The role of multilevel dynamics and agency in regional industry renewal

Rune Njøs

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Extended abstract

This dissertation investigates the theoretical and conceptual underpinnings of evolutionary economic geography (EEG) and its approach to regional restructuring. A dynamic approach considering that regional industries are continuously renewing (albeit to differing degrees) is developed. Such considerations have largely been ignored in investigations of regional restructuring and much work on EEG, which have instead focused on how to re-establish former contingencies following external shocks, i.e. a reactive approach. The concept of regional industry renewal is discussed, emphasising that regional restructuring is a continuous process characterized by different 'intensities' in different regions and/or time periods. Moreover, it is emphasized throughout this dissertation that EEG has addressed the micro level of firms and organizations, the meso level of regional settings, and the macro level of national and international settings. However, particular focus has been put on the meso level, as is illustrated by the literatures on industry clusters, regional innovation systems (RIS) and the concept of related variety. However, 'uni-level' approaches focusing on the meso level have implied that EEG has predominantly developed imprecise categorizations of micro-level activity and that the role of the macro level mainly has been approached by looking at supraregional linkages as relatively homogenous. These approaches can largely be classified as static, and dynamic approaches that treat the three levels as integrated are lacking. Thus, the approach to regional industry renewal used herein emphasizes that its sources can be both endogenous and exogenous to a region, and also that agency can play a role in shaping how these processes develop spatio-temporally, i.e. that different actors can proactively contribute to the process. In addition, the few recent contributions investigating the micro, meso and macro levels in conjunction have largely focused on path creation and new industry development, and less so restructuring of existing industry activity.

Thus, a multilevel approach to regional industry renewal is developed. Furthermore, this is connected to the debates over the role of structure and agency in EEG. It is argued that EEG has generally ascribed power to structure over agency, but that recent conceptual and empirical works have granted agency (ascribed to the micro level) a more prominent role in the evolution of economic systems. It is proposed that different actors, e.g., firms, industry clusters, and national policymakers, have different scopes and roles in the regional industry renewal processes, but that, importantly, agency resides not only at the micro level but also at the meso and macro levels. The connotation of this argument is for instance that the agency of cluster facilitation can play an important role in regional industry renewal. This is referred to as 'system agency', because deliberate actors can play a role in changing structural frameworks, e.g., through changing national regulations or regional innovation policy, and that they, in turn, can influence the practices of other (regional) actors.

These issues are explored based on seven papers, each of which used qualitative methodology. The papers contribute with theoretical and empirical insights on the role of agency and multilevel dynamics in regional industry renewal. The empirical work described in these papers focused on the Bergen region in western Norway. Based on this work, the Bergen region is argued to be characterized by beneficial multilevel dynamics as a result of strong firms and research and development organizations, and an industry structure characterized by related and diversified activities. Furthermore, policy has arguably played an important role in contributing to regional industry renewal in the Bergen region, *inter alia* through RIS development. In addition, the region is also characterized by a largely positive interweaving in global knowledge flow and trade, and several leading firms operate in the region. Thus, the Bergen region serves well as a case study illustrating the theoretical and conceptual approaches developed in this dissertation.

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Table of contents

Figures

Tables

List of papers

This dissertation covers the following papers:

#1 **Njøs R**, Jakobsen S.-E and Rosnes V. (2016) Market-driven organizational lock-in: A case study of a former first mover. *Norwegian Journal of Geography* 70(3): 140-151. DOI: http://dx.doi.org/10.1080/00291951.2015.1116601

#2 **Njøs R**, Orre L and Fløysand A. (2017) Cluster renewal and the heterogeneity of extra-regional linkages: a study of MNC practices in a subsea petroleum cluster. *Regional Studies, Regional Science* 4(1): 125-128. DOI: http://dx.doi.org/10.1080/21681376.2017.1325330

#3 Fløysand A, **Njøs R**, Nilsen T and Nygaard V. (2016) Foreign direct investment and renewal of industries: framing the reciprocity between materiality and discourse. *European Planning Studies* 25(3): 462-480. DOI: http://dx.doi.org/10.1080/09654313.2016.1226785

#4 **Njøs R** and Jakobsen S.-E. (2016) Cluster policy and regional development: scale, scope and renewal. *Regional Studies, Regional Science* 3(1): 146-169. DOI: http://dx.doi.org/10.1080/21681376.2015.1138094

#5 **Njøs R**, Jakobsen S.-E, Aslesen H.W and Fløysand, A. (2016) Encounters between cluster theory, policy and practice in Norway: Hubbing, blending and conceptual stretching. *European Urban and Regional Studies* 24(3): 274-289. DOI: http://journals.sagepub.com/doi/10.1177/0969776416655860

#6 **Njøs R** and Jakobsen S.-E. (2017) Policy for evolution of regional innovation systems: The role of social capital and regional particularities. *Science and Public Policy* scx064. DOI: https://doi.org/10.1093/scipol/scx064

#7 **Njøs R** and Fosse J.K. (under review) Linking the bottom-up and top-down evolution of regional innovation systems to policy: Organizations, support

structures and learning processes. *Revised version submitted to Industry & Innovation.*

1. Introduction

For decades, economic geographers have been interested in the restructuring of economic activity and how this is linked to spatial settings. Naturally, this theme has also been high on the agenda of policymakers and industry facilitators, as well as the firms and organizations that continuously face restructuring challenges due to external forces such as disruptive technological development, economic globalization, and other societal changes. Several academic fields have been involved in the debates on these topics (Carlsson, 2016), which have contributed different explanations and theories for how industry restructuring occurs, the role of policy in this process, and how actors adapt to changing circumstances, such as through strategy and organization. The goal of this dissertation is to discuss regional economic restructuring from the perspective of evolutionary economic geography (EEG). The EEG literature, with strong links to the innovation systems literature (Fagerberg et al., 2005), has gained momentum in recent years (Boschma and Martin, 2010; Fagerberg and Verspagen, 2009). By linking evolutionary economic theory (Nelson and Winter, 1982) to spatial frames of reference (Martin and Sunley, 2006), the EEG literature argues that past choices influence a region's current and future economic activities, which means that regional industry structures tend to be 're-produced' (Neffke et al., 2011). This means that initiation of new development paths, i.e. new industry activity, is most likely to succeed if it is related to existing industry activities (Neffke et al., 2011; Frenken et al., 2007) and that relatedness between regional industries, rather than industrial specialization, drives innovation (Aarstad et al., 2016). Consequently, though potential gains are high (Grillitsch et al., 2017), the literature claims that

> Jumping into a completely unrelated sector, though still possible, would increase fundamental uncertainty and make firms face higher costs and higher risks of failure, due to the lack of required capabilities both at the firm and the regional level (Cortinovis et al., 2017: 1181).

Another important area of insight that EEG has stressed is that regional economic restructuring is not just about adaptation, i.e. reactively responding to changing environments (an understanding linked to the role of external shocks as enablers of change [Arthur, 1989]). Rather, regional restructuring also concerns the adaptability capabilities of regional industries (Chapman et al., 2004). This implies a situation that is not about 'the "optimal fit" to existing contingencies, as with adaptationist strategies, but to endure some resource slack supporting a repertoire of potential solutions to unforeseen problems' (Staber and Sydow, 2002: 409). This is an important point in that it allows consideration of regional economic restructuring as a continuously ongoing process (cf. Penrose, 2009). However, approaches to regional restructuring have tended to focus on how former contingencies and scopes of action, whether in firms, regions or industries, can be re-established following an external shock (Martin et al., 2015; Karlsen and Dale, 2014). This is captured by the resilience concept, which explains how a region can withstand an external shock and then re-establish the economic situation as it was prior to the incident (see discussion by Hu and Hassink, 2017a). However, such 'traditional' understandings of resilience (Martin and Sunley, 2015) carry a connotation of reactivity. In contrast, by presenting how regional economic restructuring can be approached by looking at the proactivity of different actors, this dissertation emphasizes that restructuring can be understood through the concept of regional industry renewal. This understanding underscores regional economic restructuring as a continuous, ongoing process, which can also be influenced by deliberate actors. This approach considers that industries evolve over time and in space, and that they do so under the influence of change processes both from within, e.g. regional firms and research and development (R&D) organizations, and from outside, e.g. national policies or changes in global trade markets (Martin and Sunley, 2006; Martin, 2010). Moreover, though actors operate within environments that are conditioned by former choices, this does not mean that current contingencies are predetermined; rather, scopes of action are shaped by both system structures and the actors encompassed by them. Furthermore, following a 'strict' reading of the evolutionary perspective, it must also be acknowledged that previous contingencies cannot be re-established. This focus inspires exploration of the role of agency, i.e. 'an action or intervention to produce a particular effect' (Emibayer

and Mische, 1998 quoted by Sotarauta and Suvinen, forthcoming) in regional industry renewal. This topic has recently been elevated within the EEG agenda (Boschma et al., 2017). Furthermore, although regional industry renewal is a continuous, ongoing process, it must also be considered that regions differ and that the renewal processes are influenced by regional specificities (see Section 3). This means that the 'degree' of change is a matter of spatio-temporal specificities. Some regions may experience periods during which there are low degrees of renewal, i.e. continuation is dominant, while in other regions, or during other periods, renewal is more substantial, i.e. a high degree of change.

Hence, EEG argues that regional industry development is conditioned by regional capabilities that are difficult to imitate (Tödtling and Trippl, 2005; Asheim et al., 2011), but that these unique 'mixes' of tangible and intangible assets nonetheless require continuous upgrading and development, i.e. renewal, to avoid negative path dependency and lock-in. This also explains why, even in times of digitalization, automation, and increased mobility, the geographic agglomeration of economic activity is evident, as has recently been exemplified in a study of the US robotics industry (Leigh and Kraft, 2017). However, this is not to say that supraregional settings do not matter to regional industry renewal. This is often approached through investigating the activities firms and organizations across geographical borders, e.g. multinational companies (MNCs). It is argued that such linkages are crucial for contributing to novelty in regional economies (Bathelt et al., 2004; Fitjar and Rodríguez-Pose, 2013). Thus, regional industry renewal is the result of both endogenous and exogenous conditions, e.g. changes in commodity prices, regulatory regimes, disruptive technologies. In EEG, this has been approached from three analytic levels—micro, meso, and macro (Hassink et al., 2014: 1297). Some investigators have focused on how the micro level of firms and organizations (Sydow et al., 2009), the meso level of regional industry clusters (Isaksen, 2011), industries, and innovation systems (Coenen et al., 2016), and the macro level of supraregional settings (Fagerberg et al., 2009) evolve. However, little attention has been paid to the actor complexes involved and the level of abstraction that should be addressed by investigations of regional industry renewal (Dawley et al., 2015). Furthermore, EEG has been primarily occupied with the meso level, so that empirical studies have typically

investigated regional industry activity through ascription of standard industrial classification (SIC) codes, i.e. *a priori* categorization of micro-level activities (see the review by Content and Frenken, 2016). Thus, EEG has been criticized for being naïve in focusing on regional settings *per se*, without describing how supraregional influences, i.e. the macro level, also play a role in regional industry renewal (Binz et al., 2016; Trippl et al., 2017; Isaksen and Trippl, 2016a). To the latter point, it has been suggested that EEG should look to other literatures to better account for network linkages and flows of tangibles and intangibles, such as the relational economic geography literature (Bathelt and Li, 2014; Hassink et al., 2014; Fløysand and Jakobsen, 2011; Gertler 2010; Coe et al., 2004). In the words of Strambach and Halkier (2013: 3):

> The analytical perspective of path dependency in EEG is, not exclusively but primarily, the meso level with the focus on the evolution of cluster or firm populations like new branches as well as the development trajectories of cities and regions at the system level.

Another critique of EEG has been that the role of agency, which has mainly been ascribed to the micro level of firms and non-firm actors (Binz et al., 2016; Dawley et al., 2015; Vallance, 2016) has been neglected (Holmen and Fosse, 2017; Simmie, 2012; Strambach and Halkier, 2013; Steen, 2016; Sydow et al., 2009; Karnøe and Garud, 2012; Garud and Karnøe, 2010; Iammarino, 2005; Zhu et al., 2017). Consequently, recent contributions have examined the role of structure and agency in regional economic evolution. It has been acknowledged that EEG has had a structural focus rather than being sensitive to the role of agency (Boschma et al., 2017; Dawley 2014). Hence, it can be argued that EEG—despite its ontological and epistemological underpinnings (see Section 2)—has primarily focused on aggregate structures within regional settings, i.e. the meso level. It has also been argued that much of the literature is dominated by 'uni-level' approaches, which means that 'a linear perspective dominates with the understanding that relatedness measures more or less determine opportunities and set limits to possible regional diversification activities' (Kogler, 2017: 4).

With this as a starting point, this dissertation aims to investigate the role of multilevel dynamics, i.e. linkages between the micro, meso, and macro levels, of regional industry renewal, while also connecting these concepts to the role of structure

and agency. By investigating regional industry renewal in the Bergen region (western Norway), this dissertation aims to contribute to the EEG literature by developing an approach to regional industry restructuring that emphasises the role of proactive agency and multilevel dynamics. The Bergen region serves as an interesting case-in-point because it is characterized by strong, related industries and support systems, in which several industry actors have global roles in their industries. Moreover, this region has recently been tested by an external shock: i.e. the sudden, recent drop in oil prices (in late 2014). However, although the region is known for its reliance within the petroleum industry (Blomgren et al., 2013), it appears that relatedness between regional industries, coupled with supraregional linkages, have also been important in addressing the effects of the shock. In addition, it will be argued that it is important to consider the agency of different actors (Dawley 2014), e.g. cluster facilitators, MNCs, and business leaders, when investigating processes of regional industry renewal.

In other words, this dissertation discusses the importance of going beyond static, uni-level approaches to regional industry restructuring (Martin, 2010) by developing an analytical framework treating the micro, meso, and macro levels in conjunction and linking these to examinations of the role of agency. This framework has been informed by adjacent literatures, e.g. innovation studies, technological innovation systems, organizational science and strategic management. Moreover, unlike other recent contributions focusing on new industry development (Matti et al., 2017, Dawley et al. 2015), it takes into consideration how existing industries are renewed, tying up to contributions investigating the role of incumbents and existing industries in the evolution of regional economic development (Steen and Weaver, 2017). The implications of this approach for both regional economic restructuring theory and policy are discussed at the end of the dissertation. The following primary and secondary research questions are asked:

- Primary Research Question (PRQ): How can the multilevel dynamics of regional industry renewal be approached analytically?

- Secondary Research Question 1 (SRQ1): What characterizes the multilevel dynamics of regional industry renewal among the firms, industries, clusters, and regional innovation system in the Bergen region?
- Secondary Research Question 2 (SRQ2): What is the role of agency (in firms, industries, clusters, and regional innovation systems) in regional industry renewal?
- Secondary Research Question 3 (SRQ3): How do the case study investigations of multilevel dynamics and agency presented here inform theory and policy for regional industry renewal?

These questions are addressed by seven papers (Table 1).

Table 1: Papers, actor focus, and multilevel dynamics investigated.

#	Authors (year)	Title	Actor focus	Multilevel dynamics investigated
1	**Njøs**, Jakobsen and Rosnes (2016)	*Market-driven organizational lock-in: A case study of a former first mover*	Firm	*Micro–macro*
2	**Njøs**, Orre and Fløysand (2017)	*Cluster renewal and the heterogeneity of extra-regional linkages: a study of MNC practices in a subsea petroleum cluster*	Firms	*Micro–meso–macro*
3	Fløysand, **Njøs**, Nilsen and Nygaard (2016)	*Foreign direct investment and renewal of industries: framing the reciprocity between materiality and discourse*	Industries	*Micro-meso–macro*
4	**Njøs** and Jakobsen (2016)	*Cluster policy and regional development: scale, scope, and renewal*	Clusters	*Meso–macro*
5	**Njøs**, Jakobsen, Aslesen and Fløysand (2016)	*Encounters between cluster theory, policy and practice in Norway: Hubbing, blending, and conceptual stretching*	Clusters	*Meso–macro*
6	**Njøs** and Jakobsen (2017)	*Policy for evolution of regional innovation systems: The role of social capital and regional particularities*	Regional innovation systems	*Meso–macro*
7	**Njøs** and Fosse (under review)	*Linking the bottom-up and top-down evolution of regional innovation systems to policy: Organizations, support structures, and learning processes*	Regional innovation systems	*Micro–meso*

Section 2 introduces EEG, followed by a discussion of regional industry renewal and a multilevel approach that is sensitive to the discussion introduced above, i.e. a multilevel, dynamic approach to regional economic restructuring. This is further discussed in light of the agency–structure debate in EEG, and it is argued that a multilevel framework must consider the roles of both agency and structure in regional industry renewal. Section 3 links evolutionary reasoning to the qualitative case study methodology used in the papers upon which this dissertation is based, and the Bergen region's economic activity characteristics are described. Section 4 describes how each paper individually contributes theoretical and/or empirical insights into the role of agency and multilevel dynamics in regional industry renewal. Finally, Section 5 concludes with a direct response to the dissertation research questions and presents some avenues for future research.

2. Evolutionary Economic Geography: Background

2.1. Tracing the evolution of EEG

EEG build on key notions of evolutionary theory as developed by Darwin and the field of biology, where the seminal contribution by Nelson and Winter (1982) within economics (see also works by Veblen, Marshall, and Schumpeter) has been especially influential in transposing this thinking into economic geography. Overall, these ideas are underpinned by an evolutionary ontology that 'is fundamentally and persistently complex' (Castellacci, 2006: 867). Representing a critique of neoclassical economic theory (Backhaus, 2003), this school of thought employs—both explicitly and implicitly—metaphors, theories, concepts, and frames of reference from biology (Wimmer and Kössler, 2005; Essletzbichler and Rigby, 2010). Consequently, evolutionary theory, as used within economics, innovation studies, and EEG, builds on key notions of complexity, differentiation, structure, systems, openness, continuous change, and a high degree of uncertainty (Castellacci, 2006). This approach carries a host of implications. For instance, as noted by Boschma and Martin (2010: 5), 'thinking about the economy as a dynamical, irreversible and self-transformational system opens up new space for theoretical, ontological and epistemological exploration'. Economic geographers have taken on this challenge and it is argued that EEG is now a subfield within economic geography (Grabher, 2009; Kogler, 2015).

Following this integration, the ontological underpinnings of treating (regional) economic development and spatial contexts as 'evolving' have been debated. For instance, it has been argued that there are challenges with applying biological thinking to social phenomena (Cordes, 2006). Several issues arise in this regard. For instance, it has been claimed that the 'importation' of biological concepts 'have been deployed in a rather ad hoc fashion' (Essletzbichler and Rigby, 2010: 43). One way of approaching the use of evolutionary biology in social scientific studies of innovation has been to consider this 'lending' of theories as a metaphorical practice (for more on this, see

Chattoe, 2006). However, it has also been argued that such an application of biological theories has wider, thoroughgoing implications. Claims have been made that generalized Darwinism (Aldrich et al., 2008) should form the epistemological basis for research on innovation and industry development. Such an approach implies that 'core principles of evolution provide a general theoretical framework for understanding evolutionary change in complex population systems (from physical to social systems), but that the meaning of those principles and the way they operate are specific to each domain' (Essletzbichler and Rigby, 2010: 44). This suggests considering evolution as a perspective that extends from 'pure' biological theory, to a way of approaching *all* systems using the same (abstract) framework. According to Aldrich et al. (2008), generalized Darwinism is a perspective that encompasses three central concepts of systemic evolution: variety, selection, and inheritance. However—and importantly—using this way of thinking about social systems requires an approach capable of bridging the material dimension of physical systems with the discursive and socially constructed dimension of social systems. What is required from such an approach is an ability to go 'deep' enough into investigations to bridge these logics epistemologically and ontologically, i.e. to investigate interlinkages between the 'natural' and the 'social' worlds. This invokes central insights from work on critical realism (Martin and Sunley, 2006), namely that 'the social world is not closed like a laboratory but open to a complex array of influences which change both temporally and geographically, often in unexpected ways' (Edwards et al., 2014: 4). Taking this as a starting point has several implications for theory, methodology, and empirical investigation.

2.2. The 'materiality' of evolutionary thinking: a critical realist position

Considering innovation and economic development as conditioned by the evolutionary mechanisms of variety, selection, and inheritance shares several similarities with the ontology of critical realism (Castellacci, 2006). Critical realism is concerned with how 'the real', i.e. material structures, enable human agency and social constructions of the world. As a philosophical underpinning, this perspective asserts that the world consists of unchanging and changing dimensions, i.e. it emphasizes that conceptions of society are conditioned by physical material structures existing 'out there', independent of our

reasoning about them. However, unlike positivist approaches, critical realism (see e.g. Archer et al. 1998 and Sayer 2000) claims that what we observe is not 'enough' to describe reality. Critical realism simultaneously criticizes constructionist thinking by stressing the dynamics and interlinkages between materiality and discourse (Fløysand et al., 2013). Therefore, critical realism takes as a starting point that our observations are guided by stratifications of the (real) world, and that 'human agency produces effects through drawing on existing structures and practices which are reproduced and/or transformed in action' (Fairclough, 2005: 922). Thus:

> What constitutes the structure, that is, the real (deep) level of generative mechanisms, is not simply the existence of heterogeneous agents *per se,* but rather the interdependencies and relationships among them. This is the core of the systemic perspective: innovation is a social phenomenon that can only be investigated by looking at the interactions between firms, users of new technologies and public organisations within a given institutional, sectoral and national context (Castellacci, 2006: 867).

Consequently, critical realism holds that it is not enough to simply *observe* something to say how the phenomenon comes about, we are also required to go into the deep structures and generative mechanisms 'producing' events (Castellacci, 2006; Edwards et al., 2014). These events are considered to be the result of necessary and contingent conditions (Sayer, 2000), which means that observed empirical phenomena consist of both 'regularities', e.g. inheritance, selection, and variety, and 'fluctuations'. For example, in Paper #3, which addresses foreign direct investment (FDI) and renewal of regional industries, we explain that the practices of MNCs and FDI outcomes are conditioned by interplays between materiality, e.g. transfer of capital and networks, and dominant narratives in a regional industry. This means that 'similar' MNC practices contribute differently to regional industry renewal in various regions because the outcome of such intersections between the 'regularities' of FDI activity and the 'fluctuating', socially constructed narratives, differ spatio-temporally (see also Fløysand and Jakobsen, 2017). Hence, the role of FDI and MNC practices in regional industry renewal can be considered conditioned by certain necessary conditions, e.g. transfer of capital across national borders, as well as by contingent conditions, e.g. regional circumstances, such as that reflected by narratives, which influence the degree of

renewal. Critical realism argues that these interplays are of particular interest. This issue is revisited in Section 3 regarding methodology, after first providing more detail about how EEG has developed and how it relates to regional industry renewal.

2.3. Evolutionary theory, regional industry development, and innovation

When discussing regional industry development from an academic perspective, the concept of innovation and adjacent literatures soon enter the frame. Current paradigmatic work on industry development has built heavily on understandings of innovation as a driver of economic growth, and the literatures on regional industry development and (systems of) innovation have, to a large extent, conflated (Jakobsen and Høvig, 2014; Karlsen and Dale, 2014; Nightingale and Coad, 2014). Essentially, regional industry renewal, as it is approached in this dissertation, builds on several rationales from the innovation literature, e.g. that innovation plays a key role in economic development, that interactions between different actors is crucial, and that policy can play a role in stimulating such interactions. In this line of research, innovation is considered to be the result of systemic interaction between a host of different actors (Chesbrough, 2003; Lundvall, 2007; Fagerberg et al., 2005). Among the theories and concepts emphasizing innovation as systemic, national innovation systems (Freeman, 1987; Lundvall and Johnson, 1994), RIS (Asheim and Gertler, 2005), sectoral innovation systems (Malerba, 2002), triple helix (Etzkowitz and Leydesdorff, 2000), and industry clusters (Porter, 1990; Martin and Sunley, 2003) have been particularly influential, both in the academic literature and in policymaking (Balzat and Hanusch, 2004). Evolutionary theory argues that these systems and processes are influenced by former contingencies through 'inheritance' of e.g. practices, norms, and institutions. A seminal contribution on this topic was made by Nelson and Winter (1982) in their influential book *An Evolutionary Theory of Economic Change*, in which they argue that economic growth is conditioned by firms and their evolution. This perspective on economic growth and innovation has been popularized by influential contributions spanning the evolution of technology (Dosi, 1982; David, 1985), organizations (Sydow et al., 2009), institutions (North, 1994), regions (Boschma and Frenken, 2006; Martin and Sunley, 2006), and the economy more broadly (Fagerberg, 2003), to name just a

few examples. This, in turn, implies that (systemic) environments are centrepieces for explaining how innovation and economic development come about, and how they evolve. Hence, as evolutionary biological thinking has been adopted and adapted by economic geographers and innovation researchers, the paradigmatic rationale now rests on three dimensions:

1. Innovation is the result of interactions between actors in systems, i.e. environments, and
2. such systems continuously evolve (though at differing 'intensities'), where
3. both the system and the actors reciprocally influence each other.

This implies that approaches within the literature differ regarding how the 'system' is defined. Not surprisingly, economic geographers have been particularly concerned with the spatial specificities of innovation. It has been argued that innovation and economic development are highly conditioned by geography, and the regional geographical level plays a particularly important role. This has been well framed by Maskell and Malmberg (1999: 178):

> More often than not, localised capabilities have the potential to be more durable than the assets on which they were built: the physical structures and natural resources accessible in the region, as well as the institutional endowment and knowledge available. Regions rebuild obsolete structures, renew exhausted resources, restore decrepit institutions, revitalise outdated skills, and replace inadequate knowledge.

In this respect, EEG focuses on how actors and systems continuously evolve through mutual reciprocities, but it is a matter of debate where the balance between 'actors' and 'environments' may be, which leads to discussions about which of these categories should be considered 'most' important to regional industry renewal. This issue is also reflected in structure–agency debates, in which it has recently been acknowledged that EEG ascribes explanatory power to structures and systems without necessarily acknowledging the role of agency in changing system structures, i.e. 'environments'.

2.4. EEG and regional industry renewal: Actors and levels, structure and agency

2.4.1. Actors and levels

As described above, emphasis in EEG has been placed on the meso level of the region as a 'container' for innovation activity and economic development. Consequently, several authors have sought to refine the understanding of how regional settings influences regional actors and vice versa, often with contrasting conclusions. This is illustrated by the contradictory contributions by Van Oort (2015) and by Frenken and Boschma (2015) in the recently published *Handbook of Research Methods and Applications in Economic Geography* (Karlsson et al., 2015). These authors' chapters differ in terms of how they consider the role of firms and organizations, i.e. the micro level, in evolutionary theory. Van Oort argues that EEG struggles to incorporate explanations of (primarily) firm heterogeneity, while Frenken and Boschma argue that EEG accounts for these issues through its conceptual foundation (see Boschma and Frenken, 2006; Frenken and Boschma, 2015; Coenen et al., 2016). The latter point to the literature on evolutionary economic theory and its resource-based understanding of the firm (Penrose, 2009; Nelson and Winter, 1982). From this perspective, renewal is considered the result of (unique) combinations of organizational resources (Teece et al., 1997; Lawson and Samson, 2001; Nelson, 1991; Chandler, 1992) and the idea is that continuous improvement of (organizational) resources is the key to avoiding negative path dependency, lock-in, and decline. This perspective also holds that firms develop new capabilities based on existing resources (Penrose, 2009) or what is labelled 'branching' within EEG (Boschma and Frenken, 2012). This also resonates with dominant theories of regional industry development and meso-level policy (Laasonen and Kolehmainen, 2017), where it is argued that the intention of policy should be to combine regionally (unique) resources through tailored strategies/polices targeting related activities (cf. Tödtling and Trippl, 2005). This is exemplified by concepts such as smart specialization (European Commission, 2012), constructing regional advantages (Asheim et al., 2011), and platform policies (Sydow and Koll, 2017).

