenge of responding creatively through R&E to the transformation of energy topologies, SEEIT has a potential to become a prime organizer of R&E development activities which go beyond established ways of staging energy technology research. This is becoming a still more urgent challenge at partner level (including the operation of research environments) as we move closer to the implementation of Horizon 2020. If SEEIT devotes itself to the process of cartographic development, it may also position itself more distinctly compared to established research networks and EU policy voices.

On the basis of these general considerations about the nature of SEEIT, we can think about ways of strengthening SEEIT activities further. Ideas would include the following (forgive me for not using the proper lingua franca of EU funding):

- Target funds (if such exist) for network activities focused on the "cartography of future energy research" in order to strengthen the SEEIT workshop series.
- Give special attention to the design of partnership workshops in order to catalyze new approaches and cross-disciplinary dialogues. Use the München and Copenhagen workshops as cases to build upon.
- Always invite young researchers to participate in workshops in order to inspire new generations to engage in cross-cutting dialogues and research.
- Position the engagement of SEEIT in EU policy development by advocating new approaches to energy R&E. Use workshops as a place where such new ideas and needs can be formulated.
- …

These ideas are not supposed to be exhaustive. They do however implicitly suggest that we give less priority to FP7 fundraising and abandon "pure technology workshops" which do not address topological or systemic challenges. This is not to say that such workshops are not important – but maybe the need for such peer gatherings are already taken care of in existing research networks (e.g. EERA). The need for new cross-cutting dialogues might be more promising for SEEIT to address.

Any reactions, including criticism, to this input is more than welcome.

Nicolaj Tofte Brenneche, CBS.

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