However, claims such that 'an evolutionary approach reasons from the fundamental logic that firms develop firm-specific routines that differ from each other, and therefore do not easily connect, let alone learn from each other' (Frenken and Boschma, 2015: 295) are more evident from theoretical propositions than they are in much of the current empirical work. This is also noted by Bathelt and Li (p. 593):

> In fact, although evolutionary approaches are often based on a firm perspective, the actual analysis addresses aggregates, such as regional structures and developments, and derives general statements about, for instance, the persistence of regional distributions.

In general, much of the EEG literature has overlooked the heterogeneity of the micro level and instead explained how the meso level evolves. One example of this is the RIS literature. For instance, as discussed in Paper #6, there are ongoing discussions in the RIS literature about the interplay between the meso (regional policy implementation) and macro (national policy development) levels. In addition, as discussed in Paper #7, there are discussions about whether it is the micro or meso levels that drives RIS evolution (Uyarra, 2010). Hence, it is unclear how notions of the micro level have been incorporated in the dominant theories, which means that the RIS approach 'is somewhat blunt as a tool for understanding the organization of innovation from the perspective of the actors (i.e. organizations and individuals)' (Asheim et al., 2015: 279). Necessarily, the importance of certain factors such as local firms, MNCs and R&D organizations, industry/cluster facilitators, and regional and national policies, is uncontested. However, the question remains how and to what 'extent' the micro level (and its heterogeneity) is included in conceptualizations of regional industry development and renewal (for a discussion of the neglect of R&D organizations, see Vallance, 2016). This is also the case for the influential cluster literature, which has been particularly occupied with explaining and understanding clusters as isolated entities in regional contexts rather than investigating their broader geographical influence (see Paper #4; Asheim et al., 2017). This issue has been nicely captured by Martin (2010: 14), who argued that it is 'striking how often in cluster theory and cluster studies … microlevel heterogeneity or variety is ignored or assumed not to exist; instead, clusters are often portrayed as if they are internally homogenous'. Hence, as illustrated by an empirical example from the Cognac area in France (Moodysson and Sack, 2016), it should be considered that the micro level

may respond differently to the same meso- and macro-level settings, something which was also discussed in Paper #2 (see also Moodysson and Zukauskaite, 2014). Further, EEG should consider the macro level more explicitly (Trippl et al., 2017), e.g. by considering national innovation policy (Paper #6), global trade flows (Papers #1 and #2), and other supraregional influences. However, this does not imply that the micro, meso, and macro levels should be 'aligned'. For instance, meso-level support structures, e.g. RIS, do not necessarily reflect capabilities at the micro level or vice versa (Zukauskaite et al., 2017). This is exemplified in Papers #2, #3, and #5, which show how micro- and meso-level actors respond differently to the same macro-level influence. In addition, as described by authors such as Jakobsen and Lorentzen (2015) and Fitjar and Rodríguez-Pose (2011), in some firms—and contrary to claims in the cluster literature—supraregional linkages matter more than linkages to other actors within the same meso-level setting.

Hence, EEG runs the risk of conflating multilevel heterogeneity and variation into overly broad, aggregated categories (cf. Carlsson 2016; Rothaermel and Hess, 2007; Dopfer et al., 2004). This also influences how EEG approaches agency–structure dynamics, with most contributions focused on categorizations of aggregated (but related) economic activity, i.e. structure rather than agency. This is particularly well illustrated in the literature on industry clusters and by the concept of related variety (Frenken et al., 2007; Aarstad et al., 2016). The related variety approach argues that:

> the higher the number of technologically related *sectors* in a region, the more variety in related *sectors*, the more learning opportunities there are for *sectors* in that region, and the more *intersectoral* knowledge spillovers are likely to take place, resulting in higher regional growth (Boschma and Frenken, 2011: 188, italics added)

In effect, related variety has placed weight on industry structures, i.e. an *a priori* ascription of micro-level activity (Content and Frenken, 2016; Wixe and Andersson, 2017; Fitjar and Timmermans, 2017) in explaining what makes regions innovative. This means that investigations of micro-level practices, i.e. how crossovers between industries and knowledge domains occur 'in reality' (Njøs et al., 2014; Lee, 2017; Hauge et al., 2017; Enkel and Gassmann, 2010) has been investigated far less frequently. This critique of 'structure fetishism' is also valid for EEG more broadly (Simmie, 2012;

Steen, 2016) because the literature in this area has focused predominantly on structural conditions for regional industry renewal rather than acknowledging the role of agency in such processes. Moreover, agency has mainly been ascribed to the micro level (i.e. firms, organizations, individuals) and less work has conceptualized how agency can also change structures at the meso and macro levels (see Dawley 2014 for an example). However, the latter has been more thoroughly addressed recently (Tödtling and Trippl, 2014; Sotarauta and Suvinen, forthcoming), and it has been shown how deliberate 'systemic' changes can in turn influence the practices of regional actors (Fløysand et al., 2012).

2.4.2. Structure and agency

Thus, it is not just that the micro level has been 'left out'. This discussion also illustrates how aggregated structures have been given primary explanatory power over agency-sensitive accounts. However, EEG's structural focus has lately come under scrutiny, and authors have begun highlighting the role of agency in driving regional economic development (Boschma et al. 2017, Boschma 2016), at the micro (Sydow et al., 2009), meso (Holmen and Fosse, 2017), and macro levels (Steen, 2016). For instance, it has been argued that 'EEG accounts of new path creation tends to render social agency, motivation and strategy largely invisible' (Steen, 2016: 1606). However, much of this critique has been influenced by adjacent academic fields, such as organizational science and strategic management (Garud and Karnøe, 2010; Karnøe and Garud, 2012; Sydow et al., 2009; Garud et al., 2007). This means that the understanding of agency has been ascribed to the micro level of firms, organizations, and, to some extent, individuals. However, as has been discussed above, agency can also operate at the meso and macro levels. For instance, as shown in Paper #5, cluster facilitators play an important role in 'translating' macro-level cluster policies, which in turn influence practices at the micro level (see also Fløysand et al., 2012). This is also connected to discussions about RIS and the role of policy in contributing to adaptability capabilities in regional industries. An appropriate response thus means that policy should be 'open' enough to support change while simultaneously being 'conservative' enough to support existing industry activities. This argument is consistent with the discussions on the interconnections

between the meso and macro levels in Papers #3, #4, #6, and #7, such as investigating how top-down policy initiation is important for development of RIS in some regions (Paper #6), but also how the micro level is an important constituent in RIS evolution (Paper #7). This illustrates the interweaving of structure and agency in processes of regional industry renewal. Thus, in understanding how policy can support regional industry renewal, recent accounts have argued for the importance of agency across the micro, meso, and macro levels. This is reflected by writings on for instance regional leadership (Sotarauta et al., 2017; Sotarauta and Beer, 2017; Hu and Hassink, 2017b). In that literature, in addressing issues such as institutional entrepreneurship (Battilana et al., 2009), it has been submitted that agency can shape and change structures on the micro level, such as in an organization, the meso level, such as in a cluster, and the macro level, such as national regulations. Consequently, Tödtling and Trippl (2014) have proposed that there is a need to develop dynamic approaches capable of also investigating the role of 'system agency' (Hu and Hassink, 2017b), not just the agency of firm actors (Sotarauta and Suvinen, forthcoming).

2.5. Towards a dynamic multilevel approach

As discussed, EEG has generally employed static 'uni-level' approaches that do not necessarily encompass the inherent dynamics emphasized by an evolutionary ontology. For instance, regarding EEG's focus on the meso level, Van Oort (2015: 263) argued that this is 'not necessarily reproduced at the firm level because information on the variance between firms is lost when aggregated regional-level data are used.' Similar comments have been made by others, such as Kogler (2015) who warned about the dangers of employing a 'linear' approach when investigating the issue of meso-level relatedness. This coincides with other epistemological arguments proposed in the evolutionary literature (see Dopfer et al., 2004; Schroeder, 2011):

> concentrating on only one level of analysis implicitly assumes that most of the heterogeneity is located at the chosen level, whereas alternate levels of analysis are considered to be more or less homogenous. Studies of firm-level heterogeneity assume, for example, that significant variation occurs at the firm level of analysis, whereas individuals are more or less homogenous or randomly distributed across firms. Second, when focusing on one level of analysis, researchers implicitly assume that the focal level of analysis is more or less independent from interactions with other lower- or higher-order levels of

> analysis. Firm-level heterogeneity, for example, is assumed to be relatively independent from individual- or network-level effects. Taken together, the assumptions of homogeneity in, and independence from, alternate levels of analysis are serious concerns that could lead to spurious empirical findings (Rothaermel and Hess, 2007: 899).

Considering these arguments and linking them to the ontological and theoretical discussion above suggests that regional industry renewal should be understood through a dynamic multilevel approach, considering complex connections across various spheres (both tangible and intangible), geographies (Fløysand and Jakobsen, 2011), and analytical levels (cf. e.g. Berggren et al., 2015). Thus, rather than isolating the micro level from the meso or macro levels, or giving structure explanatory power over agency, investigations should instead focus on uncovering processes and mechanisms interacting between the three levels, and between 'purely' structural or agency-focused accounts (Carlsson 2016). Dopfer et al. (2004; see also Carlsson and Stankiewicz, 1991) have argued that evolutionary approaches contribute with important insight into this, and that for instance practices in which the micro level is aggregated to the meso and macro levels counteract evolutionary reasoning and instead resemble the formal, algebraic, and static logic of neoclassical economics (of which evolutionary theory is highly critical) (see Gertler 2010 for a similar argument). However, these practices disregard one of the key arguments in evolutionary theorizing, i.e. that one cannot directly sum micro into macro (Dopfer et al., 2004: 263). This is also noted by Martin and Sunley (2006: 405) in their seminal article on EEG, in which they argue that 'what is clear is that different components of an economic system do in fact change and evolve at quite different rates, some very slowly and others much more rapidly and radically'. In addition, Carlsson (2016: 14) reminds us that 'technologies have different impact in different contexts, and firms have different features such as strategies, organization, capabilities, and resources, and thus they behave differently.'

In connection to the issue of this dissertation, i.e. regional industry renewal, it becomes evident that the three levels presented above—the micro level of firms and organizations, the meso level of regional clusters and RIS, and the macro level of supraregional environments—should be considered in conjunction (Dawley et al, 2015; Matti et al., 2017). However, doing so requires insight into mechanisms linking the three

levels (Zukauskaite et al., 2017), but also implies, as mentioned above, that it is necessary to investigate the role of agency *on all three* levels (see Figure 1 below). For instance, according to Sydow et al. (2009), the aim of proactive agency is to interrupt self-reinforcing patterns that lead to path dependence and to alter the dynamics that set the dependency in motion (see Paper #1). In other words, systemic change can result from deliberate action by different actors (Papers #5 and #7; Sotarauta, 2016). For example, Holmen and Fosse (2017) have shown that what they call 'policy agents' and 'entrepreneurial agents' play important roles in the branching out of new industry paths on the meso level. Moreover, as described above, recent contributions have begun addressing issues such as how agency on the meso level, in terms of 'system agency', changes RIS (Tödtling and Trippl, 2014). Consequently, in line with the quote by Martin and Sunley above, systemic complexity can be seen to result from differences both within each of the three levels, but also, importantly, across the levels through complex multilevel dynamics (Bergek and Onufrey, 2013). This means that different parts of a system co-evolve over time (Martin, 2010; Strambach and Halkier, 2013; Carlsson 2016) and that analytical approaches must consider multilevel dynamics to investigate how 'paths can have positive as well as negative influences on each other' (Onufrey and Bergek, 2015: 540). Here, work on institutional entrepreneurship (Battilana et al., 2009) and 'fields' (Brunninge and Melander, 2016; Normann et al., 2016; Fløysand and Jakobsen, 2001) offer interesting insights, especially when linked to spatial frames of reference (Hu and Hassink, 2017b).

The point is that actors operate across different (tangible and intangible) levels. This should be considered when conceptualizing regional industry renewal. However, for analytical purposes, the distinction between micro, meso, and macro levels is here retained. For instance, Paper #2 exemplifies how diversified practices at the micro level contribute differently to cluster, i.e. meso level, development trajectories, but also that micro-level practices are influenced by macro-level global trade and FDI flows. Similarly, Paper #6 investigates the agency of the meso level in intersections between the meso and macro levels, in which the role of regional partnerships in RIS development is considered, and it is argued that regional partnerships in different regions

are given different scopes of action and autonomy in implementation of national VRI (Tools for Regional R&D and Innovation) policy.

Thus, in line with the theorizing on EEG, it is here taken as a starting point that regional settings are important for industry renewal, but that supraregional linkages, i.e. the macro level, also play a crucial role in shaping how regional economic activities evolve (Dicken, 2007; Coe et al., 2004, 2008). This topic was also addressed in a special issue in the *Journal of Management Studies* (Meyer et al., 2011), emphasizing that EEG is (heavily) influenced by the writings in other academic fields (Martin and Sunley, 2006), such as innovation studies (Edquist, 2001), organizational science (Penrose, 2009), economics (Nelson and Winter, 1982), and strategic management (Teece et al., 1997). Not surprisingly, the role of the micro level has in particular been investigated by organizational theorists and strategic management scholars (Garud and Karnøe, 2010; Sydow et al., 2009), which can partly explain the 'neglect' of micro-level approaches in EEG. Another reason for this neglect might be methodology. Data are available on the aggregated level (Content and Frenken, 2016), which implies that EEG has focused effort on identifying the relatedness between different industries (Frenken et al., 2007). However, it should be noted that promising recent methodological advances are now linking the concept of relatedness to the micro level by investigating labour mobility within regions (Fitjar and Timmermans, 2017) and individuals' education and occupation (Wixe and Andersson, 2017). Yet another reason might be theoretical and conceptual because concepts are used somewhat interchangeably due to several academic fields' influence on EEG. This is the case with the highly influential 'path dependence' concept (for a very helpful overview, see Sydow and Koll, 2017: 195). Nevertheless, even though the micro, meso, and macro analytical levels separately contribute important insights into regional industry renewal, few attempts have been made to treat these in concert (Dawley et al., 2015; Matti et al., 2017).

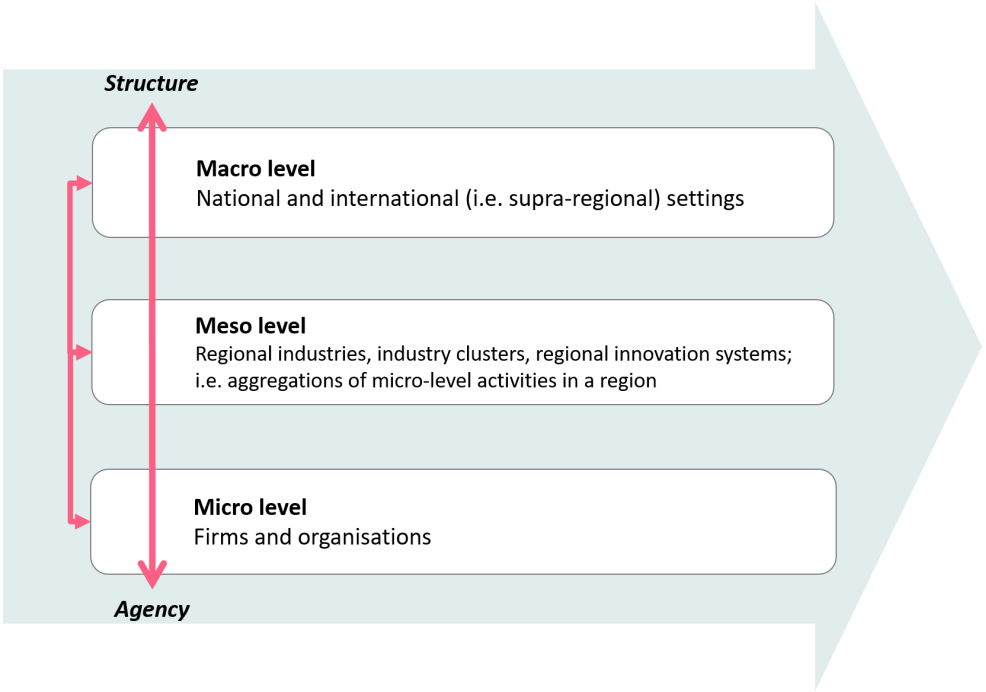

Figure 1: Regional industry renewal: A multilevel approach.

Figure 1 illustrates the approach to regional industry renewal presented here, where the micro, meso, and macro levels are treated in conjunction while simultaneously being sensitive to agency–structure dynamics. The arrow in the background represents time and evolution. Since evolutionary reasoning holds that a system's history is influencing, *but not predicating*, future development trajectories, one level can for instance dominate over the others in certain regions or time periods. In addition, intersections between two of the levels may be particularly important in a given region or a given time period (e.g. following an external shock). These are matters for empirical investigation. Moreover, following critical realist thinking, regional industry renewal can be conceptualized as the result of interplays between necessary and contingent conditions. Interplays between these dimensions inevitably lead to different 'outcomes', i.e. degrees of renewal, in different regions and/or at different points in time. Thus, regional industry renewal is not only a matter of the 'histories' of regional systems (and

of the actors therein, e.g. firms, industries, RIS); also agency across all three levels play an important role.

Thus, the argument proposed here is that a dynamic multilevel approach to regional industry renewal should be particularly sensitive to the red arrows in Figure 1. In addition, as Tödtling and Trippl have argued:

> Although individual companies and industries are exposed to market fluctuations and technology changes resulting in an expansion or a reduction of output and employment, the overall economic structure and mix of industries is often rather persistent at least in the short and medium term. This contributes to a certain stability of regional rankings of productivity, per capita income and innovation performance over time (Tödtling and Trippl, 2014: 298).

This emphasizes that regional industry renewal is a matter of both continuation and change, and that the importance of 'stasis' should be considered when approaching regional economic evolution because not everything changes all the time. This argument is consistent with elements of institutional theory. For example, Rodríguez-Pose (2013) argued that formal and informal institutions matter to the ways in which innovation and economic activity take place, which was also explained by Cortinovis et al. (2017) in their investigation of diversification and regional institutions. However, institutions are also by definition, difficult—but possible (Battilana et al., 2009)—to change, although this is nevertheless a process that takes time. Thus, the 'degree' of change and regional industry renewal varies spatio-temporally. However, these processes are continuous rather than temporal; what is temporal is the contingencies currently available to different actors.

3. Study area, methodology, and methods

The empirical work in this dissertation is focused on the Bergen region. The Bergen region[1] is here defined in accord with Statistics Norway's classification of 'economic regions'.[2] Bergen is the second largest city in Norway with 278,000 inhabitants. Bergen is in Hordaland County (inhabited by approximately 500,000 people), which is the third largest county in Norway. The counties of Rogaland, Hordaland, and Sogn og Fjordane constitute the area of western Norway. Together, western Norway represents approximately 1.1 million inhabitants. This is an important area for economic activities and wealth creation, particularly because of the area's proximity to several important natural resources, including oil and gas in the North Sea (Blomgren et al., 2013). Moreover, several large MNCs operate in western Norway, and the area has developed a global position in marine-, maritime-, and energy-related industry activities. This is particularly so for Hordaland County and the Bergen region, which has a strong position within traditional Norwegian industries that have long been central to national economic growth (Fagerberg et al., 2009).

3.1. The Bergen region

3.1.1. Firms and organizations

The Bergen region is known for its long trade history dating back to the 11th century. Its international fisheries trade dates back several hundred years and the region's rich industrial history is also reflected by present-day industry activities. The region hosts several MNCs within different industries. Examples include: Statoil, Aker Solutions, and OneSubsea in oil and gas/subsea industries; Marine Harvest, Austevoll Seafood,

[1] In addition to the dominant city centre in the municipality of Bergen, the region includes the municipalities Kvam, Fusa, Samnanger, Os, Austevoll, Sund, Fjell, Askøy, Vaksdal, Modalen, Osterøy, Meland, Øygarden, Radøy, Lindås, Austrheim, Fedje, and Masfjorden.

[2] 'Economic region is a regional classification (standard) for the level between county and municipality (89 units). The main criteria used for defining the regions are labour market and trade. The main purpose of the classification is to constitute an appropriate level for the publishing of statistics, but it shall also correspond to the NUTS 4-level in EU's regional classification. As a consequence of the latter requirement, the regions should not overlap the county borders.' (Definition from Statistics Norway's web page). There are 89 economic regions in Norway.

and Lerøy Seafood Group in seafood/fish farming industries; Odfjell and Grieg in the shipping industry; TV2 and Vizrt in media and technology; and several firms in the tourism, wholesale and retail trades, and finance and insurance industries. Several leading MNCs, particularly within fish farming, are headquartered in the region (Table 2). Of the almost 14,000 firms registered in the Bergen region in 2017, nearly 9,600 were in the municipality of Bergen. Moreover, in 2017, the municipality of Bergen hosted 264 firms with more than 100 employees each, whereas the rest of the region hosted 49 firms of similar size. Similarly, the municipality of Bergen had 66 firms with more than 250 employees, compared to 10 in the rest of the region (statistikk.ivest.no).

Table 2: The 15 largest private companies headquartered in the Bergen region.

#	Company name	Turnover (NOK)	Employees	Industry	National ranking
1	Marine Harvest Norway	32,6 bn	12,700	Food and beverage	#15
2	Laco	27.8 bn	9,200	Shipping	#20
3	Austevoll Seafood	18.9 bn	4,710	Food and beverage	#34
4	Lerøy Seafood Group	17.3 bn	2,900	Food and beverage	#35
5	Grieg Maturitas	11 bn	1,910	Shipping	#62
6	DOF	8.1 bn	4,000	Offshore	#91
7	Tryg Forsikring	8 bn	1,000	Banking and finance	#94
8	Ewos Group	7.7 bn	1,000	Food and beverage	#102
9	Odfjell	6.9 bn	2,890	Shipping	#116
10	Perestroika	6.6 bn	1,000	Production	#122
11	Grieg Seafood	6.6 bn	664	Food and beverage	#123
12	Pelagia Holding	5.7 bn	800	Food and beverage	#139
13	Odfjell Drilling	5.5 bn	1,700	Offshore	#142
14	Sparebanken Vest	5.2 bn	700	Banking and finance	#145
15	Fjordkraft	4.8 bn	172	Power distribution	#158

Source: Kapital500.no. Note that turnover and number of employees are for the companies as a whole, not just for their activities in the Bergen region. The companies are categorized according to Kapital 500's definitions; i.e. the category 'food and beverage' is, for the companies in this Table, equivalent to seafood/fish farming.

In addition to a private sector characterized by relatedness between economic activities, leading national R&D organizations are hosted in the region. Higher

education organizations (totalling approximately 30,000 students in the region) include the University of Bergen, Western Norway University of Applied Sciences, NHH Norwegian School of Economics, Royal Norwegian Naval Academy, and BI Norwegian Business School. R&D organizations include the Institute of Marine Research, Christian Michelsen Research, Uni Research, the Nansen Centre, and the Bjerknes Centre for Climate Research. Furthermore, in addition to the regional offices of Innovation Norway and the Research Council of Norway, regional industry development is also a focus of several public agencies and private actors, i.e. industry facilitators such as Bergen Chamber of Commerce and Industry and Maritime Bergen. Influential public actors include the Hordaland County Administration, Bergen Technology Transfer, and Helse Bergen and Haukeland University Hospital. Other prominent public offices include the Directorate of Fisheries and the Competition Authority, in addition to several regional branches of national authorities.

3.1.2. Industries and clusters

The preceding description presented firms and organizations in the Bergen region. Here, industry classifications and agglomerations of economic activity are presented. Table 3 classifies industry activity according to the main groups ('Sections') of the SIC. Table 3 gives a rough overview of employment in the main groups over an eight-year period, showing relative continuity and stability in the main industry sectors. Of the few differences between 2008 and 2014, note that employment in 'mining and quarrying' doubled, a development that can be ascribed to the growth in the oil and gas industry (Herstad and Sandven, 2017). Although numbers for 2016 suggest that the importance of this category has decreased, these values are not directly comparable to previous years due to changes in classification criteria. However, the decrease in total employment from 2014 to 2016 reflects the effect of the drop in oil prices on the region. This will be discussed further below. Furthermore, in 2016, about 31 % of the workforce was employed by the public sector (app. 13 % employed by the state, 2 % by the county, and 16 % by the municipalities), which shows that the private sector employed around 69 % of the workforce (statistikk.ivest.no/Statistics Norway).

Table 3: Number of employees in different industry sectors (SIC2007, main groups) in the Bergen region for selected years.

Industry	Employment 2008	Employment 2014	Employment 2016[1]
Agriculture, forestry, and fishing	*1.4%* *(2,913)*	*1.2%* *(2,711)*	**1.3%** **(2,701)**
Mining and quarrying	*1.9%* *(3,878)*	*3.6%* *(7,980)*	**3.1%** **(6,623)**
Manufacture	*10.2%* *(21,171)*	*8.7%* *(19,443)*	**7.4%** **(15,731)**
Power and water supply, sewerage/remediation activities	*1.0%* *(2,262)*	*1.1%* *(2,531)*	**1.1%** **(2,381)**
Construction	*7.8%* *(16,131)*	*7.8%* *(17,189)*	**8.1%** **(17,368)**
Domestic trade	*13.6%* *(28,085)*	*12.4%* *(27,588)*	**12.4%** **(26,608)**
Transportation and storage	*6.1%* *(12,600)*	*5.9%* *(13,105)*	**6.1%** **(12,973)**
Accommodation and food service activities	*3.3%* *(6,704)*	*3.2%* *(7,029)*	**3.2%** **(6,878)**
Information and communication	*3.1%* *(6,373)*	*3.1%* *(6,768)*	**2.8%** **(5,912)**
Finance and insurance activities	*2.6%* *(5,447)*	*2.5%* *(5,527)*	**2.4%** **(5,173)**
Real estate, professional, scientific, and technical activities	*6.4%* *(13,290)*	*6.8%* *(15,013)*	**6.6%** **(14,087)**
Administrative and support service activities	*5.6%* *(11,246)*	*5.5%* *(12,227)*	**5.1%** **(11,016)**
Public administration and defence: compulsory social security	*4.8%* *(9,954)*	*5.5%* *(12,140)*	**5.8%** **(12,476)**
Education	*8.8%* *(18,151)*	*8.5%* *(18,945)*	**8.9%** **(19,113)**
Human health and social work activities	*19.6%* *(40,325)*	*20.0%* *(44,537)*	**21.3%** **(45,500)**
Other service activities	*3.4%* *(6,959)*	*3.7%* *(8,147)*	**3.9%** **(8,279)**
Unspecified	*0.4%* *(743)*	*0.3%* *(754)*	**0.5%** **(1,055)**
Total	*206,232* *(100%)*	*221,632* *(99.8%)*	***213,924*** ***(100%)***

Source: statistikk.ivest.no/Statistics Norway.

[1] Note that due to changes in classification of the categories, numbers for 2016 are not directly comparable to previous years.

Given the increased importance of cluster-based approaches to regional industry development (see Papers #4 and #5), attempts have been made at categorizing the industry activity in western Norway according to such criteria. For instance,

Samfunnsøkonomisk Analyse [Economics Norway] (2017) recently categorized industry activity in western Norway through a cluster-based approach. Through qualitative assessment of approximately 1000 firms in western Norway, in addition to information gained from structural industry classifications, they defined the four dominant industry clusters in western Norway. These were: the maritime cluster (encompassing shipyards, ship owners, suppliers, and service suppliers), the marine cluster (encompassing fodder producers, fish farming, fishery, processing, suppliers, and service suppliers), non-renewable energy production (consisting of extraction, processing, distribution, supply, and service supply), and renewable energy production (consisting of the same subcategories as the non-renewable cluster). Hordaland County is representative of this industry composition and, according to the authors, the marine cluster in Hordaland is made up of 5,000 person-years (2015), mostly in fish farming and processing. In 2015, turnover in the marine cluster in Hordaland was 21 bn NOK. The maritime cluster provided work for 16,000 person-years in 2015, accounting for app. 9 % of employment in Hordaland. Most of this was linked to ship owners (more than 13,000 person-years in 2015). Turnover was approximately 55 bn NOK. Furthermore, 12% of all person-years in Hordaland in 2015 were in the non-renewable energy cluster, resulting in a turnover of approximately 129 bn NOK. In the renewable energy cluster, 2,600 person-years were employed in 2015. The cluster represented a turnover of 11 bn NOK (Table 4) (Samfunnsøkonomisk Analyse [Economics Norway], 2017).

Table 4: A cluster-based categorization of industry activity in Hordaland. Numbers for 2015.

Cluster	Man-years	Turnover (bn NOK)	Export value (bn NOK)
Marine cluster	5,000	21,155	12,447
Maritime cluster	15,800	55,476	1,888
Non-renewable energy cluster	20,400	128,998	66,993
Renewable energy cluster	2,600	11,043	1,223

Source: Samfunnsøkonomisk Analyse [Economics Norway], (2017).

As described above, the Bergen region is a focal point for a large share of this activity. The region's strength is also reflected by several formalized, publicly funded cluster initiatives (see Papers #4 and #5). Cluster facilitators for subsea technology (Global Centres of Expertise [GCE] Subsea), seafood (Norwegian Centres of Expertise [NCE]

Seafood Innovation), media and technology (NCE Media), tourism (NCE Tourism), design (DesignArena), and financial technology (Arena Finance Innovation) are all located in the Bergen region. In addition, in the Sunnhordland region just south of the Bergen region, the primary task of the cluster facilitator NCE Maritime CleanTech West is to develop industry activity within the field of green maritime technology. Cumulatively, this high number of formal cluster organizations is indicative of the relative strengths of industrial activities in the Bergen region.

Moreover, Table 4 indicates that although the region has high income and employment in the petroleum industry (the 'non-renewable energy cluster'), it also has relative strengths in other, related industries. However, as is evident in Table 3, the recent (late 2014) drop in oil prices affected employment numbers in the region. Several firms operating in the petroleum industry downsized, resulting in large layoffs. Interestingly, the external shock of the drop in oil price is only marginally reflected in the unemployment numbers. Table 5 shows the unemployment numbers for Hordaland County for the last seven years and during 2000 and 2005. It is evident from this table that numbers have only increased approximately 1 percentage point since 2013/2014.

Table 5: Unemployment in Hordaland County. Selected years

Year	Unemployed persons (aged 15–74 years) registered at the Employment Office
2000	*3.0%*
2005	*3.1%*
2010	2.4%
2011	2.1%
2012	1.8%
2013	2.1%
2014	2.3%
2015	3.0%
2016	3.4%

Source: Statistics Norway. Numbers for November each year.

For the Bergen region more specifically, Table 6 presents the absolute numbers for the last four years. The table illustrates an increase in unemployment from 2014 to 2015/2016. However, it should be noted that this increase (an absolute increase of about 2,500 unemployed from 2014 to 2016) does not provide the full picture; as is evident in Table 3, the total number of employees decreased by about 7,700 between 2014 and

2016. However, the unemployment numbers in Table 6 do not fully account for this because unemployment numbers only increased by approximately 2,500 individuals, which means that approximately 5,000 individuals were unaccounted for. There are several possible reasons for this, including that not all of those who are unemployed register at the unemployment office, and/or that some individuals left the region.

Table 6: Unemployment in the Bergen region; unemployed registered at the Employment Office. Last four years (available months). Absolute numbers

	2013 (August)	2014 (June)	2015 (November)	2016 (November)
Unemployed	5,165	5,397	7,021	7,967

Source: Statistics Norway

In other words, the drop in oil price led to the loss of many jobs in the Bergen region, but it is difficult to quantify this precisely. What has become evident following the oil price shock is that it triggered a shift in industry activity towards related industry sectors in the region. Several firms changed their strategic orientation to focus on new opportunities by crossing market boundaries, while others are considering this. Thus, in light of the theory presented herein, and considering the industry structure in the Bergen region, it is reasonable to expect that job opportunities have become available in other related industries for many of the workers who were made redundant. A recent study from Sweden provides a similar argument, finding that in light of external shocks, 'the presence of related industries plays a significant role in shaping workers' re-employment opportunities' (Hane-Weijman et al., 2017: 2).

Despite the effects of the recent downturn in the petroleum sectors, it can nevertheless be argued that the Bergen region is characterized by a strong private sector with related economic activity (Table 4). In addition, its global linkages are strong, and several large MNCs are headquartered in the region (Table 2). Moreover, the region has many facilitation initiatives, evident from the high number of formal cluster projects located in the region that far surpass all other regions in Norway. In addition to strong and related industries, the region is also supported by a regional structure supporting commercial activity, knowledge generation, and—to an increasing extent—knowledge circulation between firms and organizations and the R&D community.

3.1.3. The regional support structure

According to Asheim et al. (2015: 274), a RIS can be defined as 'the institutional and organizational infrastructure interacting and supporting innovation within the production system of a region'. In this dissertation, as exemplified in Papers #6 and #7, a narrow approach to RIS has been employed, which means that the concept of regional support structure is used when presenting the innovation system in the Bergen region in this section, implying a broader approach to RIS than is used in the papers.

National and regional policy approaches have focused on the importance of stimulating interlinkages between firms and R&D organizations to increase innovation and industry development (Jakobsen and Onsager, 2008), as is reflected by the Research Council of Norway and Innovation Norway's instruments, described below. R&D activities in Hordaland account for 15.9% of Norwegian person-years in R&D, and investments in R&D have increased in Hordaland in later years. However, although regional firms are investing more in R&D, Hordaland is still below the national average (Hordaland County Council, 2017). In addition, although 15.9% of Norwegian person-years in R&D are conducted in Hordaland, a large share of this is funding received by universities and university colleges; private firms in Hordaland conduct less R&D than might be expected (NIFU, 2017). For instance, 46% of total R&D in Norway during 2015 was conducted by the private sector, but only 6% of this was conducted in Hordaland (whereas more than 40% was conducted in the capital region Oslo) (NIFU, 2017: 168). Thus, several initiatives have been launched to support increased interaction between firms and R&D organizations, including the Centres for Research-Driven Innovation (SFI) and Centres for Environment-friendly Energy Research (FME), and a comprehensive support structure for R&D-industry linkages has been developed in the region.

Currently, the Bergen region hosts six Centres for Excellence in Research (SFF) funded by the Research Council of Norway. Five of these are at the University of Bergen and one is at the NHH Norwegian School of Economics. The region also hosts three SFI: one on salmon lice (the Sea Lice Research Centre), one on sustainable fish capture (CRISP), and the Centre for Service Innovation. Furthermore, there are two FME's in

the region: the Norwegian Centre for Offshore Wind Energy (NORCOWE) and Subsurface CO_2 Storage — Critical Elements and Superior Strategy (SUCCESS). Other R&D instruments include the Regional Research Funds (operated by the Research Council of Norway) and the national programs Innovation Contracts (previously IFU/OFU), BIA (User-driven Research based Innovation), SkatteFunn, Industry PhD, and Public PhD, all aimed at increasing systemic interaction among firms and R&D organizations. For example, the SkatteFunn program, a tax incentive scheme in which businesses and enterprises that are subject to taxation in Norway are eligible to apply for tax relief if their R&D projects meet certain criteria (Isaksen et al., 2017), in Hordaland is dominated by the petroleum and marine/seafood industries (Hordaland County Council, 2017). This again illustrates the industrial composition of both the Bergen region and Hordaland County.

Clearly, the Bergen region has been focused for several years on the oil and gas industry, but this has been coupled with growth in other ocean-related industries, partly in the wake of the downturn in the petroleum industry. This makes the Bergen region a particularly interesting case for studying regional industry renewal through a multilevel perspective. It represents—in the terminology of George and Bennett (2005)—a 'configurative case' useful for developing theoretical propositions and contributions to conceptual development. Thus, methodological issues are now discussed, including the role of qualitative case study methodology in EEG and linkages between critical realism and evolutionary theory, and how this informs our understanding of industry renewal in the Bergen region. Furthermore, and importantly, focus is directed to how a case study of the Bergen region informs the regional industry renewal literature more broadly.

3.2. Methodology

Section 2 discussed the ontological, theoretical, and empirical background of EEG. Considering regional industry renewal as a process of necessary conditions of multilevel dynamics and contingent spatio-temporal conditions has methodological implications which, in turn, influence the choices for empirical methods and data analysis. In this section, critical realism is discussed through a methodological lens, before considering its utilization as an 'evolutionary methodology'. This is further considered in

conjunction with case study methodology to discuss how—or if—the findings from this dissertation (of regional industry renewal in the Bergen region) are relevant beyond this geographical setting. This is followed by an introduction to data collection methods and data sources used in the papers.

3.2.1. Critical realist methodology

According to Sayer (2000) and others, the critical realist perspective holds that human agents observe real-world events, but that, unlike a positivist approach, critical realism argues that reality is more complex than what is 'simply' observable. The critical realist position also represents a critique of social constructivism by arguing that our observations are guided by stratification of the world we study (and in which we live). Linked to this, a critical realist ontology holds that reality consists of three domains: the real (which involves mechanisms with the potential to produce events), the actual (events caused by 'real' mechanisms under certain circumstances), and the empirical (observable events). The logic follows that through investigations of observable events, we increase our knowledge of the 'actual'; in other words, we develop theoretical propositions based on what we have observed. However, this theorizing is based on an 'approximation' of 'the real'. This implies that it is the position of critical realism that the real exists independent of our knowledge, and that the research we are conducting will never be fully reconciled with reality (Sayer, 2000). In other words, studies of observable phenomena (such as regional industry renewal) can advance our understanding of how, to use one example, micro–macro dynamics influence strategy and organizational structure in a firm (Paper #1), but we cannot in the same breath state that our theorizing is 'final', 'complete', or even 'objective'. Thus, how regional industry development is observed and theorized is the result of necessary and contingent conditions panning out within a spatio-temporal context (Fløysand et al., 2013; Sayer, 2000; Fløysand et al., 2016). Different (empirical) contexts represent a point of intersection between the 'regularities' of the material world and the 'fluctuating' 'subjectivities' of the socially constructed world, implying that our observations—and our theories based on these observations—are linked both to an external reality but also to our reflection of it. Thus, the same phenomena, such as market-driven organizational

lock-in, may surface differently within another context, because interplays between necessary and contingent conditions develop differently (see Section 2). This means that we need to investigate the mechanisms linking the 'material' and the 'discursive' (Paper #3), but that we can never reveal 'final' or 'absolute' mechanisms. We can merely advance our knowledge about the mechanisms in a 'cumulative' manner. Thus, the methodology of critical realism underpins the importance of investigating 'generative' (Edwards et al., 2014) or 'causal' (Sayer, 2000) mechanisms, where 'the ultimate aim is to differentiate between the necessary causal mechanisms and the contingencies in operation, thereby informing our understanding of the phenomenon in question' (Couper, 2015: 76). This is connected to the view of George and Bennett (2005), who proposed that qualitative case study methodology is an approach capable of—and suited to—investigating different phenomena through cumulative knowledge development and theorization. They propose that case study methodology in the social sciences 'aspires to cumulative and progressive generalizations about social life and seeks to develop and apply clear standards for judging whether some generalizations fit the social world better than others' (George and Bennett, 2005: 19). In other words, the 'social world is not closed like a laboratory but open to a complex array of influences which change both temporally and geographically, often in unexpected ways' (Edwards et al. 2014: 4). Thus, approaching (regional) economic development as complex, uncertain, context-specific, and conditioned by historical choices of contingencies links with evolutionary theory, which was also explicitly recognized by Sayer (2000: 26).

In other words, the aim of a critical realist methodology is to develop deep insight into real-world phenomena (Yeung, 1997). The 'extent' of knowledge is crucial, a view that permits several methods that would contribute to knowledge accumulation (Sayer, 2000). Such views might be particularly pertinent for EEG, not least because of this perspective's emphasis on complexity, differentiation, structure, systems, openness, continuous change, and a high degree of uncertainty (Castellacci, 2006). Consequently, it is informative to consider methodological frameworks for path evolution (Sydow et al., 2009, 2012; Pike et al., 2016; Martin, 2010; Vergne and Durand, 2010), i.e. tracing events in real-time or in retrospect. For instance, Pike et al. (2016: 31) encouraged a methodology in which EEG pursues interlinkages between agency and structures

through ‘following the path’ and ‘deep contextualization … of both internal and external socio-spatial relations, mechanisms and processes’. This approach is familiar to critical realist thinking and encourages, as was done in Papers #1 and #6, the investigation of the constituents of paths by studying what has set them into motion, as well as investigating what lies behind the observed paths (Sydow et al., 2009). This also implies that the notions of path evolution should be investigated by exploring a diverse set of dimensions, such as actor complex, structural determinants, triggering events, supraregional settings, etc. This in turn suggests qualitative approaches or intensive rather than extensive research (Sayer, 2000). Such a perspective also facilitates linking different theoretical perspectives, as has been argued would benefit EEG (Hassink and Klaerding, 2009; Bathelt and Li 2014; Paper #2), while also connecting to positions arguing for mixed methods research and methodological pluralism (Hurrell, 2014; Downward and Mearman, 2007). Clearly, it is important to consider the constituents of industry paths through utilization of several methods, and by being open to contributions spanning traditional polarizations of either qualitative or quantitative approaches. This has also recently been argued in economic geography through introduction of the innovation biography methodology (Butzin and Widmaier, 2016). However, since the aim here is to develop theoretical propositions, clarify concepts, and uncover the dynamics of regional industry renewal, qualitative approaches are especially pertinent from an evolutionary perspective (Steen, 2016; Bugge and Øiestad, 2015), a way of thinking that is consistent with critical realism (Edwards et al., 2014) and case study methodology (George and Bennett, 2005).

3.2.2. Qualitative case studies

As has been argued by Easterby-Smith et al. (2015), the case study approach is understood differently across academic fields, epistemologies, and research practices. For instance, the case study approach used in this dissertation moves beyond the extremely popular approach developed by Yin (2009). Yin’s reasoning was that case studies involve combining methods to provide more ‘accurate’ or ‘solid’ conclusions. Moreover, Yin’s position, an approach similar to that of Eisenhardt (1989), states that case studies are about developing ‘testable’ hypotheses, which can later be investigated

through quantitative methods. In other words, certain positivistic connotations can be traced. According to Vincent and Wapshott (2014: 149) 'Yin's approach is limited because there is nothing beyond abduction and nothing to know beyond what we confirm through the data themselves. Deeper levels disappear from view'. Consequently, it has been argued that case studies are especially appealing when attempting to develop deep understandings of generative mechanisms and necessary and contingent conditions (Kessler and Bach, 2014; Easton, 2010). However, conducting case studies is not just associated with epistemological claims; important questions regarding the research process and its methodological underpinnings persist even though a critical realist position is taken. For instance, the sampling, e.g. purposive, quota, emblematic, or snowballing, of (theoretical, empirical, similar, or different) cases is critical (Gobo, 2004), especially when it comes to qualitative research (Gobo, 2008). Furthermore, as case studies investigate (small aspects of) a context, the theoretical sampling of cases has been argued to be beneficial given that investigations are based on former insights (Gobo, 2008; Edwards et al., 2014; George and Bennett, 2005). However, although theoretical insight forms the background for performing case studies, it also points out what we are 'left with' when researching single instances/cases. From a critical realist perspective, the important point is that generalization is not about addressing the distribution of a phenomenon *per se*, but rather its constituting dimensions, i.e. generative mechanisms, that could—but not necessarily would—conclude similarly across time and space; hence, the crucial separation between necessary and contingent conditions. This implies that the generative mechanisms are only 'observed' through *a priori* theorization of 'the actual' through approximations of 'the real'. However, the real—an external reality—also initiates such theorizing. In other words, the aim of research is to develop (theoretical) insight through abductive reasoning, i.e. pending between empirical observations and theoretical propositions. This was particularly evident in Papers #6 and #7. This is also consistent with discussions about the generalizability of case study research, and about qualitative research overall, where 'in qualitative research, generalizability concerns general structures rather than single social practices, which are only an example of this structure' (Gobo, 2004: 453).

3.2.3. Generalizing from qualitative research and case studies

Critical realism argues that to uncover generative mechanisms we should a) identify regularities based on empirical investigation, b) propose possible explanations, i.e. the causal mechanism(s) for an observed regularity, c) check this explanation against further empirical evidence (Couper, 2015), and d) then repeat this 'indefinitely'. This was well framed by Fairclough (2005: 923):

> Social research proceeds through abstraction from the concrete events of social life aimed at understanding the pre-structured nature of social life, and returns to analysis of concrete events, actions and processes in the light of this knowledge.

In line with the above description of the importance placed on theory development, theories are what bring a finding from one (empirical) context to another. We continuously refine our theoretical propositions about what interplays between necessary and contingent conditions that we perceive to be real, and we, in many instances, become better at predicting outcomes. For instance, we predict how increasing returns may serve as a source of (positive or negative) lock-in (Arthur, 1989). So, how can one say something meaningful (and useful) beyond stratified (spatio-temporal) 'pieces' of reality? How do 'single events'/cases influence—and change—regional economies more broadly? And, importantly, can such investigations also say something meaningful beyond the context studied? After all, a case study is a sample of 'one single instance' (Easton, 2010: 119) and 'to generalize is to claim that what is the case in one place or time, will be so elsewhere in another time' (Payne and Williams, 2005: 296).

The topic of generalization is of interest to the dissertation (the *kappe*). Each of the individual papers addresses this issue separately, insofar as each of the empirical investigations have been linked to the empirical and/or conceptual work of others. Hence, in line with the idea of accumulation of knowledge through abductive processes, a main aim of each of the articles has been to contribute to theory development, which may, in turn, influence future empirical work within the same or other geographical contexts, i.e. a theoretical accumulation of knowledge. This was summarized by Roberts (2014: 5):

> The analytical movement in critical realist research method therefore comprises a movement from a concrete context within which causal mechanisms are abstracted and analysed and then back to the concrete context to understand how these causal mechanisms operate.

The important point here, from the critical realist epistemology and both qualitative and evolutionary methodology perspectives, is that the aim is not to apply nomothetic reasoning, i.e. to discover 'laws' predicting future activities, but rather to progress scholarly knowledge on the theoretical and conceptual approaches to regional industry renewal, regardless of time and place. This is not to say that what is contingent and what is necessary for something to occur is irrespective of time and place. Rather, research can be considered to be about how—and why—complexities, e.g. in space, time, societies, networks, lead to different outcomes as a result of (unique) interactions between the material and the socially constructed worlds (Sayer, 2000; Fløysand et al., 2016). In other words, this position holds that generalization of case study research and other qualitative methods is analytical rather than empirical, i.e. that it is informing theory (Gobo, 2004). This is clearly framed by George and Bennett (2005: 109), who argued that:

> On the inductive side of theory development, plausibility probes and studies of deviant cases can uncover new or omitted variables, hypotheses, causal paths, causal mechanisms, types or interactions effects. Theory testing aims to strengthen or reduce support for a theory, narrow or extend the scope conditions of a theory, or determine which of two or more theories best explain a case, type, or general phenomenon. While many works on research methods and the philosophy of science emphasise theory testing more than theory development, we see both enterprises as essential to constructing good theories (George & Bennett 2005: 109)

Thus, the approach used herein represents a critique and an alternative to the highly cited work of Yin (2009) described above.

3.3. Methods and data collection

3.3.1. Papers and methods

The papers covered by this dissertation are based on several qualitative methods. Data collection was conducted by myself and colleagues. Table 7 shows the methods and data sources for the individual papers. Semi-structured interviews were particularly

important in this work, with interviews conducted with several regional stakeholders (firms, R&D organizations, and public agencies), both in the Hordaland region and beyond. In addition, Papers #6 and #7 relied on comprehensive document analysis. Case study methodology was used in several papers, in which the intent was to analyse real-world phenomena through in-depth investigations. As with qualitative methods generally, the aim of all data collection herein was to refine and nuance theory, rather than to test empirical claims or quantify the empirical distribution of the phenomenon under question (see the above discussion).

Table 7: Papers, methods, and data sources.

#	Authors and year	Title	Methods	Data sources
1	Njøs, Jakobsen and Rosnes (2016)	*Market-driven organizational lock-in: A case study of a former first mover*	Participant observation, semi-structured interviews, desk research	• Participant observation (eight weeks plus six weeks, 2011) (*Rosnes*). • Five semi-structured interviews (2012) (*Rosnes*). • Secondary data.
2	Njøs, Orre and Fløysand (2016)	*Cluster renewal and the heterogeneity of extra-regional linkages: a study of MNC practices in a subsea petroleum cluster*	Interviews	• Interviews with cluster firms and stakeholders over two periods (six interviews in 2011, *Njøs*, 10 interviews in 2014, *Orre*/*Njøs*).
3	Fløysand, Njøs, Nilsen and Nygaard (2017)	*Foreign direct investment and renewal of industries: framing the reciprocity between materiality and discourse*	Comparative case studies (interviews and desk research)	• Interviews with firms and stakeholders in the salmon farming industry (*Fløysand*) and the subsea industry (*Njøs*) in Hordaland, and the oil and gas industry (*Nilsen*) and mining industry (*Nygaard*) in Finnmark. • Media reports on the four industries (2010–2015).
4	Njøs and Jakobsen (2016)	*Cluster policy and regional development: scale, scope, and renewal*	Desk research	• Secondary sources; previous analyses, publicly available information online (*Njøs*)
5	Njøs, Jakobsen, Aslesen and Fløysand (2016)	*Encounters between cluster theory, policy and practice in Norway: Hubbing, blending, and conceptual stretching*	Comparative case study methodology (interviews and desk research)	• Interviews with cluster facilitator, eight cluster firms and seven regional stakeholders in the NCE Maritime cluster in Sunnmøre (*Njøs/Fløysand*), cluster facilitator, five cluster firms and two regional stakeholders in NCE

				Subsea in the Bergen region (*Njøs*), cluster facilitator, and five cluster firms in Oslo Cancer Cluster (*Aslesen*) • Desk research; strategy documents, annual reports, the projects' home pages, newsletters, and previous studies.
6	Njøs and Jakobsen (2017)	*Policy for evolution of regional innovation systems: The role of social capital and regional particularities*	Case studies (interviews, document analysis, desk research)	• Document analysis of 45 VRI applications (*Njøs/Melvær*) • 25 interviews (*Melvær/Njøs*) • Secondary sources (particularly evaluations, annual VRI reports, and program plans)
7	Njøs and Fosse (under review)	*Linking the bottom-up and top-down evolution of regional innovation systems to policy: Organizations, support structures and learning processes*	Document analysis, interviews, desk research	• Document analysis of 45 VRI applications (*Njøs/Melvær*) • 25 interviews (*Melvær/Njøs*) • Secondary sources (particularly evaluations, annual VRI reports, and program plans)

Data were mostly collected within the Bergen region. Some of the papers also relied on data from other (national) geographical settings. Data collection was typically conducted in co-operation with other researchers, but with the exception of Paper #1, I was involved in all aspects of data collection (preparation, field work, and analysis). In Paper #1, the empirical data were collected by Vegar Rosnes as part of his Master's thesis on *Innovation and Entrepreneurship* (2012) at *Western Norway University of Applied Sciences*, before they were reanalyzed and conceptualized by myself, Stig-Erik Jakobsen, and Rosnes.

3.3.2. Qualitative methods: pros and cons

The methods used for this dissertation are a selection of several possible methods (Karlsson et al., 2015). However, as this dissertation aimed at theoretical and conceptual development, qualitative methods are considered particularly useful, not least from an evolutionary perspective (Sydow et al., 2012; Steen, 2016). As is well known, strengths of qualitative methods include that they are open to multiple interpretations, offer

flexibility, and, as a result, contribute to development of theories and concepts (George and Bennett, 2005; Edwards et al., 2014). However, qualitative methods cover a host of approaches, and choosing one over the others requires careful consideration.

The EEG literature represents a diversity in methods, although emphasis has been placed on quantitative methods, particularly in the related variety literature (Content and Frenken, 2016; Butzin and Widmaier, 2016; Steen, 2016). However, important contributions have also been made by scholars adhering to qualitative methods, including case studies (David, 1985; Karnøe and Garud, 2012; Sydow et al., 2012) that often were built on semi-structured interviews (see Binz et al., 2016 for an example). Semi-structured interviews were particularly important in this dissertation (see Papers #1, #2, #5, #6, and #7). Semi-structured or qualitative interviews have been defined as 'a verbal interchange where one person, the interviewer, attempts to elicit information from another person by asking questions' (Longhurst, 2003: 17). From a critical realist perspective, it has been argued that interviews with informants should be guided by an *a priori* theoretical understanding, in which interview guides are developed in accord with current knowledge in the field. However, interviews must be 'open enough' to contribute novel perspectives and interpretations introduced by the informant(s). This implies that the 'researcher/interviewer is involved in a 'teaching-learning' process, which shows respondents how to bring their awareness and understanding to bear on the researcher's theory, especially regarding contexts and outcomes' (Smith and Elger, 2014: 117). As in other qualitative methods, this approach is not without limitations. These include preoccupations, vantage points, and interests of specific informants (Smith and Egler, 2014: 122). A way to address such concerns is through 'contextualizing' the information and derived data, as was done in Papers #6 and #7. In those Papers, we complemented a comprehensive document analysis with semi-structured interviews. However, as reported in Paper #6, page 5, informants can be:

> […] prone to portray a positive view of the effectiveness of strategies and actions taken (see e.g. Zohrabi 2013). In addition to this possible selection bias, another limitation of our data collection is that informants were asked to trace the evolution of their projects in retrospect, meaning that some narratives may be deliberately presented over others.

Following critical realist reasoning this will be a recurring theme in all research—we can never 'know' that what we observe is 'real'. The only 'solution' is to progress knowledge about phenomena through continued research and 'unlayering' of real-world generative mechanisms (though this does not mean that issues on reliability and validity should not be considered).

The work covered in this dissertation also involved document analysis/text analysis (Papers #6 and #7). In conducting the document analysis, we put a lot of effort into developing theoretically informed codes, which were used to analyze the data material. By switching between the empirical material and theoretical propositions, after several rounds we developed a set of categories then used to analyze the data. Furthermore, Paper #1 involved the use of participatory observation. A co-author, Vegar Rosnes, conducted participatory observations as part of his work on gaining insight into the inner workings of the case firm. Participatory observation is particularly useful if the aim is to investigate collaboration, constitution of meaning, and real-world events in real-time (Grønmo, 2007). This approach is characterized by flexibility, uncertainty, and presuppositions (something that should be considered in the data analyses). Finally, desk research and use of secondary data sources is important in all aspects of social science research. For the work in this dissertation, this approach was especially important in Paper #4. Conducting literature reviews is an obvious part of this approach, but desk research also involves identifying and critically approaching others' (empirical and conceptual) work. Such work is also important for increasing the validity of one's own work, given that it implies investigating alternative theories and explanations. In Paper #4, desk research was deemed a suitable method for exemplifying our conceptual argument (regarding the role of 12 NCE projects in renewal of regional industries). This demonstrates how secondary data can be helpful in theoretical and conceptual development.

4. Contributions

This section presents the contributions of the individual papers. Each paper represents a unique contribution in that it addressed specific theoretical, conceptual, and/or empirical themes connected to the topic of regional industry renewal. In Section 5, the papers are synthesized and discussed in light of the research questions raised in the Introduction.

Paper #1: 'Market-driven organizational lock-in: A case study of a former first mover'

Published in *Norwegian Journal of Geography* (2016) with co-authors Stig-Erik Jakobsen and Vegar Rosnes, this paper explains how the innovation activity of an oil and gas firm in the Bergen region became locked-in following path-dependent development. Strong reliance on (mainly) international customers, i.e. the macro level, led the firm into a situation in which its former position as a first mover was changed to taking a reactive approach to innovation and new product development. The case firm was formerly known as an innovator that had introduced cutting-edge products within the oil and gas market in the 1980s. However, since then, focus had been primarily on reaping the benefits of these products. Thus, innovation work was characterized by knowledge exploitation rather than knowledge exploration, though the latter was a precondition for introduction of novel products in the first place. Focus became primarily on reaping the benefits of the (at the time of data collection) booming oil and gas market and developing modified products according to their customers' specifications.

Theoretically, and as influenced by the works of Sydow et al. (2009, 2012), the paper aimed to contribute to EEG by showing how firms and organizations can be understood from evolutionary theory. An additional aim was to discuss how proactive agency can contribute to 'path breaking', i.e. to overcome negative path dependencies and lock-in situations. Based on theoretical discussion, we analyzed how the organizational architecture, i.e. formal and informal structure, and strategies for innovation, of the case firm led it to 'market-driven organizational lock-in'. However,

we also found support in this framework for discussing how this situation can be overcome by proactive agency. We argue that the firm, to move away from an overly customer-focused approach and high reliance on the oil and gas market, should reactivate its competence for knowledge exploration while simultaneously stimulating its knowledge exploitation capabilities. This is linked to the literature on innovation, which argues that both 'technology push' and 'market pull' are important drivers for innovation (Harmsen et al., 2000). Thus, we stress that both customers and other actors, possibly in the RIS, i.e. the meso level, can be important sources of novelty and renewal of existing activities. Though the firm had experienced successes, it mostly relied on supraregional knowledge sources, represented almost exclusively by foreign customers, i.e. the macro level. Hence, as the informants in 2012 expressed their concerns about the long-term consequences of a lack of product innovation, they noted that the firm was vulnerable to changing market trends and that renewal of innovation activities should be encouraged. The paper argues that agency can play a role in overcoming this, since organizational structure and strategy, i.e. the organizational architecture, can be changed and modified by leaders and managers.

In other words, the paper discusses intersections between the micro and macro levels. The work was conducted prior to the drop in oil price in 2014, but an important topic was that sudden, external events might represent a threat to the firm if it was unable to change its innovative work. The paper considered that changes in external circumstances should be met through a) striking a better balance between proactive and reactive agency, b) balancing mechanical and organic features of the organization, and c) through combining technology push and market pull as drivers of innovation. Thus, to avoid lock-in situations, agency, e.g. decisions of chief executive officers or the board, can play an important role. In other words, the paper contributed to the topic of this dissertation by linking micro–macro level dynamics and explaining the role of agency in path-breaking from the perspective of a firm actor.

Paper #2: 'Cluster renewal and the heterogeneity of extra-regional linkages: a study of MNC practices in a subsea petroleum cluster'

Similar to Paper #1, this paper, co-published with Lina Orre and Arnt Fløysand in *Regional Studies, Regional Science* (2017), focused on firm actors by discussing the diversified practices of MNCs and how this is linked to cluster evolution and renewal. From a theoretical perspective, we argued that EEG should better incorporate approaches from relational economic geography. This is most prominently linked to how the literature in that field highlights the content of relations between clustered actors, not just the evolution of relations *per se*. This certainly means that a stronger focus on the macro level must also be considered. We argued that the current literature has not delved into such discussions sufficiently, i.e. that it has treated the practices of MNCs as *homogenous*. Through theoretical and empirical investigation, we argued that relational approaches inform us about how renewal of the subsea petroleum cluster in Hordaland is influenced by the *heterogeneity* of MNC practices, and that these practices, in turn, contribute differently to cluster renewal, i.e. the meso level. It is shown how MNC-out involves local firms internationalizing and contributing to specialization of cluster activities, whereas MNC-in contributes to sectoral diversification and, hence, widening of the cluster scope. The latter practices lead to introduction of novelty, contributing to high degrees of renewal, whereas the former contributes to continuation, i.e. a low degree of renewal. However, we submit that both processes are important for cluster evolution and to avoid lock-in. Moreover, we demonstrate how firm actors partake differently in meso-level settings, and that their inherent agency can play a decisive role in regional industry renewal. For instance, large global players operating in the subsea cluster are characterized by unique capabilities and competences, but they also—through actions that often take place in remote geographical settings—influence cluster development in the Bergen region.

Thus, this paper highlights the intersections between the micro, meso, and macro levels of regional industry development, and considers the role of agency (represented by choices made by MNCs). Moreover, the paper illustrates how the subsea petroleum cluster should not only be investigated by examining its linkages to the *petroleum* industry. Instead, it is important to also consider the cluster as being engrained in a wider

regional setting, something that appears to encourage MNC activity (see also Paper #4) and renewal.

Paper #3: 'Foreign direct investment and renewal of industries: framing the reciprocity between materiality and discourse'

This paper was published in *European Planning Studies* (2016) and authored by Arnt Fløysand, myself (as second author), Trond Nilsen, and Vigdis Nygaard (Norut Northern Research Institute). The paper discusses the role of FDI, conceptualized as MNCs' practices, in contributing to regional industry renewal. Though we discuss the roles of MNCs, the main actor upon which we focused was regional industries, i.e. the meso level. We argue that industry-level outcomes are a result of interplays between material outcomes from FDI (understood as positive or negative regional spillovers) and narratives of FDI and MNC activity. Thus, the paper links the micro, meso, and macro levels, exploring their dynamics by focusing on four regional industries in two Norwegian regions.

A claim is made in this paper that MNCs can contribute to both stagnation and progress in a regional economy, but that the outcome is the result of (regional-specific) interplays between material, observable processes, such as employment or patenting, and narratives and discourses, e.g. *pro et contra* attitudes towards FDI and MNC activity. Thus, we delve into an epistemological discussion about the role of materiality and discourse in regional industry renewal, illustrating our argument with an empirical investigation set in Hordaland and Finnmark (in northern Norway) counties. The industries investigated in light of their interweaving in global capital flows were the fish farming and subsea industries (Hordaland) and the mining and oil and gas industries (Finnmark). In the empirical discussion, we demonstrated how these four industries' claims about the role of FDI and MNC activity differ, even within the same region. In Hordaland, a *pro*-FDI narrative is traced to the subsea petroleum industry, whereas in fish farming a *contra*-FDI narrative is identified. However, these expressions are not necessarily linked to material, observable outcomes. For instance, in both of the industries in Hordaland, supraregional capital flows have been incredibly important to their current global positions. In the fish farming industry, outward FDI has explicitly

contributed to the firms' substantial economic growth. Similarly, in the subsea petroleum industry, FDI activity has contributed to wealth creation and regional spillovers (cf. Paper #2). However, though the two industries are located in the same region, they have different perspectives, particularly about inward FDI. Thus, this illustrates how the interplay among the micro, meso, and macro levels can result in different outcomes, even within the same region. This provides important insight, insofar as this paper, similar to Paper #2, shows the nuances about the assumptions often made in the literature about regional settings as 'containers' for economic activity. They do so by showing how different industries and firms evolve along different trajectories without necessarily considering 'outside' influences. Hence, we argued in this paper that 'in the spectacle of regional development, while industries evolve within regions, at the same time different sublevels … also follow different paths' (Paper #3: 463).

In other words, the paper emphasizes the dynamics between the micro, meso, and macro levels, and proposes that 'substantial change', i.e. a high degree of industry renewal, takes place when FDIs represent shared capital interests, networking, and transfer of knowledge between MNCs and the host region and when these positive regional spillovers are connected to a pro-FDI narrative. Conversely, minor change, i.e. low degrees of renewal, results from FDI activity characterized by capital transfers without positive regional spillovers, i.e. networking and knowledge transfer, and when this is associated with negative narratives among host region actors. Cumulatively, the results of this paper imply that materiality and discourse do not necessarily 'communicate' within the process of regional industry renewal, which means that different industries within the same region may be characterized by different micro-, meso-, and macro-level dynamics.

Paper #4: 'Cluster policy and regional development: scale, scope and renewal'

This paper, co-authored with Stig-Erik Jakobsen and published in *Regional Studies, Regional Science* (2016), discusses the role of national cluster policy in contributing to regional industry renewal. It links the macro and meso levels and argues that, although the theoretical cluster approach stresses clusters as entities consisting of related

economic activity, many scholarly and policy approaches have focused on clusters as specialized entities often operating within single industries/markets or value chains. Through exploring the approach by Innovation Norway's NCE cluster program, we found that this was the case for Norwegian cluster policy. We argued that this program was overly focused on clusters as specialized, 'isolated' entities within a region. We also argued, consistent with discussions of concepts such as related variety, that cluster policy should stimulate relatedness between regional industries, i.e. that 'clusters should be treated as *regional* constellations of *related* actors with multilevel linkages' (Paper #4: 159, italics in original). This is connected to the argument that regional firms (micro level) and industries (meso level) become more innovative if their 'crossover' capabilities are strengthened (Enkel and Gassmann, 2010; Hauge et al., 2017), i.e. focusing more on the scope of clusters implies that different, though related, regional capabilities are used. From a theoretical perspective, this is believed to sustain long-term regional development by stimulating renewal processes.

In other words, the contribution of this paper is in explaining how cluster policy can avoid stimulating 'regional champions' on behalf of novelty, emerging, and maturing industries. Taking this into consideration means that clusters are understood from an EEG perspective and not, as has often been the case, value chain theorization. It also explains how cluster projects and cluster policy can contribute to stimulation of regional adaptability, i.e. to avoid negative path dependencies and possible lock-in situations. Through conceptual discussion, the strategies 'mono-cropping', 'blending', and 'hubbing' are introduced, each weighting the role of scale and scope in contributing to cluster renewal and novelty to a different degree. We illustrated these strategies by exploring secondary data about 12 NCE projects and concluded that the profile of the NCE national cluster program has influenced the ways in which regional projects have developed. We found that eight of the 12 NCE projects were based on a 'hubbing' approach, i.e. emphasizing clusters as value chain constructs, in which cluster upgrading results from extension of geographical linkages, i.e. expansion of scale. We also suggest that a greater focus on the 'blending' strategy should be encouraged in order to emphasize the role of intra-regional crossovers, related variety, and endogenous capabilities. This is so both for the macro level of national policy and the meso level of

cluster projects. However, this strategy must also be coupled with supraregional linkages. Thus, as 'policies for cluster evolution may lead to decreasing scope of contingencies and negative path dependency within regional industry structures if related variety and the regional context is not taken into account' (Paper #4: 151), both policy and cluster projects should also focus on the roles of other intra-regional resources by expanding their current value chain focus. This is consistent with the discussion in Paper #5, in which we investigated how meso-level actors (cluster facilitators) interpret macro-level cluster policies, and in which we considered the role of agency in the development of regional industry clusters.

Paper #5: 'Encounters between cluster theory, policy and practice in Norway: Hubbing, blending and conceptual stretching'

Co-authored by Stig-Erik Jakobsen, Heidi W. Aslesen, and Arnt Fløysand, and published in *European Urban and Regional Studies* (2016), this paper focused on the role of agency in shaping understandings of what industry clusters are, and what they could and should be. It investigated the intersections between the meso and macro levels by showing how the industry clusters literature has generally treated industry clusters from an instrumental perspective, i.e. as a material, real-world entity, without considering how clusters and cluster projects are also influenced by socially constructed interpretations. What this means is that a cluster project does not necessarily reflect that a material cluster is present within an area, and, similarly, that not all (well-functioning) clusters are represented by a cluster project (see Paper #6 for a similar argument linked to RIS). Moreover, as shown in both Paper #2 and Fløysand et al. (2012), industry clusters evolve through micro–meso–macro interplay, in which successful top-down policy plays a role only insofar as it provides opportunities for context-specific implementation approaches by regional stakeholders. These regional approaches, it is argued, are the result of linkages between socially constructed and 'real-world' material clusters, which lead to different outcomes, i.e. cluster projects, in different regional contexts. Thus, as also presented in Paper #3, materiality and discourses do not necessarily 'communicate' in processes of regional industry renewal in general, or in cluster development in particular.

With this as the point of departure, the paper discusses the fuzziness of cluster theory as represented by academics, and how this is reflected in policy and policy implementation. We argue that these 'encounters' between cluster theory, policy, and practice make way for meso-level agency in defining and describing what a cluster is, and how cluster projects can be tailored to fit context-specific challenges and opportunities. Case studies on NCE Maritime (Møre og Romsdal), NCE Subsea (Hordaland), and Oslo Cancer Cluster (Oslo) were used to exemplify how the macro-level NCE program provides leeway to meso-level cluster facilitators. We described how each of the three cases implemented unique cluster development strategies, which illustrated how the socially constructed cluster concept was 'stretched' by interactions between theory, policy, and practice. Thus, agency was primarily ascribed to the meso level of cluster facilitation and other regional stakeholders, i.e. 'system agency'. Consequently, 'there seems to be a discrepancy between the theoretical understanding of clusters, the understanding of clusters found in national cluster policies and the understandings traced in the different cluster projects … [illustrating how regional] cluster stakeholders launch strategies that they believe are advantageous for the member firms' (Paper #5: 12). This illustrates the dynamic interplay between the macro and meso levels of regional industry renewal, and, most prominently, it shows how agency can play an influential role in regional industry renewal. Moreover, it also shows how agency can result from actors operating on the meso level, not only the micro level, as has often been the situation in EEG (see Section 2).

Paper #6: 'Policy for evolution of regional innovation systems: The role of social capital and regional particularities'

This paper was published in *Science and Public Policy* (2017), and co-authored by myself and Stig-Erik Jakobsen. Consistent with Paper #5, this work was concerned with regional implementation of national-level policy, i.e. the dynamics between the macro and meso levels. The paper contributed to the debate about RIS evolution, empirically describing how the VRI policy program has contributed to the development of RIS in Norwegian regions. The VRI program was operated by the Research Council of Norway, and involved all of the Norwegian counties. The program ran for 10 years over three program periods. We described how, at a national level, the program represented

an evolutionary logic in which RIS evolved into more well-functioning infrastructures towards the end of the program (see also Paper #7). However, regional implementation of the program emphasize how regional specificities were considered, and that regional approaches differed. Consistent with paper #5, this insight reflected a role for agency on the meso level, i.e. that regional partnerships were given leeway to develop regionally relevant projects.

We approached RIS evolution through the concept of regional social capital. Through a narrow RIS approach (Asheim and Gertler, 2005), we showed how RIS can be understood by viewing the collective personality of a region (Malecki, 2012), i.e. regional social capital. Linking this to policy, we argue that a policy role in RIS evolution is to support development of social capital. Since we employed a narrow approach to RIS, we operationalised innovation systems as regional partnerships for innovation and explored how this was connected to the micro level of firms and organizations. Thus, we proposed that policy can play a role in stimulating interaction between different regional actors (which, after all, is at the core of RIS theory), and that RIS evolution—from a theoretical perspective—can be considered related to the three evolutionary phases; preformation, path formation, and the mature phase. We argue that, following a theoretical logic, RIS policy should attempt to first stimulate 'structural' social capital by setting up systemic 'infrastructures' such as partnerships, before next focusing on development of 'relational social capital' by encouraging 'real' interaction between the partners. Finally, and specific to the mature phase, the aim of policy—again from a theoretical perspective—is to develop a shared understanding among the actors, i.e. to focus on developing 'cognitive social capital'. A central finding from the paper was that RIS policy should consider the 'amount' or 'type' of regional social capital dominant in a region *a priori* policy implementation. This can be further related to the topic of regional industry renewal. For instance, RIS (and RIS policy) can take a proactive role in regional industry renewal by supporting the needs of regional industry and R&D actors, and adapting policy approaches to specific needs within the different regional industries (Moodysson and Zukauskaite, 2014; Isaksen and Jakobsen, 2016). However, it can also contribute to expanding the scale and scope of regional firms and R&D organizations, e.g. through encouraging crossover activity and internationalization

(cf. Paper #4). As is also described in Paper #7, this means that intersections between the national level and regional implementation should be 'open enough' to support regional solutions, i.e. agency, while simultaneously being 'strict' enough to contribute to change in a given direction. However, if the aim is to 'progress' the system towards renewal and economic sustainability (Tödtling and Trippl, 2014), it is important to discuss whether policy approaches should focus merely on the perceived needs of the micro level, or whether—and possibly how—policy can lead a system in a normative direction (Schlaile et al., 2017), i.e. resembling a more 'mission-oriented' approach to innovation policy (Mazzucato, 2015).

Moreover, as discussed above in Section 3, the Bergen region is characterized by strong R&D environments and an industry structure resembling related variety, but that interaction between these groups has been less extensive than is desirable. The VRI program has been important in developing such relations, but, in the case of Hordaland, focus has primarily been on development of structural social capital. The regional partnership has worked hard at including relevant regional actors, and to set up a system that can support development of relations between regional actors. It is difficult to provide definitive conclusions about how VRI Hordaland has contributed to regional industry renewal, but it should be noted that, in VRI 1, the target areas were 'energy', 'maritime', 'marine', and 'tourism', which meant that the strong, traditional industries were targeted through 'industry-relevant competence', 'entrepreneurship', and 'innovation and entrepreneurship'. In VRI 2, the target areas were 'VRI as a mobilization tool for other instruments', 'networks of firms and emerging clusters', and 'focus on tools'. In VRI 3, the target areas were 'firms in emerging clusters and networks', 'development and transfer of knowledge between industries', 'increased innovation in rural areas', and 'co-operation between regional policy instruments and R&D environments about research in firms'. Thus, in the early VRI phase, the focus was on developing the already-strong industries, whereas in the latter phases, greater focus was explicitly towards contributing to regional industry renewal through supporting crossovers and novelty, i.e. emerging industry activity. However, as pointed out by an informant from Hordaland:

> In such a big, regional setting that Hordaland represents in terms of research, R&D environments and research institutes, then I cannot see that VRI has affected any general trends at all. I am totally convinced about that. But within some segments, for instance these [immature] clusters and networks, especially the Arena-networks, then I think VRI has achieved some new perspectives for some people. Without necessarily changing the innovation system.

However, as is discussed further below regarding Paper #7, a key VRI output has been the learning aspect, including at the meso level. This means that upgrading and knowledge development has been an important VRI contribution to stimulating regional industry renewal. Changes on the micro level have been fewer, but in general it can be asserted that the RIS has become better able to contribute to regional industry renewal, and that whether this opportunity will be utilized will depend on strategy and policy. At present, this appears to be the case, as policy and regional development actors are focused on addressing challenges caused by the recent drop in oil prices, and actors in the RIS are working to coordinate their efforts to stimulate crossover activity between regional firms, as well as between firms and R&D organizations.

Paper #7: 'Linking the bottom-up and top-down evolution of regional innovation systems to policy: Organizations, support structures and learning processes'

Co-authored by Jens Kristian Fosse and currently under review in *Industry and Innovation*,[3] this paper considers RIS evolution by investigating the dynamics between the micro and meso levels. Consistent with Paper #6, the VRI program is investigated from an evolutionary perspective, in which we connected dialogues about the roles of the meso and micro levels in RIS evolution (see also Isaksen et al., 2016). The paper addresses one of the key issues in the innovation systems literature: i.e. (systemic) learning. Specifically, we consider the role of RIS policy in contributing to learning in firms and organizations and in regional partnerships. We argue that stimulating learning at both the micro and meso levels is important for RIS development, but that the question of where to strike a balance between organizational- and system-level support is a matter of regional circumstances. In regions with well-functioning regional partnerships, we argue that policy support should be targeted at the micro level. Conversely, in regions

[3] A revised version has been submitted following a minor revision.

characterized by innovative firms and competent R&D and support organizations, but which lack an 'environment' for interaction, policy should target the meso level (as has been the case in Hordaland). The paper furthermore contributes to the debate about structure and agency, describing how different micro-level organizations and their agency can influence RIS development, e.g. R&D organizations. Moreover, it continues the discussion about the role of RIS policy in regional industry renewal (see Paper #6) by demonstrating how top-down policy implementation is important if the aim is to 'guide' a system in a 'desired' direction. As this dissertation has shown, agency can also be ascribed to the meso level, which means that there is room to manoeuvre by 'system agents' wishing to use RIS and RIS policy as tools for encouraging regional industry renewal. However, such efforts must acknowledge the importance of micro-level embeddedness if they are to contribute to real change (Zukauskaite et al., 2017), which means that policy attempts will often fail unless the practices at the micro level are considered. Paper #7 contributes insight into this issue by assessing mechanisms linking the micro and meso levels of RIS evolution, arguing that addressing only the micro, meso, or macro levels is insufficient if the aim is to promote regional industry renewal. Instead, it is the dynamics between the levels that are particularly important to consider.

5. Concluding discussion

Calls for regional industry renewal are often voiced by academics, business leaders, and policymakers, but such calls are often reactive, i.e. restructuring is called for after an external shock has 'shaken up' a system (Martin and Sunley, 2015). Often, this is also echoed by a call for public spending and, thus, external financial support, not unlike Norwegian industry policies of bygone times (Jakobsen and Høvig, 2014). Consequently, 'restructuring is typically interpreted as consisting of *temporary* processes initiated and facilitated by *public actors* at multiple scales (Karlsen and Dale, 2014: 71, my italics). In contrast, this dissertation has considered an evolutionary approach to regional economic restructuring through the concept of regional industry renewal, which underscores that this is a continuously ongoing process. Evolution of regional economic activity, no matter where or when, will include some degree of both continuation and change (Martin and Sunley, 2006, 2010). This is also addressed, *inter alia*, in Papers #2 and #4, which discusses the importance of supraregional linkages in introducing novelty to industry clusters, but also that intra-regional networks and activities are important for upholding cluster identity and profile – continuation is also important. However, the 'intensity' of each category (continuation vs. change) is subject to spatio-temporal specificities, meaning that in some periods regions may experience a high degree of renewal, whereas elsewhere, or during other time periods, continuation and conservation may dominate.

Through theoretical and empirical exploration, it has been shown that, in EEG, investigations of regional industry development in general, and regional economic renewal in particular, tend to focus on the meso level of industry structures, RIS, and industry clusters. Arguments are often raised that macro-level linkages are particularly important for avoiding lock-in and to stimulate novelty at the meso level, or, to an increasing degree, that the meso level is influenced by the micro level, such as by strong firms or regional development agencies. However, few attempts have been made to connect these three analytical levels or to treat them in conjunction. Here, it has been

proposed that regional industry renewal results from dynamic multilevel interplays between the micro, meso, and macro levels. Thus, PRQ asked: 'How can the multilevel dynamics of regional industry renewal be approached analytically?'

From the ontological and epistemological perspective of EEG, multilevel dynamics are key for a 'truly' evolutionary approach. Despite this, much EEG work has either focused on one of the levels, or it has examined how one of the levels influences another (typically the role of macro-level external shocks in triggering meso-level responses). Fewer attempts have been made to treat the levels in conjunction (see for instance Dawley et al, 2015; Matti et al., 2017). This was described through both theoretical and empirical perspectives in Section 2, which informed the development of an analytical approach. This approach emphasizes the role of multilevel dynamics in processes of regional industry renewal, and it has been argued herein that investigations should consider that different actors (be they on the micro, meso, or macro levels) can influence the processes of regional industry development differently (see Paper #3). Moreover, this dissertation has explained that both endogenous and exogenous resources matter when it comes to stimulating regional industry renewal, and that a multilevel approach must consider the importance of both. Thus, SRQ1 asked: 'What characterizes the multilevel dynamics of regional industry renewal among the firms, industries, clusters, and regional innovation system in the Bergen region?' This question was addressed through discussion of each of the seven papers. Synthesizing the findings, the Bergen region is clearly characterized by strong firms and R&D organizations, industry facilitators and formalized cluster projects, and its industry structure is characterized by related variety and supraregional linkages (Section 3). This puts the Bergen region in a strong position, even considering the recent drop in oil prices (the petroleum industry is the dominant industry in the region). Thus, it appears that the region has the ability to 'bounce back' because of its diversified economic activities. That is not to say that the downturn in the petroleum industry has not affected the region; rather, it implies that there is room in which to manoeuvre for regional actors, e.g. firms, policymakers, and R&D organizations. SRQ2 was connected to this topic, and asked: 'What is the role of agency (in firms, industries, clusters, and regional innovation systems) in regional industry renewal?' EEG has mainly focused on the structural

determinants of the meso level, implying that agency has largely been overlooked. In addressing SRQ2 via theoretical and empirical perspectives, it has been argued that agency can play a role at all three analytical levels. This was exemplified in several of the papers, in which agency was given explanatory power at the micro level of firms (Papers #1, #2, and #7) and R&D organizations (Paper #7), and at the meso level of cluster facilitation (Paper #5) and RIS (Paper #6). Hence, complementing the micro-level agency approach of much EEG work with the notion of system agency (cf. e.g. Tödtling and Trippl, 2014), agency can play important roles in stimulating processes of regional industry renewal and influencing evolution at the meso and macro levels.

Finally, SRQ3 asked: 'How do the case study investigations of multilevel dynamics and agency presented here inform theory and policy for regional industry renewal?' This dissertation has emphasized that EEG is closely linked to policy development and implementation (also evidenced by several of the papers). The findings presented herein inform both theory and policy. By using a case study approach, in which the aim has been to contribute to theory development and conceptual clarification by investigating a 'configurative case' (George and Bennett, 2005), this dissertation has shown how regional industry renewal processes take place in the Bergen region. The findings here emphasize the importance of treating the micro, meso, and macro levels in conjunction. Agency plays a role in stimulating this interplay and can inform similar processes within other geographical contexts. This is related to the ontological position presented, in which it has been shown that alternating between theory and empirical work, and by gaining deeper insights into mechanisms linking the necessary and contingent conditions of regional industry renewal, the case study described here contributes both theoretical and conceptual insight into why and how regional industry renewal is a complex multilevel process. This implies that it is insufficient for policy to focus only on regional actors or structures (Isaksen and Jakobsen, 2016). Rather, the focus should also be on linking the activities of firms and organizations, industries, and industry clusters, at both national and supranational settings, in coherent frameworks that address their unique, context-specific dynamics. As discussed in Papers #6 and #7, focus should be on not only 'gathering' the relevant actors, work must also be done to develop relations between the actors and to work towards shared 'visions' and frames

of reference. For the Bergen region, this suggests focusing on coordination of different, though highly competent and related, actors from industry and the R&D sector, particularly considering the region's many clusters and industry facilitation initiatives. Moreover, policy can also play a role in contributing to upholding or increasing scopes of contingencies through encouraging expansion of scale and scope across the micro and meso levels. Finally, it should be noted that internationalization is a topic of interest to the region. As shown in this dissertation, internationalization is a two-way process, i.e. firms and organizations going out and firms coming in, which is something that policymakers should also consider. These processes may contribute differently to regional industry renewal, and should be treated accordingly (see Papers #2 and #3). In so doing, policies should acknowledge that it is not enough to develop 'innovation systems', these must also be connected to the practices, competences, capabilities, and roles of different regional actors (see Paper #7). This argument is consistent with the discourses on smart specialization (Foray, 2014) and creating regional advantages (Asheim et al., 2011), among others.

Naturally, there are limitations to this work. First, this dissertation has described regional industry renewal in a region characterized by strong industry activities, competent R&D organisations and facilitation initiatives, i.e. it is an 'organizationally thick and diversified' region (Isaksen and Trippl, 2016b). However, this dissertation contributes new insights by explaining the links between organizational and system levels in regional settings because it has often been taken for granted that strong industries are characterized by a competent support structure and vice versa (Zukauskaite et al., 2017). Second, other regional settings may struggle with different issues; this is certainly true for many rural regions (Morgan, 2017). However, although the findings presented here specifically considered renewal in the Bergen region, this dissertation also contributes insight into certain conditions necessary for regional industry renewal generally, e.g. that it is continuous, multilevel, and characterized by both agency and structure. This may inform future research in other regions (and in other types of regions), where analytically, these same dimensions should be considered. Third, the data should be elaborated to better cover the downturn in the oil and gas industry, i.e. 'hard facts' demonstrating the effects of turnover and employment with

more accurate quantification. However, since this was a relatively recent event, no studies have yet quantified its effect and it is too soon to deduce conclusions from official statistics. Future investigations should also consider the 'distribution' of regional industry renewal processes through quantitative work, i.e. to investigate the spatio-temporal specificities of e.g. high and low degrees of renewal. For instance, the interplays between the three analytical levels may differ between regions operating under the same and/or different national-level settings, for instance, is it so that one level 'dominates', and how does the interplay between the three levels evolve over time? Fourth, it has been argued that a multilevel perspective facilitates consideration of the role of agency not just on the micro level; 'systemic agency' can also play a role on the meso and macro levels. This has been shown at the meso level, but none of the papers herein have addressed the role of agency at the macro level, e.g. changing regulatory regimes at a national or international level. Here, work on institutional entrepreneurship may provide interesting insight; as shown by Sjøtun (under review), regional renewal can result from deliberate action by regional actors toward national-level policymakers, leading to regulatory changes and illustrating agency at the macro level.

This dissertation also suggests additional avenues for further research. Among the issues discussed here and in the individual papers, linking EEG to adjacent literatures, e.g. relational economic geography, appears to be particularly important toward developing the multilevel approach (see e.g. Paper #2). In addition, exploring linkages to transition studies literature and technological innovation systems, among others, may also be of interest for further research (Boschma et al., 2017). This may especially be so because, as claimed by, Carlsson (2016: 52)

> What distinguishes sectoral and technological innovation systems from geographically defined ones is the emphasis on dynamics, on the importance of the knowledge base and knowledge flows, and on the role of individual actors, especially entrepreneurs. These elements are essential for innovation systems to be useful as tools for dynamic analysis. Dynamic systems consist of subsystems and components, relationships among these, and their characteristics or attributes.

Likewise, theoretical and political approaches to the role of regional industry renewal and regional settings can be helpful in addressing global grand challenges such as environmental change, social disparities, and migration. Thus, to advance the EEG

literature from its currently meso-level-oriented focus, both related and unrelated literatures should be considered in order to stimulate novelty, and, in turn, understand how regional industry renewal is influenced by multilevel dynamics and agency.

It should also be noted that this dissertation contributes to a more nuanced understanding of the mechanisms and processes of regional industry renewal. It does so without going into detail on the side effects of innovation and regional industry development, which can often be detrimental. Thus, further research should examine the relative processes of regional industry renewal and concepts such as responsible innovation (Fløysand et al., under review), 'greening' of industry activity, and the role of new, disruptive technology, e.g. artificial intelligence. Regarding the 'greening' of the Norwegian (i.e. natural resource-based) economy, a forthcoming special issue in the *Norwegian Journal of Geography,* edited by Markus Steen (SINTEF) and myself, investigates the role of economic geography and the approaches to such issues taken by young economic geography PhD students. In part, one of the main ideas of the special issue is to investigate how approaches to innovation in general, and the more narrow (yet highly multidisciplinary) field of sustainability transitions research specifically, are key intellectual breeding grounds for understanding how 'green shifts' develop in different economic landscapes (Truffer and Coenen, 2012). To this end, we propose that economic geography can—and should—benefit from interaction with other academic fields (Turok et al., 2017). However, regardless of whether the aim is to understand the 'direction' of regional industry development and innovation (Schlaile et al., 2017), it is still crucial to augment such approaches with an understanding of the mechanisms of such activities and how they develop spatio-temporally. This has been the primary aim of this dissertation.

In conclusion, this dissertation has expounded a dynamic multilevel approach to regional industry renewal. Moreover, it has given agency a more prominent role by arguing: a) that decision-makers, e.g. cluster facilitators, business leaders, and policymakers, are able to proactively influence change processes; and b) that bygones will forever be bygones. Former contingencies can never be 'recovered' or 're-established'. Instead, there is a need to adapt current capabilities to constantly changing

settings (e.g. in line with Penrose, 2009). Consequently, conceptualizing regional economic restructuring through the perspective presented here is relevant if the aim is to understand how regions can avoid ‘putting all their eggs in one basket’, or, to frame it differently, to avoid negative path dependency and lock-in ‘before it occurs’ (Kogler, 2015).

6. References

Aarstad J, Kvitastein OA and Jakobsen S-E. (2016) Related and unrelated variety as regional drivers of enterprise productivity and innovation: A multilevel study. *Research Policy* 45: 844-856.

Aldrich HE, Hodgson GM, Hull DL, et al. (2008) In defence of generalized Darwinism. *Journal of Evolutionary Economics* 18: 577-596.

Archer M, Bhaskar R, Collier A, Lawson T and Norrie A (eds). (1998) *Critical Realism: Essential Readings.* London: Routledge.

Arthur WB. (1989) Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal* 99: 116-131.

Asheim BT, Boschma R and Cooke P. (2011) Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies* 45: 893-904.

Asheim BT, Coenen L and Moodysson J. (2015a) Methods and applications of regional innovation systems analysis. In: Karlsson C, Andersson M and Norman T (eds), *Handbook of Research Methods and Applications in Economic Geography.* Cheltenham: Edward Elgar.

Asheim BT and Gertler MS. (2005) The geography of innovation: Regional innovation systems. In: Fagerberg J, Mowery DC and Nelson RR (eds), *The Oxford Handbook of Innovation.* Oxford: Oxford University Press, 291-317.

Asheim BT, Isaksen A, Martin R and Trippl M (2017) The role of clusters and public policy in new regional economic path development. In: Fornahl D and Hassink R (eds), *The Life Cycle of Clusters*. Cheltenham: Edward Elgar, 13-34.

Backhaus JG. (2003) *Evolutionary Economic Thought: European Contributions and Concepts*. Cheltenham: Edward Elgar.

Balzat M and Hanusch H. (2004) Recent trends in the research on national innovation systems. *Journal of Evolutionary Economics* 14: 197-210.

Bathelt H and Li P-F. (2014). Evolutionary Economic Geography and Relational Geography. In: Fischer M and Nijkamp P (eds), *Handbook of Regional Science*. Berlin Heidelberg: Springer-Verlag, 591-607.

Bathelt H, Malmberg A and Maskell P. (2004) Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography* 28: 31-56.

Battilana J, Leca B and Boxenbaum E. (2009) How actors change institutions: Towards a theory of institutional entrepreneurship. *The Academy of Management Annals* 3: 65-107.

Bergek A and Onufrey K. (2013) Is one path enough? Multiple paths and path interaction as an extension of path dependency theory. *Industrial and Corporate Change* 23: 1261-1297.

Berggren C, Magnusson T and Sushandoyo D. (2015) Transition pathways revisited: Established firms as multi-level actors in the heavy vehicle industry. *Research Policy* 44: 1017-1028.

Binz C, Truffer B and Coenen L. (2016) Path creation as a process of resource alignment and anchoring: Industry formation for on-site water recycling in Beijing. *Economic Geography* 92: 172-200.

Blomgren A, Quale C, Brosvik Bayer S, et al. (2013) *Industribyggerne: Norsk olje- og gassnæring ut med havet og mellom bakkar og berg [Industry Entrepreneurs: Norwegian Oil and Gas Industry by the Ocean and Between Mountains]*. Stavanger: Rapport IRIS - 2013/031, International Research Institute of Stavanger, https://www.menon.no/wp-content/uploads/22iris-rapport-nr-31-2013-industribyggerne.pdf

Boschma R, Coenen L, Frenken K, et al. (2017) Towards a theory of regional diversification: Combining insights from evolutionary economic geography and transition studies. *Regional Studies* 51: 31-45.

Boschma R and Frenken K. (2006) Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. *Journal of Economic Geography* 6: 273-302.

Boschma R and Frenken K. (2011) Technological relatedness, related variety and economic geography. In: Cooke P, Asheim B, Boschma R, et al. (eds), *Handbook of Regional Innovation and Growth.* Cheltenham: Edward Elgar, 187-197.

Boschma R and Frenken K. (2012) Technological relatedness and regional branching. In: Bathelt H, Feldman M and Kogler D (eds), *Beyond Territory. Dynamic Geographies of Knowledge Creation, Diffusion and Innovation.* London: Routledge, 64-81.

Boschma RA and Martin R. (2010) *The Handbook of Evolutionary Economic Geography*. Cheltenham: Edward Elgar.

Brunninge O and Melander A. (2016) The dynamics of path dependence on the individual, organizational and the field levels: MoDo, the Kempe family and the Swedish pulp and paper industry 1873–1990. *Management & Organizational History* 11: 189-210.

Bugge MM and Øiestad S. (2015) The micro-foundations of regional branching—The case of digitization of publishing. *European Planning Studies* 23: 764-784.

Butzin A and Widmaier B. (2016) Exploring territorial knowledge dynamics through innovation biographies. *Regional Studies* 50: 220-232.

Carlsson B. (2016) Industrial dynamics: A review of the literature 1990–2009. *Industry and Innovation* 23: 1-61.

Carlsson B and Stankiewicz R. (1991) On the nature, function and composition of technological systems. *Journal of Evolutionary Economics* 1: 93-118.

Castellacci F. (2006) A critical realist interpretation of evolutionary growth theorising. *Cambridge Journal of Economics* 30: 861-880.

Chandler AD. (1992) Organizational capabilities and the economic history of the industrial enterprise. *The Journal of Economic Perspectives* 6: 79-100.

Chapman K, MacKinnon D and Cumbers A. (2004) Adjustment or renewal in regional clusters? A study of diversification amongst SMEs in the Aberdeen oil complex. *Transactions of the Institute of British Geographers* 29: 382-396.

Chattoe E. (2006) Using evolutionary analogies in social science: Two case studies. In: Wimmer A and Kössler R (eds), *Understanding Change. Models, Methodologies and Metaphors.* New York: Palgrave Macmillan, 89-98.

Chesbrough HW. (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Boston, MA: Harvard Business Press.

Coe NM, Dicken P and Hess M. (2008) Introduction: Global production networks - debates and challenges. *Journal of Economic Geography* 8: 267-269.

Coe NM, Hess M, Yeung HW-C, et al. (2004) 'Globalizing' regional development: A global production networks perspective. *Transactions of the Institute of British Geographers* 29: 468-484.

Coenen L, Asheim B, Bugge MM, et al. (2016) Advancing regional innovation systems: What does evolutionary economic geography bring to the policy table? *Environment and Planning C: Politics and Space* 35: 600-620.

Content J and Frenken K. (2016) Related variety and economic development: A literature review. *European Planning Studies* 24: 2097-2112.

Cordes C. (2006) Darwinism in economics: from analogy to continuity. *Journal of Evolutionary Economics* 16: 529-541.

Cortinovis N, Xiao J, Boschma R, et al. (2017) Quality of government and social capital as drivers of regional diversification in Europe. *Journal of Economic Geography* 17: 1179-1208.

Couper P. (2015) *A Student's Introduction to Geographical Thought.* London: SAGE.

David PA. (1985) Clio and the economics of QWERTY. *The American Economic Review* 75: 332-337.

Dawley S, MacKinnon D, Cumbers A, et al. (2015) Policy activism and regional path creation: The promotion of offshore wind in North East England and Scotland. *Cambridge Journal of Regions, Economy and Society* 8: 257-272.

Dawley S (2014). Creating new paths? Offshore wind, policy activism, and peripheral region development. *Economic Geography* 90(1): 91-112).

Dicken P. (2007) *Global Shift. Mapping the Changing Contours of the World Economy.* London: Sage Publications.

Dopfer K, Foster J and Potts J. (2004) Micro-meso-macro. *Journal of Evolutionary Economics* 14: 263-279.

Dosi G. (1982) Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change. *Research Policy* 11: 147-162.

Downward P and Mearman A. (2007) Retroduction as mixed-methods triangulation in economic research: Reorienting economics into social science. *Cambridge Journal of Economics* 31: 77-99.

Easterby-Smith M, Thorpe R and Jackson PR. (2015) *Management & Business Research.* London: SAGE.

Easton G. (2010) Critical realism in case study research. *Industrial Marketing Management* 39: 118-128.

Edquist C. (2001) Innovation policy - A systematic approach. In: Lundvall BÅ and Archibugi D (eds), *Major Socio-Economic Trends and European Innovation Policy.* Oxford: Oxford University Press, 219-238.

Edwards PK, O'Mahoney J and Vincent S. (2014) *Studying Organizations Using Critical Realism: A Practical Guide*. Oxford: Oxford University Press.

Eisenhardt KM. (1989) Building theories from case study research. *Academy of Management Review* 14: 532-550.

Emirbayer M and Mische A. (1998). What is agency? *The American Journal of Sociology* 103(4): 962-1032.

Enkel E and Gassmann O. (2010) Creative imitation: exploring the case of cross-industry innovation. *R&D Management* 40: 256-270.

Essletzbichler J and Rigby DL. (2010) Generalized Darwinism and evolutionary economic geography. In Boschma R and Martin R: *The Handbook of Evolutionary Economic Geography.* Cheltenham: Edward Elgar, 43-61.

Etzkowitz H and Leydesdorff L. (2000) The dynamics of innovation: From National Systems and "Mode 2" to a Triple Helix of university–industry–government relations. *Research Policy* 29: 109-123.

European Commission. (2012) Guide to Research and Innovation Strategies for Smart Specialisations (RIS3). Luxembourg: Publications Office of the European

Union, http://ec.europa.eu/regional_policy/sources/docgener/presenta/smart_specialisation/smart_ris3_2012.pdf

Fagerberg J. (2003) Schumpeter and the revival of evolutionary economics: An appraisal of the literature. *Journal of Evolutionary Economics* 13: 125-159.

Fagerberg J, Mowery DC and Nelson RR. (2005) *The Oxford Handbook of Innovation*. Oxford: Oxford University Press.

Fagerberg J, Mowery DC, Verspagen B, et al. (2009) *Innovation, Path Dependency and Policy: The Norwegian Case.* Oxford: Oxford University Press.

Fagerberg J and Verspagen B. (2009) Innovation studies—The emerging structure of a new scientific field. *Research Policy* 38: 218-233.

Fairclough N. (2005) Discourse analysis in organization studies: The case for critical realism. *Organization Studies* 26: 915-939.

Fitjar RD and Rodríguez-Pose A. (2011) When local interaction does not suffice: Sources of firm innovation in urban Norway. *Environment and Planning A* 43: 1248-1267.

Fitjar RD and Rodríguez-Pose A. (2013) Firm collaboration and modes of innovation in Norway. *Research Policy* 42: 128-138.

Fitjar RD and Timmermans B. (2017) Regional skill relatedness: towards a new measure of regional related diversification. *European Planning Studies* 25: 516-538.

Fløysand A, Hidle K and Jakobsen S-E. (2013) Hvordan forholde seg til ideer og materie i studier av innovasjonspraksis [How to relate to ideas and materiality in studies of innovation practice]? In: Abelsen B, Isaksen A and Jakobsen S-E (eds), *Innovasjon - organisasjon, region, politikk [Innovation – organization, region, policy]*. Oslo: Cappelen Damm, 323-338.

Fløysand A and Jakobsen S-E. (2001) Clusters, social fields, and capabilities: Rules and restructuring in Norwegian fish-processing clusters. *International Studies of Management & Organization* 31: 35-55.

Fløysand A and Jakobsen S-E. (2011) The complexity of innovation: A relational turn. *Progress in Human Geography* 35: 328-344.

Fløysand A, Jakobsen S-E and Bjarnar O. (2012) The dynamism of clustering: Interweaving material and discursive processes. *Geoforum* 43: 948-958.

Fløysand A and Jakobsen SE. (2017) Industrial renewal: Narratives in play in the development of green technologies in the Norwegian salmon farming industry. *The Geographical Journal* 183: 140-151.

Fløysand A, Jakobsen SE and Njøs R. (under review) The trinity of responsible innovation: The dynamism materiality, practice and discourse. *Journal of Responsible Innovation*.

Fløysand A, Njøs R, Nilsen T, et al. (2016) Foreign direct investment and renewal of industries: Framing the reciprocity between materiality and discourse. *European Planning Studies* 25: 462-480.

Foray D. (2014) *Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy*. London: Routledge.

Freeman C. (1987) *Technology Policy and Economic Performance: Lessons from Japan*. London: Pinter Publishers.

Frenken K and Boschma R. (2015) Geographic clustering in evolutionary economic geography. In: Karlsson C, Andersson M and Norman T (eds), *Handbook of Research Methods and Applications in Economic Geography.* Cheltenham: Edward Elgar, 291-302.

Frenken K, Van Oort F and Verburg T. (2007) Related variety, unrelated variety and regional economic growth. *Regional Studies* 41: 685-697.

Garud R, Hardy C and Maguire S. (2007) Institutional entrepreneurship as embedded agency: An introduction to the special issue. *Organization Studies* 28: 957-969.

Garud R and Karnøe P. (2010) Path dependence and path creation? *Journal of Management Studies* 47: 760-764.

George AL and Bennett A. (2005) *Case Studies and Theory Development in the Social Sciences.* Cambridge, MA: MIT Press.

Gertler M. (2010). Rules of the game: The place of institutions in regional economic change. *Regional Studies* 44(1): 1-15.

Gobo G. (2004) Sampling, representativeness and generalizability. In: Seale C, Gobo G, Gubrium JF, et al. (eds), *Qualitative Research Practice.* London: Sage Publications, 405-426.

Gobo G. (2008) Re-conceptualizing generalization: Old issues in a new frame. In: Alasuutari P, Bickman L and Brannen J (eds), *The SAGE Handbook of Social Research Methods*. London: SAGE Publications, 193-213.

Grabher G. (2009) Yet another turn? The evolutionary project in economic geography. *Economic Geography* 85: 119-127.

Grillitsch M, Asheim B and Trippl M. (2017) Unrelated knowledge combinations: Unexplored potential for regional industrial path development. *Working Paper, Lund University, CIRCLE-Centre for Innovation, Research and Competences in the Learning Economy*, http://wp.circle.lu.se/upload/CIRCLE/workingpapers/201710_grillitsch_et_al.pdf

Grønmo S. (2007) *Samfunnsvitenskapelige metoder [Methods in Social Science]*. Bergen: Fagbokforlaget.

Hane-Weijman E, Eriksson RH and Henning M. (2017) Returning to work: regional determinants of re-employment after major redundancies. *Regional Studies.* DOI: https://doi.org/10.1080/00343404.2017.1395006.

Harmsen H, Grunert KG and Declerck F. (2000) Why did we make that cheese? An empirically based framework for understanding what drives innovation activity. *R&D Management* 30: 151-166.

Hassink R and Klaerding C. (2009) Relational and evolutionary economic geography: Competing or complementary paradigms? *Papers in Evolutionary Economic Geography, Utrecht University,* http://econ.geo.uu.nl/peeg/peeg0911.pdf.

Hassink R, Klaerding C and Marques P. (2014) Advancing evolutionary economic geography by engaged pluralism. *Regional Studies* 48: 1295-1307.

Hauge ES, Kyllingstad N, Maehle N, et al. (2017) Developing cross-industry innovation capability: Regional drivers and indicators within firms. *European Planning Studies* 25: 388-405.

Herstad S and Sandven T. (2017) Towards regional innovation systems in Norway? An explorative empirical analysis. Oslo: Nordic Institute for Studies in Innovation, Research and Education (NIFU), https://brage.bibsys.no/xmlui/bitstream/handle/11250/2441343/NIFUreport2017-8.pdf?sequence=1

Holmen AKT and Fosse JK. (2017) Regional agency and constitution of new paths: A study of agency in early formation of new paths on the west coast of Norway. *European Planning Studies* 25: 498-515.

Hordaland County Council. (2017) Forskingsfylket Hordaland [The Research County Hordaland]. AUD-report nr. 05-17, https://www.hordaland.no/globalassets/for-hfk/rapportar-og-statistikk/aud-rapportar/aud-rapport-05-17-forskingsfylket-hordaland-v2.pdf

Hu X and Hassink R. (2017a) Exploring adaptation and adaptability in uneven economic resilience: A tale of two Chinese mining regions. *Cambridge Journal of Regions, Economy and Society* 10: 527-541.

Hu X and Hassink R. (2017b) Place leadership with Chinese characteristics? A case study of the Zaozhuang coal-mining region in transition. *Regional Studies* 51: 224-234.

Hurrell SA. (2014) Critical realism and mixed methods research. In: Edwards PK, O'Mahoney J and Vincent S (eds), *Studying Organization Using Critical Realism.* Oxford: Oxford University Press, 241-263.

Iammarino S. (2005) An evolutionary integrated view of regional systems of innovation: Concepts, measures and historical perspectives. *European Planning Studies* 13: 497-519.

Isaksen A. (2011) Cluster evolution. In: Cooke P, Asheim B, Boschma R, et al. (eds), *Handbook of Regional Innovation and Growth.* Cheltenham: Edward Elgar, 293-303.

Isaksen A and Jakobsen S-E. (2016) New path development between innovation systems and individual actors. *European Planning Studies* 25: 355-370.

Isaksen A, Normann RH and Spilling OR. (2017) Do general innovation policy tools fit all? Analysis of the regional impact of the Norwegian Skattefunn scheme. *Journal of Innovation and Entrepreneurship* 6: 6.

Isaksen A and Trippl M. (2016a) Exogenously led and policy-supported new path development in peripheral regions: Analytical and synthetic routes. *Economic Geography* 93: 436-457.

Isaksen A and Trippl M. (2016b) Path development in different regional innovation systems: a conceptual analysis. In: Parrilli D, Fitjar RD and Rodriguez-Pose A (eds), *Innovation Drivers and Regional Innovation Strategy.* London: Routledge, 66-84.

Isaksen A, Tödtling F and Trippl M. (2016) Innovation policies for regional structural change: Combining actor-based and system-based strategies. *Vienna University of Economics and Business: SRE-Discussion 2016/05*, http://epub.wu.ac.at/5225/1/sre%2Ddisc%2D2016_05.pdf

Jakobsen S-E and Høvig ØS. (2014) Hegemonic ideas and local adaptations: Development of the Norwegian regional restructuring instrument. *Norsk Geografisk Tidsskrift [Norwegian Journal of Geography]* 68: 80-90.

Jakobsen S-E and Lorentzen T. (2015) Between bonding and bridging: Regional differences in innovative collaboration in Norway. *Norsk Geografisk Tidsskrift [Norwegian Journal of Geography]* 69: 80-89.

Jakobsen S-E and Onsager K. (2008) Innovasjonspolitikk for regional næringsutvikling [Innovation policy for regional industry development]. In: Isaksen A, Karlsen A and Sæther B (eds), *Innovasjoner i norske næringer - et geografisk perspektiv [Innovations in Norwegian Industries - A Geographic Perspective]*. Bergen: Fagbokforlaget, 269-288.

Karlsen A and Dale B. (2014) From regional restructuring to regional renewal: Cases from Norway. *Norsk Geografisk Tidsskrift [Norwegian Journal of Geography]* 68: 71-79.

Karlsson C, Andersson M and Norman T. (2015) *Handbook of Research Methods and Applications in Economic Geography.* Cheltenham: Edward Elgar.

Karnøe P and Garud R. (2012) Path creation: Co-creation of heterogeneous resources in the emergence of the Danish Wind Turbine Cluster. *European Planning Studies* 20: 733-752.

Kessler I and Bach S. (2014) Comparing cases. In: Edwards PK, O'Mahoney J and Vincent S (eds), *Studying Organizations Using Critical Realism.* Oxford: Oxford University Press, 168-184.

Kogler DF. (2015) Editorial: Evolutionary economic geography – Theoretical and empirical progress. *Regional Studies* 49: 705-711.

Kogler DF. (2017) Relatedness as driver of regional diversification: a research agenda - a commentary. *Regional Studies* 51: 365-369.

Laasonen V and Kolehmainen J. (2017) Capabilities in knowledge-based regional development–towards a dynamic framework. *European Planning Studies* 25: 1673-1692.

Lawson B and Samson D. (2001) Developing innovation capability in organisations: A dynamic capabilities approach. *International Journal of Innovation Management* 5: 377-400.

Lee N. (2017) Psychology and the geography of innovation. *Economic Geography* 93: 106-130.

Leigh NG and Kraft BR. (2017) Emerging robotic regions in the United States: Insights for regional economic evolution. *Regional Studies*. DOI: https://doi.org/10.1080/00343404.2016.1269158

Longhurst R. (2003) Semi-structured interviews and focus groups. In: Clifford NJ and Valentine G (eds), *Key Methods in Geography.* London: Sage Publications, 103-115.

Lundvall B-Ä and Johnson B. (1994) The learning economy. *Journal of Industry Studies* 1: 23-42.

Lundvall BÅ. (2007) National innovation systems—Analytical concept and development tool. *Industry and Innovation* 14: 95-119.

MacKinnon D, Cumbers A, Pike A, et al. (2009) Evolution in economic geography: Institutions, political economy, and adaptation. *Economic Geography* 85: 129-150.

Malecki EJ. (2012) Regional social capital: Why it matters. *Regional Studies* 46: 1023-1039.

Malerba F. (2002) Sectoral systems of innovation and production. *Research Policy* 31: 247-264.

Martin R. (2010) Roepke Lecture in Economic Geography—Rethinking regional path dependence: Beyond lock-in to evolution. *Economic Geography* 86: 1-27.

Martin R and Sunley P. (2003) Deconstructing clusters: Chaotic concept or policy panacea? *Journal of Economic Geography* 3: 5-35.

Martin R and Sunley P. (2006) Path dependence and regional economic evolution. *Journal of Economic Geography* 6: 395-437.

Martin R and Sunley P. (2010) The place of path dependence in an evolutionary perspective on the economic landscape. *Handbook of Evolutionary Economic Geography.* Cheltenham: Edward Elgar, 62-92.

Martin R and Sunley P. (2015) On the notion of regional economic resilience: conceptualization and explanation. *Journal of Economic Geography* 15: 1-42.

Martin R, Sunley P and Tyler P. (2015) Local growth evolutions: recession, resilience and recovery. *Cambridge Journal of Regions, Economy and Society* 8: 141-148.

Maskell P and Malmberg A. (1999) Localised learning and industrial competitiveness. *Cambridge Journal of Economics* 23: 167-185.

Matti C, Consolli D and Uyarra E. (2017) Multi level policy mixes and industry emergence: The case of wind energy in Spain. *Environment and Planning C: Politics and Space* 35(4): 661-683.

Mazzucato M. (2015) *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*. New York: Public Affairs.

Meyer KE, Mudambi R and Narula R. (2011) Multinational enterprises and local contexts: The opportunities and challenges of multiple embeddedness. *Journal of Management Studies* 48: 235-252.

Moodysson J and Sack L. (2016) Institutional stability and industry renewal: Diverging trajectories in the Cognac beverage cluster. *Industry and Innovation* 23: 448-464.

Moodysson J and Zukauskaite E. (2014) Institutional conditions and innovation systems: On the impact of regional policy on firms in different sectors. *Regional Studies* 48: 127-138.

Morgan K. (2017) Nurturing novelty: Regional innovation policy in the age of smart specialisation. *Environment and Planning C: Politics and Space* 35: 569-583.

Neffke F, Henning M and Boschma R. (2011) How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography* 87: 237-265.

Nelson RR. (1991) Why do firms differ, and how does it matter? *Strategic Management Journal* 12: 61-74.

Nelson RR and Winter S. (1982) *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.

NIFU. (2017) *Det norske forsknings- og innovasjonssystemet - statistikk og indikatorer [Report on Science and Technology Indicators for Norway]*. Oslo: NIFU.

Nightingale P and Coad A. (2014) Muppets and gazelles: political and methodological biases in entrepreneurship research. *Industrial and Corporate Change* 23: 113-143.

Njøs R, Jakobsen S-E, Fosse JK, et al. (2014) Challenges to bridging discrepant knowledge bases: A case study of the Norwegian Centre for Offshore Wind Energy. *European Planning Studies* 22: 2389-2410.

Normann RH, Johnsen HCG, Knudsen JP, et al. (2016) Emergence of regional leadership–a field approach. *Regional Studies* 51: 273-284.

North DC. (1994) Economic performance through time. *The American Economic Review* 84: 359-368.

Onufrey K and Bergek A. (2015) Self-reinforcing mechanisms in a multi-technology industry: Understanding sustained technological variety in a context of path dependency. *Industry and Innovation* 22: 523-551.

Payne G and Williams M. (2005) Generalization in qualitative research. *Sociology* 39: 295-314.

Penrose E. (2009) *The Theory of the Growth of the Firm.* Oxford: Blackwell.

Pike A, MacKinnon D, Cumbers A, et al. (2016) Doing evolution in economic geography. *Economic Geography* 92: 123-144.

Porter ME. (1990) *The Competitive Advantage of Nations.* London: Macmillan.

Roberts JM. (2014) Critical realism, dialectics, and qualitative research methods. *Journal for the Theory of Social Behaviour* 44: 1-23.

Rodríguez-Pose A. (2013) Do institutions matter for regional development? *Regional Studies* 47: 1034-1047.

Rothaermel FT and Hess AM. (2007) Building dynamic capabilities: Innovation driven by individual-, firm-, and network-level effects. *Organization Science* 18: 898-921.

Samfunnsøkonomisk Analyse [Economics Norway]. (2017) *Nøkkeltall Vestlandet 2017 [Key Figures Western Norway 2017]*. Oslo: Samfunnsøkonomisk Analyse AS [Economics Norway], https://www.hordaland.no/globalassets/for-hfk/pdf-til-nyheiter-2017/nokkeltallsrapport-2017.pdf.

Sayer A. (2000) *Realism and Social Science.* London: SAGE.

Schlaile M. P, Urmetzer S, Blok V, Andersen A.D, Timmermans J, Mueller M, Fagerberg J and Pyka A. (2017) Innovation systems for transformations towards sustainability? Taking the normative dimension seriously. *Sustainability* 9.

Schroeder H. (2011) Application possibilities of the micro-meso-macro framework in economic geography. *Papers in Evolutionary Economic Geography, Utrecht University,* http://econ.geo.uu.nl/peeg/peeg1115.pdf.

Simmie J. (2012) Path dependence and new technological path creation in the Danish wind power industry. *European Planning Studies* 20: 753-772.

Sjøtun S. (under review) A ferry making waves: A demonstration project 'Doing' institutional work in a greening maritime industry. *Paper submitted to Norwegian Journal of Geography*.

Smith C and Elger T. (2014) Critical realism and interviewing subjects. In: Edwards PK, O'Mahoney J and Vincent S (eds), *Studying Organization using Critical Realism.* Oxford: Oxford University Press, 109-131.

Sotarauta M. (2016) An actor-centric bottom-up view of institutions: Combinatorial knowledge dynamics through the eyes of institutional entrepreneurs and institutional navigators. *Environment and Planning C: Government and Policy* 35: 584-599.

Sotarauta M and Beer A. (2017) Governance, agency and place leadership: Lessons from a cross-national analysis. *Regional Studies* 51: 210-223.

Sotarauta M, Beer A and Gibney J. (2017) Making sense of leadership in urban and regional development. *Regional Studies* 51: 187-193.

Sotarauta M and Suvinen N. (forthcoming) Institutional agency and path creation - Institutional path from industrial to knowledge city. In: Isaksen A, Martin R and Trippl M (eds), *New Avenues for Regional Innovation Systems - Theoretical Advances, Empirical Cases and Policy Lesson.* New York: Springer.

Staber U and Sydow J. (2002) Organizational adaptive capacity: A structuration perspective. *Journal of Management Inquiry* 11: 408-424.

Steen M. (2016) Reconsidering path creation in economic geography: Aspects of agency, temporality and methods. *European Planning Studies* 24: 1605-1622.

Steen M and Weaver T. (2017) Incuments diversification and cross-sectorial energy industry dynamics. *Research Policy* 46: 1071-1086.

Strambach S and Halkier H. (2013) Reconceptualising change. Path dependency, path plasticity and knowledge combination. *Zeitschrift für Wirtschaftsgeographie [The German Journal of Economic Geography]* 57: 1-14.

Sydow J and Koll F. (2017) Platforming for path-breaking? The case of regional electromobility initiatives in Germany. In: Glückler J, Lazega E and Hammer I (eds), *Knowledge and Networks.* New York, NY: Springer, 191-219.

Sydow J, Schreyögg G and Koch J. (2009) Organizational path dependence: Opening the black box. *Academy of Management Review* 34: 689-709.

Sydow J, Windeler A, Müller-Seitz G, et al. (2012) Path constitution analysis: A methodology for understanding path dependence and path creation. *BuR-Business Research* 5: 155-176.

Teece DJ, Pisano G and Shuen A. (1997) Dynamic capabilities and strategic management. *Strategic Management Journal* 18: 509-533.

Trippl M, Grillitsch M and Isaksen A. (2017) Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography* https://doi.org/10.1177/0309132517700982.

Truffer B and Coenen L. (2012) Environmental innovation and sustainability transitions in regional studies. *Regional Studies* 46: 1-21.

Turok I, Bailey D, Clark J, et al. (2017) Global reversal, regional revival? *Regional Studies* 51: 1-8.

Tödtling F and Trippl M. (2005) One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy* 34: 1203-1219.

Tödtling F and Trippl M. (2014) Transformation of regional innovation systems: from old legacies to new development paths. In: Cooke P (ed) *Re-framing Regional Development.* Milton Park: Routledge, 297-317.

Uyarra E. (2010) What is evolutionary about 'regional systems of innovation'? Implications for regional policy. *Journal of Evolutionary Economics* 20: 115-137.

Vallance P. (2016) Universities, public research, and evolutionary economic geography. *Economic Geography* 92: 355-377.

Van Oort F. (2015) Unity in variety? Agglomeration economics beyond the specialization-diversity controversy. In: Karlsson C, Andersson M and Norman T (eds), *Handbook of Research Methods and Applications in Economic Geography.* Cheltenham: Edward Elgar, 259-271.

Vergne J and Durand R. (2010) The missing link between the theory and empirics of path dependence: Conceptual clarification, testability issue, and methodological implications. *Journal of Management Studies* 47: 736-759.

Vincent S and Wapshott R. (2014) Critical realism and the organizational case study: A guide to discovering institutional mechanisms. In: Edwards PK, O'Mahoney J and Vincent S (eds), *Studying Organizations Using Critical Realism.* Oxford: Oxford University Press, 148-167.

Wimmer A and Kössler R. (2005) *Understanding Change*. Palgrave: Macmillan.

Wixe S and Andersson M. (2017) Which types of relatedness matter in regional growth? Industry, occupation and education. *Regional Studies* 51: 523-536.

Yeung HW-C. (1997) Critical realism and realist research in human geography: A method or a philosophy in search of a method? *Progress in Human Geography* 21: 51-74.

Yin RK. (2009) *Case Study Research. Design and Methods.* London: Sage Publications.

Zhu S, He C and Zhou Y. (2017) How to jump further and catch up? Path-breaking in an uneven industry space. *Journal of Economic Geography* 17: 521-545.

Zukauskaite E, Trippl M and Plechero M. (2017) Institutional thickness revisited. *Economic Geography* 93: 325-345.

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Cluster renewal and the heterogeneity of extra-regional linkages: a study of MNC practices in a subsea petroleum cluster

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ABSTRACT

The cluster literature in general and evolutionary economic geography in particular emphasizes the importance of extra-regional linkages for cluster evolution. However, the literature does so without necessarily nuancing the content, i.e., heterogeneity, of such linkages. We argue that treating extra-regional linkages as homogeneous hampers an important aspect of cluster renewal; namely, that it is context specific and dependent upon the diversified practices of the involved multinational companies (MNCs). In so doing, we also argue that relational approaches to economic geography offer an important insight into the evolutionary perspective. We investigate one of Norway's strongest and most dynamic industry clusters, the subsea cluster in Hordaland county, and discuss the usefulness of combining relational and evolutionary understandings in analytical frameworks that address cluster renewal. This study shows that the practice of regional firms that internationalize (labelled *MNC out*) and foreign-owned MNCs coming into the cluster (*MNC in*) contribute in different ways to renewal of the cluster. We find that the practices of *MNC out* contribute to further specialization of the cluster, whereas the practices of *MNC in* contribute to diversification of economic activities. Both types of extra-regional linkages are important for renewal of the cluster, as they together represent a mix between continuation and change of existing activities. Necessarily, such interplays between MNC practices and cluster evolution pan out differently in different contexts, but we argue that the literature should acknowledge that extra-regional linkages are heterogeneous and contribute differently to cluster evolution in general and renewal in particular.

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INTRODUCTION

Evolutionary theory has proven useful in explaining how industry systems develop along given paths based on former contingencies and choices (e.g., Kogler, 2015; Martin, 2010; Martin & Sunley, 2010; Sydow, Windeler, Müller-Seitz, & Lange, 2012; Wimmer & Kössler, 2005). Linked

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to this, the literature on evolution of industry clusters emphasizes the importance of stimulating regional cluster capabilities through the utilization of both intra- and extra-regional linkages (Njøs & Jakobsen, 2016; Trippl, Grillitsch, Isaksen, & Sinozic, 2015) in order to stimulate processes of cluster renewal (Chapman, MacKinnon, & Cumbers, 2004; Hassink, 2005). Through contributing with novelty, extra-regional linkages have been argued to be particularly important (e.g., Bathelt, Malmberg, & Maskell, 2004; Boschma & Iammarino, 2009; Fitjar & Rodríguez-Pose, 2011, 2013; Isaksen, 2009). We understand extra-regional linkages to be those that span a cluster's national context, i.e., practices linking a cluster to the global economy. In the cluster literature, a common way of operationalizing extra-regional linkages is through investigating the practice of multinational companies (MNCs). However, when discussing extra-regional linkages as a source for cluster renewal, the literature has largely treated such linkages as *homogenous*. Thus, extra-regional linkages are considered to contribute to cluster evolution, but nuancing the content of such linkages – and their adjoining practices – is important if we are to advance our understanding of cluster renewal. Such an understanding is currently missing from the cluster literature and evolutionary economic geography.

Hence, we base our approach on an understanding of MNC activity as a practice of networking and transfer of knowledge (Fløysand, Njøs, Nilsen, & Nygaard, 2016; Nilsen, 2016, 2017). Consequently, in developing our approach, we argue that there is a need to incorporate relational understandings (e.g., Fløysand & Jakobsen, 2011; Hassink & Klaerding, 2009) in conceptualizations of cluster renewal. Linking up to the theoretical discussion, we analytically separate between *MNC in* (foreign-owned MNCs coming into the cluster) and *MNC out* (regional firms internationalizing) in order to account for the heterogeneity of extra-regional linkages. Furthermore, this links up to arguments that regional contexts matter for how MNC activity influences processes of regional development more broadly.

To illustrate our point, we present a qualitative study of a cluster operating in the subsea sector oriented towards the oil and gas industry, located in and around the county of Hordaland in western Norway. This cluster serves the aftermarket segment of the subsea production chain, and it has been affected by the current economic downturn in the oil and gas industry. This makes the renewal perspective not only theoretically interesting but also highly relevant. Furthermore, as the firms in the cluster are strongly internationally oriented, this cluster provides an interesting context for studying the impact of extra-regional linkages on cluster renewal. We investigate these aspects through a qualitative analysis of MNC practices. The analysis shows how the practice of *MNC out* contributes to increased specialization of the cluster (extending current activities, but broadening their geographical reach). In contrast, the practice of *MNC in* contributes to the expansion of the cluster's profile through diversifying its activities. When linking this to a theoretical discussion of cluster renewal, the latter practice appears particularly important for upholding contingencies and stimulating regional development and avoiding lock-in. However, also extension of current activities is important for maintaining cluster identity and capabilities. This is achieved by *MNC out*. Thus, the balance between continuation and change appears beneficial for the cluster. Consequently, our analysis illustrates the importance of considering the interplay between the practices of *MNC in* and *MNC out* – what we term the 'heterogeneity of extra-regional linkages' – in theoretical and analytical frameworks addressing cluster renewal.

THEORETICAL BACKGROUND

Renewal of industry clusters

In times of falling commodity prices and economic recession, regional industry structures specialized within one or a few markets face particular challenges (Arthur, 1989). Regional economic restructuring is a recurring theme in studies of industrial development, and recent advancements

in the literature have been accompanied by promising insights from the literature on evolutionary theory. Evolutionary perspectives, which emphasize the complexity, heterogeneity and openness of economic development (Aldrich et al., 2008; Boschma & Martin, 2010; Castellacci, 2006; Schreyögg & Sydow, 2010), have become particularly influential in frameworks that analyse innovation and regional industrial development. Concepts such as path development, increasing returns and lock-in are central. These evolutionary concepts are also linked to the paradigmatic approach of innovation as *systemic*, i.e., that innovation and industrial development result from complex interlinkages between actors in (different types of) innovation systems (Fagerberg, Mowery, & Nelson, 2005; Lundvall & Johnson, 1994). Associated with this is the especially influential concept of *industry clusters*, which was popularized by strategist Michael Porter in the 1990s (Porter 1990, 1998). Industry cluster theory emphasize the importance of linkages between related (economic) activity in regional agglomerations, and clusters are thought to evolve based on unique combinations of region-specific and extra-regional linkages (Bathelt et al., 2004; Frenken & Boschma, 2015; Njøs & Jakobsen, 2016; Wolfe & Gertler, 2004). Relating this concept to nature-based resource industries such as the petroleum industry (e.g., Chapman et al., 2004; Cumbers, Mackinnon, & Chapman, 2003) implies that industry clusters are entities that contribute to, for example, the market orientation of clustered firms and the development of new technology, as well as influence regulatory regimes.

A cluster's background or history can reveal how geographical proximity (Boschma, 2005) between firms facilitates the flow of particular types of knowledge, which in turn can lead to a concentration of local competence and agglomeration effects. Following from this, economies of scale and externalities will emerge that further encourage the firms to follow the same path (Martin & Sunley, 2006). Such self-reinforcing processes have been classified as *path development*, where, as time goes by, former choices influence current and future contingencies and scopes of action (Sydow, Schreyôgg, & Koch, 2009). Thus, the term *path dependency* refers to the process by which a cluster grows in step with its spatial environment, as an agglomeration follows a trajectory of decreasing contingencies leading to development of established practices, routines and institutional frameworks (Fløysand, Jakobsen, & Bjarnar, 2012). In many instances, this is a positive development. It is also crucial if a cluster is to be established; cluster evolution requires that several firms and organizations develop in tune and that their activities are related and interlinked. This, in turn, leads to maturation and a distinct cluster profile and identity (Fløysand et al., 2012; Malmberg & Power, 2006). However, the path dependency along which a cluster evolves can become negative if its specialization becomes too rigid, i.e., that its profile becomes too narrow. This can result in lock-in, i.e., that a cluster is locked into a path dependency. Such situations are hard to get out of if/when readjustment is required (Martin & Sunley, 2006; Menzel & Fornahl, 2010; Sydow et al., 2009). In other words, path dependency can be considered a neutral concept in terms of its implications for a region: it can be both positive (stimulating cluster evolution) and negative (e.g., if a cluster becomes too specialized and an external shock destabilizes the system). Thus, a particular challenge in cluster evolution is to uphold contingencies and to develop capacities that makes a cluster capable of adapting to changing circumstances. This is referred to as *cluster renewal*.

Cluster renewal is a process stimulated by the adaptability of the clustered firms, and is therefore characterized by simultaneous processes of continuation (extension of practices) and change (novelty). Thus, renewal of a cluster implies upholding contingencies in the industry environment, while also avoiding narrow specialization and overreliance on, for example, one activity, market or commodity (e.g., Chapman et al., 2004). Accordingly, the more specialized a cluster is the harder it is to break out of an existing path dependency (Sydow et al., 2009) and to uphold adaptability and scopes of action. This discussion on cluster renewal and the balancing act between continuation and change is exemplified by Tichy's definition of 'the cluster paradox' (referred to by Menzel & Fornahl, 2010): although strict specialization can increase the cluster's ability

to exploit technological synergies between firms, too much specialization can lead to negative lock-in that reduces the cluster firms' adaptability and the likelihood that they will develop radical innovations. Thus, according to the logic of evolutionary theory, cluster renewal is more likely to occur if a cluster is located in a region with several related industry activities (Aarstad, Kvitastein, & Jakobsen, 2016; Boschma & Frenken, 2012; Frenken, Van Oort, & Verburg, 2007; Neffke, Henning, & Boschma, 2011; Njøs & Jakobsen, 2016), and, thus, needs to adapt its resources to changing external circumstances (cf. Nelson & Winter, 1982; Penrose, 1959; Teece, Pisano, & Shuen, 1997).

As this discussion suggests, clusters may be a source of both positive and negative lock-in. The literature on the evolution of clusters argues that to avoid negative path dependency and lock-in in clustered firms and industries (Coenen, Moodysson, & Martin, 2014; Hassink, 2005), clusters must balance regional specificities (Asheim, Isaksen, Martin, & Trippl, 2016; Frenken et al., 2007; Njøs, Jakobsen, Aslesen, & Fløysand, 2016) and external linkages (Bathelt et al., 2004; Fitjar & Rodríguez-Pose, 2013; Isaksen, 2009). However, the evolutionary literature has been criticized for failing to understand how actors and functions shape the development of an industry system (Bergek, Jacobsson, Carlsson, Lindmark, & Rickne, 2008; Boschma, 2016; Carlsson, Jacobsson, Holmén, & Rickne, 2002; MacKinnon, Cumbers, Pike, Birch, & McMaster, 2009), e.g., a cluster (Holmen & Fosse, 2017). This has raised a discussion on the importance of complementing the evolutionary approach with a *relational* understanding (e.g., Bathelt & Glückler, 2003; Fløysand & Jakobsen, 2011; Hassink & Klaerding, 2009; Hassink, Klaerding, & Marques, 2014).

A relational understanding implies that studies of economic practice must be broadened to include the social situations of actors and their various network relationships at different and overlapping spatial scales. These contributions in the economic geography literature are intended to develop more context- and process-sensitive understandings of economic practices (Bathelt & Glückler, 2003; Storper, 1997; Yeung, 2005). First, it is argued that the practices of MNCs cannot be explained by referring to their internal capabilities or their ability to copy the successes of other firms; it needs to be explained by network performances (Yeung, 2005). Second, networks are not fixed in time and space but constantly changing and multi-spatial. Third, the formal and informal stores of knowledge that are (re)produced in networks are not only influenced by business relationships, market situations, political regulations and the strategies of rivals, but also they have legacies that are informed by discourses, narratives and rules of conduct produced within the social context where the economic practice arises (Fløysand & Jakobsen, 2011). Thus, a relational understanding of economic practice involves focusing on networks of actors, the flow of knowledge and assets within these networks, and the interconnectivity of various networks. Linking this to cluster renewal and evolution, a common way of operationalizing extra-regional linkages is to investigate the relational practice of MNCs.

Extra-regional linkages and renewal of industry clusters

Following up our theoretical arguments, we define MNC practice as a complex that involves what we label the *relational characteristics of economic activity*, i.e. to which extent MNC practices involve shared capital interests, networking and the transfer of knowledge at the firm level. In this view, cluster renewal is the result of encounters between MNCs and a cluster in which exchange of capital as well as the networking and knowledge outputs partly depend on the particular practices it generates within the region (Fløysand et al., 2016). According to cluster theory, proximity promotes externalities that do not exist beyond the regional scale (Gordon & McCann, 2000). This also applies to knowledge externalities; although MNCs are more internationally oriented than regional/national relationships, they do indeed have a geographical embeddedness that influences their practices (Asheim & Isaksen, 2002; Hess, 2004; Maskell & Malmberg, 1999; Schoenberger, 1999).

As Chapman et al. (2004) suggest, if clusters follow a highly specialized development path, stagnation and decline can in the long run occur. This is because strengthening of current specializations does not stimulate cluster renewal, i.e., it does not uphold contingences and scopes of action, making firms in the cluster particularly vulnerable to external shocks. Therefore, processes of cluster renewal are important for avoiding lock-in and possible path exhaustion. In order to avoid such detrimental development, renewal of a cluster should take place through diversification of the activities of the clustered firms. When discussing the role of diversification in cluster renewal, Chapman et al. distinguish between the categories *geographical diversification* and *sectoral diversification*.

Summing up the discussion above, cluster renewal is considered to be stimulated by influx of novelty either from other sectors within a region, or through extra-regional linkages (e.g., Njøs & Jakobsen, 2016). We have placed particular emphasis on extra-regional linkages in contributing with novelty in clusters, emphasizing the importance of understanding MNC practices. However, the cluster literature has yet to incorporate understandings of how the practice of MNCs takes different forms. Hence, extra-regional linkages, represented by the practice of MNCs, have largely been treated as a homogenous category considered to contribute with novelty in evolution of clusters. Nuancing this view, we argue that understanding MNC practices is crucial in frameworks addressing cluster renewal, and that such frameworks should take into account that extra-regional linkages should be considered heterogeneous rather than homogenous.

INVESTIGATION

Methodology

In order to exemplify our theoretical argument, we conducted a qualitative case study of a subsea petroleum cluster in the county of Hordaland in western Norway. Thus, we employed a methodology where the aim is not to provide statistical representativeness or to develop empirical generalizations (George & Bennett, 2005), but to nuance theoretical assumptions through abductive reasoning (Edwards, O'Mahoney, & Vincent, 2014; Sayer, 2000). A central aim of qualitative case studies is to contribute to theory development through *analytical* generalization (George & Bennett, 2005; Gobo, 2004). It has been argued that case studies are especially appealing for developing deep understandings of empirical phenomena (Easton, 2010; Kessler & Bach, 2014) because this methodology has as its particular strength in that it offers high conceptual validity, it contributes to development of new hypotheses, it uncovers causal mechanisms in the context of the studied case, and it addresses causal complexities (George & Bennett, 2005, p. 19). Thus, as argued by George and Bennett (2005):

> The development of theory via case studies should be distinguished from the deductive development of theory. Deductive methods can usefully develop entirely new theories or fill gaps in existing theories; case studies can test deductive theories and suggest new variables that need to be incorporated. […] But theory development via case studies is primarily an inductive process. (p. 111)

Case study, context and data collection

The subsea cluster in Hordaland is specialized in the subsea sector of the oil and gas industry (Njøs et al., 2016), and is considered one of Norway's strongest industry clusters. This is attested to by its status as a global centre of expertise (GCE). In Norway, the policy programme National Innovation Clusters consists of three levels. The first level, ARENA, is a status given to immature clusters intended to develop towards a dynamic cluster. The next level, Norwegian centres of

expertise (NCE), consists of mature, dynamic clusters that represent particularly strong industry environments and which have a strong position in international markets. Lastly, the GCE level, a status given to only three clusters, is considered to represent Norway's strongest industry environments. These clusters represent the most dynamic and internationally oriented clusters in Norway. The subsea cluster in Hordaland was from 2006 part of the NCE programme. In 2015, the cluster was assigned GCE status, underlining that this cluster has particularly strong extra-regional linkages and capabilities for renewal.

The Norwegian subsea sector is distributed throughout the country in specialized regions, and the subsea cluster around the Bergen area in Hordaland emphasizes the aftermarket segment of the subsea sector value chain. The cluster is internationally oriented and it actively promotes internationalization. The firms in this cluster mainly install, maintain and modify subsea equipment. The cluster consists of approximately 120 firms, research and development (R&D) institutions and other supporting agencies. Clustering firms have been heavily affected by the decline in the oil and gas industry and, therefore, they are facing several challenges, such as downsizing, the standardization of products and services, and organizational changes.

We collected data for this study during two fieldwork sessions, in October–November 2011 and September–November 2014. Data collection was conducted for two master projects investigating internationalization of the subsea cluster. Both master projects were part of large research projects investigating cluster development, internationalization and the role of policy for cluster evolution.

The cluster in question can roughly be categorized according to its value chain. The oil company Statoil is focal for several of the cluster firms, and this operating company has been hugely influential in how the cluster has developed within the petroleum market. Typically, the systems suppliers (e.g., Aker Solutions, FMC Technologies) deal directly with Statoil, whereas the third level of the supply chain in the cluster, the sub-suppliers, represent the bulk of the clustered firms in terms of numbers. In other words, the subsea cluster is characterized by an influential oil company (Statoil) setting the framework conditions for the other actors, where a few systems suppliers have had an important role in linking the sub-suppliers to Statoil. The systems suppliers represent important actors in the Norwegian petroleum sector, and they are also important global players within the industry. Overall, though, a large bulk of the clustered firms consist of sub-suppliers to the systems suppliers. We sought to reflect these cluster characteristics when analysing the cluster. When conducting our data collection, we interviewed informants of firms in the cluster, but we also conducted four interviews with two key informants (the cluster facilitator of the NCE/GCE Subsea initiative, and a representative from the board of the cluster initiative which has been involved in development of the cluster project since its inception). The second round of interviews (2014) were based on insight gained in the first round (2011). In addition to the primary data collection, we were also informed on other studies of the cluster through our participation in the two research projects. Coupled with media reports and general insight into the cluster and the region, we have gained deep insight into how cluster firms operate and who are the central actors in the development of the cluster. The key informants served as important discussion partners where our understandings of how the cluster functions was confirmed, while also helping to nuance our assumptions and findings.

The interview guides for both fieldwork sessions involved questions on topics such as knowledge flows, internationalization processes (motives for *MNC out/in*, challenges arising when internationalizing), transfer of knowledge through extra-regional linkages, processes of cluster renewal (whether cluster firms are moving towards specialization or diversification), MNC practices, innovation activities, and regional embeddedness (e.g., regional cooperation, support infrastructure for innovation, cluster identity and modes of operation).

As explained above, we argue for the importance of distinguishing between *MNC in* and *MNC out*. In our empirical investigation, *MNC out* refers to firms from the region internationalizing.

Conversely, *MNC in* refers to foreign firms that have activity in Norway and operate within the cluster.

The 2011 fieldwork session comprised six interviews (two with key informants, one *MNC out*, three *MNC in*); the 2014 session comprised 10 interviews (two with key informants, four *MNC in* and four *MNC out*). The same key informants were interviewed in 2011 and 2014. The 2011 session involved one interview with the operating company, one with a systems supplier and two interviews with systems suppliers. In 2014, the two interviews with key informants were coupled with eight interviews with sub-suppliers. In both fieldwork sessions, cluster firms were selected that were (1) located in the cluster and (2) either had established an office branch, an agent relationship or a subsidiary abroad, or had been incorporated into a foreign corporation through acquisition or joint venture. Based on information we acquired from the internet, regional newspapers and our key informants, we selected the key multinational actors in the cluster. In addition to the information we obtained from the 16 interviews, we used secondary data sources (firms' home pages, regional newspapers, reports and previous research) as the background for our analysis. All the interviews were audiorecorded and transcribed.

MNC practice and networking

Our study revealed that *MNC out* are primarily represented internationally through established subsidiaries, local agents or other facilities. Not surprisingly, the regions where most *MNC out* operate are Houston, Rio de Janeiro, Aberdeen (UK), the Arabian Peninsula, Angola and Perth (Western Australia). According to our informants, the subsea cluster in Hordaland represents an industry environment that holds advanced knowledge on petroleum and subsea technology, making it interesting for foreign firms to link up to this cluster. When it comes to internationalization, the informants emphasize the importance of knowledge of the host market. One informant explained: 'Take Brazil as an example, which is a gigantic subsea market. You cannot cover that from here [Norway]. You have to go to Brazil to do that' (*MNC out* representative, 2011). Thus, it appears that the motivation for an *MNC out* to internationalize is to establish a local presence to lower barriers to the introduction of new products and services. Oil and gas market opportunities are the main drivers for firm internationalization from the cluster (see also Aarstad, Pettersen, & Jakobsen, 2015): 'We are delivering a lot to the US, to Houston, and we are delivering a lot to Aberdeen, UK. We also have supplies to several other locations, such as West Africa, etc., and we are expanding our international channels' (*MNC out* representative, 2014). According to our informants, delivery of products and services appears to be the main motivation for *MNC out*. However, in order to succeed with such activities, knowledge of foreign markets and practices are crucial. Our informants reflect on the challenges relating to this, and argue that it is important to approach foreign markets through focusing on a narrow set of activities, i.e., through specialization of its activities. In addition, access to new knowledge, market impulses, technology trends etc. is also portrayed as important for *MNC out*.

MNC in are characterized by large MNCs setting up national/regional subsidiaries *within* the cluster. The parent companies of *MNC in* are large, Western MNCs with diversified activities on a global scale. According to our informants, the main motivation for *MNC in* to locate in the Hordaland subsea cluster is to gain access to relevant competence, technology and products, but they also want to take a market share and gain access to (new) customers. Furthermore, informants representing *MNC in* portray the cluster as a leading and attractive location for networking in the global subsea oil and gas market:

> There are a lot of companies in Norway [in the subsea cluster] developing exciting technology and that have come a long way in doing so. That's probably well recognized by the big actors; that a lot of exciting things have popped up here. (*MNC in* representative, 2014)

In addition, *MNC in* representatives also report having an extensive set of linkages to the global oil and gas hubs reported by *MNC out*. Thus, as with *MNC out*, the same geographical hubs are presented as key centres for the global oil and gas industry. However, despite this strong international interweaving, our informants point out the importance of a 'local buzz' to explain the competitive strength of the cluster (and its strength as a dynamic industry environment). This was reflected in comments by two *MNC in* representatives:

> So the owner company came in here, and they convinced the board that they actually wanted to keep the firm as it was […] I think it helped that we could show that the reason we were here was to be near this environment [the subsea cluster in Hordaland]. (*MNC in* representative, 2014)

> An international player, like [the large owner company], they decide to invest here in Bergen. And why do they do that? Because there is competence and knowledge in [the acquired firm], but there is also a lot of competence in our surroundings, in the cluster, right? (*MNC in* representative, 2011)

Our informants emphasized *MNC in* and *MNC out* firms as hubs-in-spokes (Markusen, 1996), linking actors and networks in the cluster with extra-regional sources of knowledge, information and market opportunities. However, access to other clustered actors through regional networks was stressed as highly important, and *MNC in* include suppliers or business partners within the cluster in sales and/or development projects (Jakobsen & Fløysand, 2011). Hence, the encouragement and facilitation of networking are important aspects of MNC practice in the cluster. This also illustrates MNC practice as networking and transfer of knowledge, indicating that what was argued in the introduction, i.e., that such relations should be investigated in-depth, is important when explaining how MNCs contribute to cluster renewal.

MNC practice and knowledge flows

Another topic of interest here is how MNC practices relate to knowledge flows. Interestingly, our data revealed that *MNC in* and *MNC out* have different effects on flows of knowledge and learning. The necessary knowledge about a foreign market and what is required to operate there are mainly distributed by *MNC out*. Because such knowledge is acquired through experience, our informants emphasized the importance of their personal and professional networks in their *MNC out* practice, again reflecting the importance of local buzz: 'Market knowledge is important. […] When you are developing a company, you have to have people who have been in that business, people who have market channels, who have that network at the ready' (*MNC out* representative, 2014). This exemplifies the role of (positive) path dependency in terms of firm internationalization in the cluster. According to the informants, choosing to specialize towards some geographical markets appears important, indicating that maintaining and developing market relations (and knowledge) takes time. This may also serve as an explanation of why the cluster firms choose to, in general, internationalize towards the same geographical areas; they learn from each other and share important information on past experiences in foreign markets.

When it comes to *MNC in*, it was noted that when firms in the cluster have been acquired by foreign firms, they have become part of large MNCs. Such changes necessarily lead to organizational challenges, but the informants emphasized that *MNC in* brings with it a host of opportunities, not the least due to organizational size and geographical reach. It should be noted that the *MNC in* we interviewed represent companies that are large global players with several different business activities. However, according to the informants, the new constellations are often open to new ideas, knowledge and technology, which leads to marketing, distribution and business networking opportunities: 'We can use their products, they can use ours, we get new sales persons, we get international offices […]' (*MNC in* representative, 2014). Furthermore, in our case it appears that *MNC in* have relatively diversified marketing and technology portfolios, and

that they provide access to complementary competences and technologies that may contribute to upgrading. According to the informants, *MNC in* integrates clustering firms into a global system in which actors can share with and learn from each other, thus strengthening innovative capabilities. Finally, the practice of *MNC in* should be seen as providing access to new resources and often to financial support and support for R&D activities, indicating that *MNC in* plays an important role in development of the cluster.

MNC practice and cluster renewal

A cluster's geographical diversification is the result of investments in new, geographically distant markets. In the case study conducted, such activities are the results of *MNC out* practices. Our data indicate that *MNC out* triggered increased specialization in the subsea cluster, given that the motive for internationalizing in many instances was to reach out to new, geographically distant markets with existing products and services. In particular, *MNC out* reported that a distinct and specialized profile is crucial for them to stand out as an influential subsea actor abroad, thereby strengthening their competitive position. As long as they maintain an international focus, they do not see any immediate incentives for sectoral diversification, because specialization is the key factor that legitimates their position abroad, they argue. This was reflected by a key informant (2014): 'Many of the cluster firms are very focused on subsea activity and might not have had to look towards other markets.' Thus, we would argue that the geographical diversification of *MNC out* appears to promote further specialization of the cluster through influx of knowledge and networks within the cluster's existing profile. This was exemplified by an informant:

> If we were to branch out to other industries, we would lose focus. […] We work with ultrasound meters. There's a lot of ultrasound in medicine. So, if we were to branch out to that industry too, we would become something totally different. That wouldn't work. I don't think so. We would be lost in both areas. (*MNC out* representative, 2014)

On the other hand, the *MNC in* informants talked about scope-wise diversification. As noted, *MNC in* informants explain how firms gain access to knowledge, competence and technology from a wide spectrum of economic activities, indicating that these actors appear to encourage *sectoral diversification* through linkages to other industries: 'It's nuclear technology, it's wind-power; there's turbines and locomotive engines and aircraft engines […]'; 'not to mention geotechnics […] housebuilding or urban planning' (*MNC in* representative, 2014). Several informants also mentioned links to the Norwegian armed forces, the spaceflight industry, and the monitoring and mapping of seabed minerals. Thus, from the perspective of the subsea cluster in Hordaland, it can be argued that *MNC in* appears to support expanding the scope of the cluster through encouraging diversification of economic activities. This is illustrated by a representative (2014) from a *MNC in*:

> Internally [in the new company], we can discuss very openly regarding our technology. And this is of course a company that spans a lot of technology, meaning that we can exploit our technology from other areas where [the owner company] has been involved, like medicine or nuclear technology. […] That has been very good.

DISCUSSION

The difference in practices between *MNC in* and *MNC out* in the subsea cluster in Hordaland illustrates how extra-regional cluster linkages should be considered heterogeneous, and, moreover, that the different practices influence cluster renewal differently. In the investigated case, *MNC out*

emphasize the importance of maintaining a distinct profile as specialized to remain competitive abroad. Linking this to the regional cluster level, the role of *MNC out* appears to strengthen path dependencies and current trajectories, as *MNC out* operations support the adaptation of routines and strategies to an existing specialized market. Furthermore, as *MNC out* in our setting were oriented towards global oil and gas hubs, this appeared further to strengthen cluster specialization. An implication of this could be that the chances for radical innovation in the regional cluster are reduced, implying that *MNC out* practice encourages minor changes in clustered firms' orientations. Thus, the knowledge pools in the foreign hubs where *MNC out* is directed may be too similar to the clustered firms' existing knowledge pools, leading to learning that (at a higher level) only results in incremental innovation and the continuation of existing practices (Boschma & Iammarino, 2009). Nevertheless, international operations through *MNC out* generate new market possibilities abroad that limit a company's vulnerability vis-à-vis the home region, while at the same time they contribute new knowledge to the home region. Thus, by engaging in *MNC out*, firms can keep growing and thereby maintain regional growth and employment, as long as the market is experiencing growth and commodity prices remain relatively predictable (Arthur, 1989). The evolution of the cluster is necessarily related to these practices and firm-level development paths, implying that as long as clustered firms are on a positive development path, these practices can be considered beneficial. Also, such processes are important in extending current core activities and to support cluster identity and profile.

Contrary to *MNC out*, *MNC in* promotes diversification and variety in the cluster, where *MNC in* appear to create several new learning opportunities. Our informants perceived *MNC in* as 'extremely diversified' and to be dealing with 'related businesses'. With respect to theory, this implies that *MNC in* can create new (industry-spanning) knowledge that influences and possibly stimulates development of new paths. In the long-term, this may benefit the cluster, as it involves diversifying markets and technologies, and it may also lead to better possibilities for radical innovation (Aarstad et al., 2016; Boschma & Iammarino, 2009). In addition, diversification implies a more robust position in the event of market stagnation or a drop in (commodity) prices.

The case study presented here exemplifies how *MNC in* and *MNC out* in different ways and to a differing extent influence cluster renewal. Whereas both regional dynamics and extra-regional linkages of course are important for cluster renewal (Njøs & Jakobsen, 2016), we have intended to exemplify how extra-regional linkages should be considered heterogeneous. Through including central aspects of theory from relational economic geography, we believe that cluster studies and evolutionary theory should take into account how diversified MNC practices influence processes of cluster renewal. We have attempted to illustrate how emphasizing the relational characteristics of economic activity (Fløysand et al., 2016; Nilsen, 2017), operationalized as the practice of MNCs, adds nuance to the typical view of extra-regional cluster linkages. Arguments for such a dualistic approach that considers the heterogeneity of extra-regional linkages and MNC practices has also been highlighted in, for instance, the literature on global value chains (e.g., Gereffi, Humphrey, & Sturgeon, 2005) and global production networks (e.g., Coe, Dicken, & Hess, 2008; Coe, Hess, Yeung, Dicken, & Henderson, 2004; Henderson, Dicken, Hess, Coe, & Yeung, 2002). Research in these areas emphasizes the importance of diversified input–output relationships and the spatial specificity of such practices and outcomes. However, cluster pipelines (i.e., extra-regional linkages) have largely been approached through a linear understanding. In addition, the relational content of such relationships is treated as homo- rather than heterogeneous. Thus, for analytical purposes, it is important that evolutionary frameworks nuance their understanding of economic practices. Moreover, this calls for context-specific approaches where the characteristics and uniqueness of different clusters are incorporated into theoretical and analytical frameworks (cf., e.g., Tödtling & Trippl, 2005). In addition, advancing this argument would require investigation of how interplays between differentiated MNC practices and cluster renewal takes place also in other industry clusters. We have indicated that balancing between continuation (i.e., extension of current practices)

and change (influx of novelty and diversified practices) is important for cluster renewal, and that *MNC in* and *MNC out* contribute differently in this processes.

CONCLUSIONS

This study illustrates how interplays between *MNC in*, *MNC out* and regional cluster dynamics influence cluster renewal. We have pointed out the importance of including a relational approach to current evolutionary reasoning, arguing for a perspective that views MNC activity as a practice involving networking and knowledge sharing. In our empirical example, *MNC in*, which refers to extra-regional firms coming into the cluster, was shown to contribute to sectoral diversification, i.e., expanding the cluster's profile. In contrast, *MNC out*, which refers to clustering firms of local origin internationalizing, was shown to contribute to increased specialization. However, the intention here is not to argue that *MNC in* contributes to a high degree of cluster renewal, whereas *MNC out* leads to a low degree of cluster renewal per se. In light of theoretical discussion, we have argued that the practices of *MNC in* and *MNC out* are important in the evolution of the cluster, as they balance each other and contribute to a continuation of the cluster profile (*MNC out*) and influx of novelty (*MNC in*).

Necessarily, outcomes of interplays between MNC practices and cluster evolution are the result of regional particularities and context specificities, implying that these interplays pan out differently in different cases. Nevertheless, this study contributes to the nuancing of theoretical assumptions on the role of extra-regional linkages in cluster renewal. The literature on cluster evolution and evolutionary economic geography should account for the heterogeneity of MNC practices when investigating cluster renewal. This requires investigation of the interplays between extra-regional linkages and context specificities such as regional particularities, the industrial affiliations of clusters and firm-level strategies when studying conditions for cluster evolution and renewal. Thus, the evolutionary literature on cluster evolution should also account for the relational content of internal and external cluster linkages, as these linkages in reality appear more complex than current evolutionary frameworks take into consideration.

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REFERENCES

Aarstad, J., Kvitastein, O., & Jakobsen, S.-E. (2016). Related and unrelated variety as regional drivers of enterprise productivity and innovation: A multilevel study. *Research Policy, 45*, 844–856.

Aarstad, J., Pettersen, I.-B., & Jakobsen, S.-E. (2015). Assessing drivers of export orientation in the subsea oil and gas industry. *SpringerPlus, 4*, 403. Retrieved from http://download.springer.com/static/pdf/291/art%253A10.1186%252Fs40064-015-1203-4.pdf?originUrl=http%3A%2F%2Fspringerplus.springeropen.com%2Farticle%2F10.1186%2Fs40064-015-1203-4&token2=exp=1495618151~acl=%2Fstatic%2Fpdf%2F291%2Fart%25253A10.1186%25252Fs40064-015-1203-4.pdf*~hmac=9b138f5e08bb73b3e73c7206ed306a92f54b55efda211e8985bdc31b8c9ad598

Aldrich, H.-E., Hodgson, G. M., Hull, D. L., Knudsen, T., Mokyr, J., & Vanberg, V. (2008). In defence of generalized Darwinism. *Journal of Evolutionary Economics, 18*, 577–596.

Arthur, W. B. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal, 99*, 116–131.

Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems: The integration of local 'sticky' and global 'ubiquitous' knowledge. *The Journal of Technology Transfer, 27*, 77–86.

Asheim, B. T., Isaksen, A., Martin, R., & Trippl, M. (2016). The role of clusters and public policy in regional economic path development. In D. Fornahl & R. Hassink (Eds.), *The life cycle of clusters* (pp. 13–34). Cheltenham: Edward Elgar.

Bathelt, H., & Glückler, J. (2003). Toward a relational economic geography. *Journal of Economic Geography, 3*, 117–144.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography, 28*, 31–56.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., & Rickne, A. (2008). Analyzing the functional dynamics of technological innovation systems: A scheme of analysis. *Research Policy, 37*, 407–429.

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*, 61–74.

Boschma, R. (2016). Relatedness as driver of regional diversification: A research agenda. *Regional Studies, 51*(3), 1–14.

Boschma, R., & Frenken, K. (2012). Technological relatedness and regional branching. In H. Bathelt, M. Feldman, & D. Kogler (Eds.), *Beyond territory. Dynamic geographies of knowledge creation, diffusion and innovation* (pp. 64-68). London: Routledge.

Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic Geography, 85*, 289–311.

Boschma, R., & Martin, R. (2010). *The handbook of evolutionary economic geography*. Cheltenham: Edward Elgar.

Carlsson, B., Jacobsson, S., Holmén, M., & Rickne, A. (2002). Innovation systems: Analytical and methodological issues. *Research Policy, 31*, 233–245.

Castellacci, F. (2006). A critical realist interpretation of evolutionary growth theorising. *Cambridge Journal of Economics, 30*, 861–880.

Chapman, K., MacKinnon, D., & Cumbers, A. (2004). Adjustment or renewal in regional clusters? A study of diversification amongst SMEs in the Aberdeen oil complex. *Transactions of the Institute of British Geographers, 29*, 382–396.

Coe, N. M., Dicken, P., & Hess, M. (2008). Introduction: Global production networks – Debates and challenges. *Journal of Economic Geography, 8*, 267–269.

Coe, N. M., Hess, M., Yeung, H. W.-C., Dicken, P., & Henderson, J. (2004). 'Globalizing' regional development: A global production networks perspective. *Transactions of the Institute of British Geographers, 29*, 468–484.

Coenen, L., Moodysson, J., & Martin, H. (2014). Path renewal in old industrial regions: Possibilities and limitations for regional innovation policy. *Regional Studies, 49*, 850–865.

Cumbers, A., Mackinnon, D., & Chapman, K. (2003). Innovation, collaboration, and learning in regional clusters: A study of SMEs in the Aberdeen oil complex. *Environment and Planning A, 35*, 1689–1706.

Easton, G. (2010). Critical realism in case study research. *Industrial Marketing Management, 39*, 118–128.

Edwards, P. K., O'Mahoney, J., & Vincent, S. (2014). *Studying organizations using critical realism.* Oxford: Oxford University Press.

Fagerberg, J., Mowery, D. C., & Nelson, R. R. (Eds.). (2005). *The oxford handbook of innovation*. Oxford: Oxford University Press.

Fitjar, R. D., & Rodríguez-Pose, A. (2011). When local interaction does not suffice: Sources of firm innovation in urban Norway. *Environment and Planning A, 43*, 1248–1267.

Fitjar, R. D. & Rodríguez-Pose, A. (2013). Firm collaboration and modes of innovation in Norway. *Research Policy, 42*, 128–138.

Fløysand, A., & Jakobsen, S.-E. (2011). The complexity of innovation: A relational turn. *Progress in Human Geography, 35*, 328–344.
Fløysand, A., Jakobsen, S.-E., & Bjarnar, O. (2012). The dynamism of clustering: Interweaving material and discursive processes. *Geoforum, 43*, 948–958.
Fløysand, A., Njøs, R., Nilsen, T., & Nygaard, V. (2016). Foreign direct investment and renewal of industries: Framing the reciprocity between materiality and discourse. *European Planning Studies, 25*(3), 1–19.
Frenken, K., & Boschma, R. (2015). Geographic clustering in evolutionary economic geography. In C. Karlsson, M. Andersson, & T. Norman (Eds.), *Handbook of reserach methods and applications in economic geography* (pp. 291–302). Cheltenham: Edward Elgar.
Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*, 685–697.
George, A. L., & Bennett, A. (2005). *Case studies and theory development in the social sciences*. Cambridge, MA: MIT Press.
Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy, 12*, 78–104.
Gobo, G. (2004). Sampling, representativeness and generalizability. In C. Seale, G. Gobo, J. F. Gubrium, & D. Silverman (Eds.), *Qualitative resarch practice* (pp. 405–426). London: Sage.
Gordon, I. R., & McCann, P. (2000). Industrial clusters: Complexes, agglomeration and/or social networks? *Urban Studies, 37*, 513–532.
Hassink, R. (2005). How to unlock regional economies from path dependency? From learning region to learning cluster. *European Planning Studies, 13*, 521–535.
Hassink, R., & Klaerding, C. (2009). *Relational and evolutionary economic geography: Competing or complementary paradigms? No. 0911*. Utrecht University, Section of Economic Geography.
Hassink, R., Klaerding, C., & Marques, P. (2014). Advancing evolutionary economic geography by engaged pluralism. *Regional Studies, 48*, 1295–1307.
Henderson, J., Dicken, P., Hess, M., Coe, N. M., & Yeung, H. W. -C. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy, 9*, 436–464.
Hess, M. (2004). 'Spatial' relationships? Towards a reconceptualization of embeddedness. *Progress in Human Geography, 28*, 165–186.
Holmen, A. K. T., & Fosse, J. K. (2017). Regional agency and constitution of new paths: A study of agency in early formation of new paths on the west coast of Norway. *European Planning Studies, 25*(3), 1–18.
Isaksen, A. (2009). Innovation dynamics of global competitive regional clusters: The case of the Norwegian centres of expertise. *Regional Studies, 43*, 1155–1166.
Jakobsen, S.-E., & Fløysand, A. (2011). *Subseabedriftenes regionale forankring. Funn fra en spørreundersøkelse gjennomført blant subseabedrifter i Hordaland* [The regional embeddedness of subsea firms. Findings from a survey conducted among subsea firms in Hordaland], SNF-arbeidsnotat 48/10. Bergen: Samfunns- og næringslivsforskning.
Kessler, I., & Bach, S. (2014). Comparing cases. In P. K. Edwards, J. O'Mahoney, & S. Vincent (Eds.), *Studying organizations using critical realism* (pp. 168–184). Oxford: Oxford University Press.
Kogler, D. F. (2015). Editorial: Evolutionary economic geography – Theoretical and empirical progress. *Regional Studies, 49*, 705–711.
Lundvall, B.-Å., & Johnson, B. (1994). The learning economy. *Journal of Industry Studies, 1*, 23–42.
MacKinnon, D., Cumbers, A., Pike, A., Birch, K., & McMaster, R. (2009). Evolution in economic geography: Institutions, political economy, and adaptation. *Economic Geography, 85*, 129–150.
Malmberg, A., & Power, D. (2006) True clusters. A severe case of conceptual headache. In B. Asheim, P. Cook, & R. Martin (Eds), *Clusters and regional development. Critical reflections and explorations* (pp. 50–68). London: Routledge.
Markusen, A. (1996). Sticky places in slippery space: A typology of industrial districts. *Economic Geography, 72*, 293–313.

Martin, R. (2010). Roepke lecture in economic geography – Rethinking regional path dependence: Beyond lock-in to evolution. *Economic Geography, 86*(1), 1–27.
Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography, 6*, 395–437.
Martin, R., & Sunley, P. (2010). The place of path dependence in an evolutionary perspective on the economic landscape. *Handbook of Evolutionary Economic Geography,* 62–92.
Maskell, P., & Malmberg, A. (1999). The competitiveness of firms and regions: Ubiquitification' and the importance of localized learning. *European Urban and Regional Studies, 6*, 9–25.
Menzel, M. P., & Fornahl, D. (2010). Cluster life cycles – Dimensions and rationales of cluster evolution. *Industrial and Corporate Change, 19*, 205–238.
Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*, 237–265.
Nelson, R. R., & Winter, S. (1982). *An evolutionary theory of economic change.* Cambridge, MA: Harvard University Press.
Nilsen, T. (2016). Why Arctic policies matter: The role of exogenous actions in oil and gas industry development in the Norwegian high north. *Energy Research & Social Science, 16*, 45–53.
Nilsen, T. (2017). Firm-driven path creation in arctic peripheries. *Local Economy, 32*, 77–94.
Njøs, R., & Jakobsen, S.-E. (2016). Cluster policy and regional development: Scale, scope and renewal. *Regional Studies, Regional Science, 3*, 146–169.
Njøs, R., Jakobsen, S.-E., Aslesen, H. W., & Fløysand, A. (2016). Encounters between cluster theory, policy and practice in Norway: Hubbing, blending and conceptual stretching. *European Urban and Regional Studies*. doi: 10.1177/0969776416655860
Penrose, E. (1959). *The theory of the growth of the firm*. Oxford: Blackwell.
Porter, M. (1990). *The competitive advantage of nations*. London: Macmillan.
Porter, M. (1998). Clusters and the new economics of competition. *Harvard Business Review, 76*, 77–99.
Sayer, A. (2000). *Realism and social science.* London: Sage.
Schoenberger, E. (1999). The firm in the region and the region in the firm. In M. S. Gertler & T. J. Barnes (Eds.), *New industrial geography: Regions, regulations and institutions* (pp. 205–224). Florence, SC: Routledge.
Schreyögg, G., & Sydow, J. (2010). *The hidden dynamics of path dependence: Institutions and organizations*. New York, NY: Springer.
Storper, M. (1997). *The regional world: Territorial development in a global economy*. New York, NY: Guilford Press.
Sydow, J., Schreyögg, G., & Koch, J. (2009). Organizational path dependence: Opening the blackbox. *Academy of Management Review, 34*, 689–709.
Sydow, J., Windeler, A., Müller-Seitz, G., & Lange, K. (2012). Path constitution analysis: A methodology for understanding path dependence and path creation. *Business Research, 5*, 155–176.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*, 509–533.
Tödtling, F., & Trippl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy, 34*, 1203–1219.
Trippl, M., Grillitsch, M., Isaksen, A., & Sinozic, T. (2015). Perspectives on cluster evolution: Critical review and future research issues. *European Planning Studies, 23*, 2028–2044.
Wimmer, A., & Kössler, R. (2005). *Understanding change*. Amsterdam: Palgrave Macmillan.
Wolfe, D. A., & Gertler, M. A. (2004). Clusters from the inside and out: Local dynamics and global linkages. *Urban Studies, 41*, 1071–1093.
Yeung, H. W.-C. (2005). Rethinking relational economic geography. *Transactions of the Institute of British Geographers, 30*, 37–51.

III

IV

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Cluster policy and regional development: scale, scope and renewal

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Consistent with Marshallian/Porterian theories, the Norwegian cluster policy has been linked to the development of specialized regional industry environments. Cluster projects are relatively sector-specific entities often supporting (already) strong regional industries and sectors. Following a review of the current literature on clusters and innovation, and informed by evolutionary thought, we argue that such constellations of specialized clusters may hamper the long-term innovation ability of regions. In a conceptual discussion of cluster evolution and its links to innovation and regional path renewal, we argue that special emphasis – both theoretical and political – has been placed on the geographical scale of clusters, but there has been less emphasis on scope. Accordingly, we present three theory-based strategies for cluster evolution and link these to regional development and innovation by assessing their impact on regional path renewal. We illustrate our argument empirically using examples from the Norwegian Centre of Expertise (NCE) cluster programme.

Keywords: cluster policy; cluster evolution; regional renewal; scale; scope

Introduction

Industrial clusters are considered to be core entities of economic growth and innovation in the modern world. As such, clusters are seen as a central structuring element of economic activity for firms, regions and even national economies. In line with this view of innovation as a systemic phenomenon, clusters have risen to prominence not only in the academic community but also among strategists seeking to increase firm and regional value creation during globalization. Thus, industrial clusters are a phenomenon investigated by academics. Clusters can develop not only organically but also because of targeted efforts by policy-makers and practitioners, most notably through cluster projects. It is believed that targeted policy efforts can contribute to the growth of clusters and regions, a field of particular interest to evolutionary economic geographers (Cooke, 2012a; Fosse & Normann, forthcoming; Fløysand, Jakobsen, & Bjarnar, 2012; Malmberg & Power, 2006). However, it has been claimed that a thorough discussion of the contribution of cluster policy to advantageous regional development has been lacking (Cooke, 2012a; Uyarra & Ramlogan, 2012).

In a recent special issue of *Regional Studies* on 'Evolutionary Economic Geography', guest editor Dieter F. Kogler addresses an ongoing struggle in the field related to 'how to initiate and support regional transition from a locked-in mature and declining industry, towards related new industries with growth potential […]' (Kogler, 2015, p. 708). Kogler then raises the question of whether evolutionary economic geography

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could 'provide insights to enable the identification of regional lock-in before it occurs in order to apply measures to avoid it' (p. 709) (see also Coenen, Moodysson, & Martin, 2014). This is undoubtedly a significant question that indicates a need to address both the theoretical underpinnings of regional renewal and the policies that encourage processes of change. The present paper contributes to this debate by discussing how cluster policy can drive innovation and regional path renewal. Innovation and its regional characteristics are central to the discussion of the assumption in the literature that proactive policies can stimulate cluster development and also regional economic development and regional renewal more broadly (Asheim, Boschma, & Cooke, 2011; Cooke, 2007).

In evolutionary thinking and path-dependent theory, it is common to differentiate between path extension and path renewal as two different trajectories for regional development (Martin, 2012). The first entails 'more of the same', while the second entails a strong degree of dynamism and novelty within the regional industry path. In line with such theories, Chapman, MacKinnon, and Cumbers (2004) portray cluster development as a spectrum between adaptation and adaptability. Adaptations involve minor changes in a cluster's orientation and evolution – i.e., path extension – while adaptability involves a significant change in a cluster's orientation, entailing novelty and path renewal (see also Østergaard & Park, 2015). However, the question is not only *how* clusters evolve but also how they can contribute to long-term regional development through path renewal and strengthened *regional* adaptability. To examine these topics, we review the literature before using this assessment as a point of departure for describing various cluster development strategies. The empirical part of the paper elaborates upon these strategies through an analysis of the Norwegian Centres of Expertise (NCE) programme, a public programme for mature clusters. We seek to answer the following research question: How can strategies for the development of mature industry clusters contribute to regional renewal?

In the literature, cluster development has primarily been linked to changes in the scale of clusters (through the internationalization of regional clusters) (e.g., Bathelt, Malmberg, & Maskell, 2004; Reve & Sasson, 2012; Sölvell, Lindqvist, & Ketels, 2003). However, insights from recent contributions from the evolutionary perspective have been critical towards the idea of narrow specialization and geographic scale as sources of growth. It has been argued that it is important to emphasize a second dimension – scope – in the promotion of innovation and the evolution of clusters (e.g., Chapman et al., 2004; Cooke, 2012a; Fløysand et al., 2012). This focus on scope suggests a connection between cluster development and regional development. For instance, regional branching and cooperation between firms in related industries and clusters are considered to be especially important for innovation and advantageous regional development (Aarstad, Kvitastein, & Jakobsen, 2016; Asheim et al., 2011; Boschma & Frenken, 2011). However, the question is how policies for mature clusters (which are assumed to have a great impact on regional economic activity) can support this transition.

Accordingly, our premise is that directed policy programmes can guide cluster development (e.g., Fosse & Normann, forthcoming) and that given appropriate political ambitions, cluster projects can play an important role in regional development. The conceptual argument takes the NCE programme as an example. Cluster projects and organizations have recently become very important in Norway, and cluster projects have gained a visible and influential role in regional development. In addition, a related question is to what extent cluster projects affect the orientation of cluster actors. How and to what extent cluster policy influence the practices of clustered firms is not addressed in the discussion. We assume that Norwegian cluster policies function to some degree as

intended, which is confirmed by several evaluations of the policy instruments (Econ Pöyry, 2009, 2011; Jakobsen, Iversen, et al., 2012; Oxford Research, 2013).

This paper begins presentation with a discussion of the scale and scope dimension of cluster evolution and it links this to the question of regional development in general and regional path renewal in particular. This is followed by a conceptualization of cluster development strategies. We then discuss the profile and practices of the Norwegian NCE programme and its projects, before concluding the discussion with some normative policy implications. We believe that the conclusions merit interest in settings outside Norway, and have theoretical and political implications.

The scale and scope of clusters

Cluster scale

Traditionally, cluster programmes in Norway and other Western countries have emphasized that clusters are regional and specialized (Fløysand et al., 2012; Isaksen, 2009; Sölvell, Lindqvist, & Ketels, 2003). In addition, there has been a strong focus on strengthening external cluster linkages, and there is a consensus that external links are crucial for cluster evolution and growth. To be innovative, strong clusters are dependent on factors such as new knowledge and networks to avoid lock-in and decline (Bathelt et al., 2004; Breschi & Malerba, 2001; Nadvi & Halder, 2005), and it has been widely acknowledged that such ties need to be balanced between the local and the global (Bathelt et al., 2004; Birkinshaw & Hood, 2000; De Martino, Reid, & Zygliodopoulos, 2006; Fornahl & Tran, 2010; Giblin, 2011; Humphrey & Schmitz, 2002; Kramer & Diez, 2011; Larsson & Malmberg, 1999; Montagnana, 2010; Owen-Smith & Powell, 2004; Perkmann, 2006; Phelps, Mackinnon, Stone, & Braidford, 2003; Raines, Turok, & Brown, 2001; Rosenfeld, 1997; Turok, 1993; White, 2004; Zucchella, 2006). Accordingly, the interplay between spatial levels has been of interest to geographers since the introduction of Porter's cluster concept (Humphrey & Schmitz, 2002; Malmberg & Power, 2006; Martin & Sunley, 2003), famously conceptualized as local buzz and global pipelines (Bathelt et al., 2004). Thus, the combination and balance of regional specificities and supra-regional flows of knowledge and information are considered to be decisive in the evolution of industry clusters (e.g., Fornahl & Tran, 2010; Porter, 1998; Wolfe & Gertler, 2004), where the most internationally oriented firms and industries need to develop complex global networks to stay competitive in a fast-paced capitalist environment (Dicken, 2007; Fitjar & Rodríguez-Pose, 2013; Sassen, 2001). Thus, upgrading of clusters has been linked to stimulation of networking between cluster firms, coordination of purchasing and marketing efforts, development of specialized business services, and the establishment of an infrastructure for collective innovation projects. In other words, the focus of such programmes has been on organizing well-functioning localized (i.e., regionalized) value chains in an efficient manner (Fløysand et al., 2012).

Cluster scope

The scope of a cluster is linked to its industry profile, i.e., the type of firms or branches it encompasses. However, it is becoming increasingly apparent that the formation of 'global pipelines' – for example, in the form of the location of foreign firms in regional clusters – can also follow functional agglomeration patterns rather than sectoral ones. In

other words, firms might be clustering and attracting foreign firms based on the concentration of similar functions in the value chain (e.g., production versus research and development (R&D)) rather than similar sectors (where competition might prevail) (Crescenzi, Pietrobelli, & Rabellotti, 2014). However, as stated above, discussions of *clusters* until recently have highlighted the importance of industry specialization and geographical scale. Such agglomerations of similar firms promotes 'location economies', involving technological spillovers (knowledge leakages between firms), non-traded inputs (social relations), and labour market pooling (specialization of the labour force) (Hoover, 1954; Marshall, 1890). There has been a special emphasis on knowledge leakages and informal networking between cluster participants (Vatne, 2011). However, new papers written from the evolutionary perspective are more sceptical (Cooke, 2012a, 2012b). They argue that specialization works against innovativeness. Innovativeness is widely understood to involve new combinations of dissimilar types of knowledge (Schumpeter, 1934), and 'diversity trumps homogeneity where innovation is concerned', as Cooke (2012a, p. 19) notes. Thus, diversity is seen as more important than specialization for promoting innovation because of knowledge spillovers between branches (Feldman & Audretsch, 1999; Garcia-Vega, 2006). Frenken, Van Oort, and Verburg (2007) explain how proximity – and especially geographical proximity between actors in different industries – is beneficial for regional growth and innovation. The degree of spillover in a specialized milieu differs from that in a more diversified economy. Tensions between actors, industries and geographical locations are crucial for innovative activity. Frenken et al. claim that 'scope-wise' knowledge spillovers should therefore be more likely to occur between related sectors than between unrelated ones. Consequently, innovation and innovative activity in clusters can be seen as a combination of different forms of knowledge. This is in line with Schumpeter, who saw innovation as a new way of combining existing knowledge (Fagerberg, 2003; Schumpeter, 1934).

However, the question concerns the degree of difference between related and unrelated forms of knowledge and knowledge bases that is beneficial. The term 'related variety' is informative in this regard, a concept that concerns the ongoing discussion of 'proximity' (Boschma, 2005). Too much proximity (similarity) leads to lock-in and decline, while too little proximity (diversity) leads to unrelatedness – put differently, related variety is the middle ground between Marshall–Arrow–Romer (MAR) and Jacobs externalities. The latter is linked to advantages for all type of firms in a location, both related and unrelated, because of a rise in activity level. Such agglomeration forces have also been labelled 'urbanization economies' (Hoover, 1954).

Hence, the idea of related variety implies that innovations in clusters grow from a variety of knowledge shared between actors both within and between industry sectors and value chains, while at the same time knowledge shared between related actors should not be too different (unrelated) (Boschma & Iammarino, 2009). In line with these observations, Aarstad et al. (2015) found that related industry variety is a positive regional driver of productivity, especially for enterprise innovation, while industry specialization is a driver of enterprise productivity but does not have a significant positive effect on enterprise innovation. This is also argued for elsewhere, and, for instance, in a comparative study between the United States and Europe it is found that in a European context '[s]pecialization is […] negatively associated with the genesis of innovation […]' (Crescenzi, Rodríguez-Pose, & Storper, 2007, p. 31). The same authors also note that in Europe agglomerations are key to innovation, though, as again noted, agglomerations should be considered in a wider contextual, geographical setting in order to explain their impact on innovation.

Regional development

Literature with a strong focus on the scope of clusters and on collaboration between firms in related co-located clusters links cluster evolution to regional development. The point of departure from the evolutionary perspective is that 'the emergence of self-reinforcing effects steer a technology, industry or a regional economy along one path rather than another' (Martin, 2010, p. 3). In analyses of such path-dependent regional development, it is important to emphasize the twin processes of continuation and change (Aarset & Jakobsen, 2015; Jakobsen, Byrkjeland, et al., 2012; Martin, 2010). There is a broad continuation of evolutionary possibilities from a 'static' situation as one extreme point (characterized solely by continuation and rigidity and no dynamics or change) to a constantly changing regional economy where everything is in a state of flux and nothing is stable as the other extreme point (Martin, 2012).

Thus, we can make a stylistic distinction between two alternative development paths for a regional economy. The first is *regional path extension*. This implies that industries and clusters within a region develop along well-established technological trajectories. It is mainly 'more of the same', and the focus of firms and industries is on reduced cost and improved efficiency in existing value chains. Some incremental product and process innovations take place, but in this 'race to the bottom' situation, regional industries may eventually experience stagnation and a gradual decline because of a lack of renewal (Hassink, 2010; Martin, 2012). What has been a 'positive lock-in situation', where the regional industry is centred on several expanding industries that benefit from location economies, may turn into a 'negative lock-in situation'. In the latter situation, the system ceases to grow and becomes stuck in established practices and technology trajectories that no longer generate economic returns in the market (Engstrand & Stam, 2002; Martin & Sunley, 2006).

The second alternative is *regional path renewal.* New related activities are introduced, new markets are exploited and the structure of the industry in the region evolves. There is a strong degree of novelty on this regional path (Boschma & Frenken, 2011; Tödtling & Trippl, 2013). An important driver of regional renewal is local firms' diversifying or branching into related activities and sectors. The possibilities for regional path renewal are strengthened when a region's industry structure includes related variety, i.e., the region has a wide range of industries that are technologically related (Frenken et al., 2007). New industries may also be latent or may spin off from existing ones, and there are several examples of new industries building on the knowledge bases and institutions established by already successful industries (Klepper, 2007; Schamp, 2010) and of regional industries diversifying or branching into new but closely related activities (Boschma & Frenken, 2011). The main point is that knowledge and other resources that exist in regional firms shape the type of renewal that occurs (Neffke, Henning, & Boschma, 2011).

Returning to clusters more specifically, as with demarcations of the cluster concept per se, cluster *evolution* is a field of much research and academic debate (e.g., Østergaard & Park, 2015). This debate is most prominently linked to the conception of cluster life cycles (Martin & Sunley, 2011), where the rationale is that clusters move through different development phases (e.g., Isaksen, 2011; Menzel & Fornahl, 2010). The cluster life cycle can be categorized as consisting of four phases: (1) an emergence phase, (2) a growth phase, (3) a maturity phase and (4) a decline and possible renewal phase. Recent contributions have pointed to the importance of stimulating different life cycle phases with tailor-made policies (e.g., Fosse & Normann, forthcoming, Ingstrup &

Damgaard, 2013), concurring with more axiomatic understandings of regional development where it is highlighted that tailor-made, context-specific instruments and policies are key to achieve regional economic growth and renewal (Lagendijk, 2011; OECD, 2010; Tödtling & Trippl, 2005). In evolutionary theory, conditions for renewal are linked to the rationale that

> [t]he higher the number of technologically related sectors in a region, the more variety in related sectors, the more learning opportunities there are for sectors in that region, and the more intersectoral knowledge spillovers are likely to take place, resulting in higher regional growth. (Boschma & Frenken, 2011, p. 188)

Thus, through the lens of cluster theory, one should assume that cluster evolution is closely linked to regional industry structures and related variety. However, the literature has largely treated clusters as regionally isolated, specialized entities operating within relatively well-defined industry spheres and evolving organically through targeted strategies and policies. On the contrary, though, cluster evolution should be considered subject to a host of differing trajectories (Martin & Sunley, 2011), especially in the early phases of path formation. As contingencies decrease through time and are based on former choices (David, 1985; Martin, 2010; Martin & Sunley, 2006; Sydow et al., 2012), clusters in regions with a high degree of related variety should, in theory, be better equipped to meet intensified global competition and market fluctuations than clusters in specialized industry structures. The question, however, is how to utilize such 'beneficial industry structures' through cluster policy in order to achieve long-term, sustainable economic growth and innovation, i.e., regional economic development (e.g., Boschma, 2014). Consequently, we argue that policies for cluster evolution may lead to decreasing scope of contingencies and negative path dependency within regional industry structures if related variety and the regional context is not taken into account. This is reflected by Martin and Sunley (2011, p. 1304), who contend that '[c]lustering leads to the emergence of cluster-wide macro-effects and structures – such as various localization economies and spillovers, and various institutions and organizations – that serve to reinforce the geographical concentration and competitive advantage of the individual firms concerned'. However, in situations where policies for cluster evolution are linked to specialized industry clusters, this may result in lock-in and eventual decline, hampering regional development (at least in a short- and medium-time perspective).

In other words, path dependencies eventually lead the evolution of clusters targeted by policy efforts towards some trajectories on the behalf of others. For instance, linked to the Norwegian context, it has previously been shown how such trends in regional innovation policy have impacts for regional development (Jakobsen, Byrkjeland et al., 2012), and from a regional development perspective there is indeed a danger of facilitating spiralling lock-in tendencies and negative path dependencies through stimulating specialized, relatively isolated industry clusters.

Hence, from a more broad regional perspective, cluster project strategies set the framework conditions for choice of trajectories and, therefore, narrowing of contingencies. This would necessarily be the result of any innovation policy (as some areas are prioritized while others are not), but, as is exemplified by its widespread implementation, cluster theory and strategies for cluster development have a wide impact on regional development. This impact, however, can result in either regional path extension or regional path renewal. Moreover, we believe that such strategies can set important framework conditions for long-term regional adaptability. The question is then *how* can

cluster projects in different ways be important in stimulating processes of regional renewal to achieve long-term regional development and adaptability? Based on our discussion of the scale and scope of clusters, the next section outlines three policy strategies for cluster evolution and links them to regional development outcomes.

Cluster policy and cluster strategies

The common feature of cluster evolution and regional development is that they are not predictable or standardized processes; they are complex and multilevel, and should be treated accordingly (Fløysand & Jakobsen, 2011). However, facilitating such processes is considered to be possible, thus making it interesting to 'guide' and facilitate regional development (Martin, 2010). For instance, in a geographical setting, the framework for 'smart specialization' laid down by the European Commission (2006) is based on the rationale that it is possible to stimulate localized endogenous (competitive) advantages by building on former contingencies and (beneficial) development paths by specializing in (regionally) unique traits. At the same time, the academic debate on the evolution of mature clusters has placed its main emphasis on scale as a source of cluster development (famously labelled global buzz and global pipelines; Bathelt et al., 2004). However, as shown, the evolutionary perspective also highlights scope as an important source of development and innovation. Based on the theoretical discussion above, we have conceptualized three policy strategies for mature cluster development: 'monocropping', 'hubbing' and 'blending' (Table 1). These are idealized strategies, and it is reasonable to assume that elements of all these strategies are present in cluster projects. However, these strategies may be useful for conceptual purposes and as an analytical framework for assessing dimensions of scale and scope in the development of cluster projects and their contribution to regional path renewal.

Monocropping

The monocropping strategy aims to strengthen the cluster as a regional specialized milieu. This is in many ways the 'classical' perception of a cluster and is very similar to the idea of Marshallian districts and the operationalization of Porter's idea of clusters by policy-makers (Desrochers & Sautet, 2004; Sölvell, Lindqvist, & Ketels, 2003). This strategy adopts the well-known criterion for a 'true cluster' (Malmberg & Power, 2006), which is that it supports specialization within a regionally delimited area. The monocropping strategy is intended to develop trust between co-located firms and to increase the degree of cluster specialization and bonding. Local buzz is supported and nurtured, and the strategy can encourage the development of trust and social bonding between cluster members (Malecki, 2012). This can also facilitate the development of a common cluster identity among its members. In other words, this strategy is directed toward stimulating, or boosting, the occurrence of Marshallian externalities and locational economies. Although Marshall did not explicitly state it, linkages and/or cooperation with firms outside the district are assumed to be minimal (Markusen, 1996).

Monocropping can be important for emerging clusters lacking networks and strong (regional) ties between their members. If the strategy is used for a mature cluster, such as projects in the NCE programme, it can aid in upgrading of the cluster through improving the functioning and efficient organization of the regional value-chain linkages. Thus, this strategy reflects a view of clusters as value chains (Humphrey & Schmitz, 2002) but is also strongly informed by a Marshallian understanding. We

Table 1. Policy strategies, cluster evolution and regional development.

Strategy	Cluster scale	Cluster scope	Main characteristic	Supporting theories	Sources for cluster evolution	Likely regional output
Monocropping	Regional	Specialization	Homogeneity (scale and scope)	Industrial districts/Marshallian districts	Local buzz	Path extension
Hubbing	National/ international	Specialization	Homogeneity (scope)	Value chains, global production networks	Internationalization/global pipelines	Path extension/ minor path renewal
Blending	Regional	Related variety	Related variety/ heterogeneity	Regional innovation platforms, regional innovation systems, related variety, smart specialization	Industry crossovers	Path renewal

believe that this strategy, implemented in mature clusters, will mainly lead to regional path extension, i.e., more of the same. The main aim of the strategy is to encourage members to become more 'similar' and to specialize within the same sector, which as argued above, may hamper regional development and innovation in the long term. Because the networks are regional and the range of knowledge and industry affiliation is narrow (making it vulnerable to influences such as market fluctuations, political regulation or access to input factors), this strategy may also lead to negative regional lock-in in the long term.

Hubbing

As discussed above, a common understanding of cluster evolution, in both the literature and cluster programmes, is linked to expanding scale of the cluster. We have termed this a 'hubbing' strategy, which is commonly used to develop 'traditional' (regionally specialized) clusters through the geographical expansion of linkages, i.e., to expand their geographical areas of impact. This has been captured especially well by the influential framework of local buzz *and* global pipelines proposed by Bathelt et al. (2004). Like the monocropping strategy, it reflects a view of clusters as value chains (Humphrey & Schmitz, 2002) where the main idea is that the value chain can be upgraded through an expansion of its geographical scale. Linked to this is also the rationale that such expansions should be sector specific (i.e., clusters are specialized), as the hubbing strategy emphasizes the importance of building external pipelines based on a cluster's sector-specific field of expertise. Thus, a hubbing strategy means that the cluster establish new junctions or assemblage point outside the original geographical core area of the cluster, and are linked to utilization of scale. Such strategies are intended to complement and further to develop specialized clusters through extra-regional pipelines and the development of relations with specialized actors external to the cluster. This resembles both the idea of global pipelines as a driver of innovation within the cluster literature (Bathelt et al., 2004) and the focus on learning through connecting highly competent and specialized actors within the sectoral system of innovation approach (Malerba, 2002).

The strategy implies the development of extra-regional ties to relevant and highly competent industry partners and research milieus, at both a national and especially an international level – at the expense of building linkages to firms in related branches. The cluster can also establish 'satellites' or 'nodes' in relevant milieus, both nationally and internationally. These extra-regional networks will encourage the cluster to innovate and to stimulate the processes of learning and development. However, when the focus is on the extra-regional level, it may be a challenge to encourage and maintain local buzz.

We believe that this cluster strategy can contribute to both regional path renewal and regional path extension. External linkages can bring new dynamism to the region, stimulating innovation processes. Nevertheless, it is important to note that the strong focus on efficient organization (i.e., a value chain rationale) and the sector specificity of external pipelines will most likely lead to 'more of the same'.

Blending

An alternative way to facilitate the evolution of a mature cluster is to broaden its scope. The blending strategy is concerned with cooperation between related firms and between related actors and milieus *within a region*. This is linked to theoretical understanding of related variety (Frenken et al., 2007), regional branching (Boschma & Frenken, 2011),

and regional innovation platforms (Cooke et al., 2010), but it also encompasses functional agglomeration (Crescenzi et al., 2013) as it highlights various proximity dimensions (Boschma, 2005), such as cognitive and organizational, rather than industry specialization and (only) geographical proximity. This strategy brings the *region* to the fore. It is about strengthening clustered firms' linkages to related sectors in a region and stimulating knowledge spillovers between differentiated, but related, sectors and actors, i.e., bridging related knowledge domains and encouraging cross-industry innovation (Enkel & Gassmann, 2010). Thus, the key issue is to ensure an upgrading of the cluster and a strengthening of the innovation capabilities of cluster firms by facilitating 'blending' or 'mixing' of different but related competences. Consequently, blending strategies are concerned with expanding the industrial scope of cluster projects by stimulating cooperation and learning between firms in related branches and firms with different but related knowledge. In practice, blending implies a stronger emphasis on the regional dimension and is, as such, linked to the theoretical concept of regional innovation systems (RIS) (Cooke, 1992; Cooke et al., 1997), i.e. the "institutional infrastructure supporting innovation within the production structure of a region" (Asheim & Gertler 2005, 299).

Facilitating regional cross-industry ties may strengthen the innovation capabilities of firms, although there is a risk of a negative regional lock-in if this is not combined with the development of extra-regional linkages. There is also a risk for the facilitator in stimulating networking between unrelated firms in the region, which can turn out to be unproductive. The rationale of the strategy is that it discourages traditional sector specialization (Cooke, 2012c) and instead support a more diverse system with elements of both internal cluster cooperation and cross-cluster networking between related *regional* industry sectors. It also entails a broader definition of what a cluster actually is, i.e., an agglomeration of firms in related industries and not an industry-specific entity. Also, innovation is without doubt linked to agglomeration (Crescenzi et al., 2007). Thus, it has elements of Hassink's (2005, p. 532) concept of a learning cluster:

> a concept […] able to bridge the gap between regional learning, which increasingly crosses the borders of regions and nations due to the globalization of production networks, and the learning region strategy, which focuses on the regional SMEs [small and medium-sized enterprises] active in a variety of different clusters with different characteristics.

By broadening the scope of the cluster, and stimulating collaboration between related firms and diversification into related markets, this strategy has strong potential for contributing to regional renewal. However, it is important to note that this presupposes that intraregional collaboration is supplemented with extra-regional linkages.

To exemplify and elaborate upon our theory informed categorization, the next section discusses how the Norwegian cluster policy programme for mature clusters relates to these cluster policy strategies.

The Norwegian NCE programme

Cluster programmes are one of the central pillars of Norwegian innovation policy, and three national cluster programmes, grouped under the programme Norwegian Innovation Clusters, are in operation. The ARENA programme is aimed at emerging, immature and potential clusters, and is intended to explore and to structure industry clusters in an early phase of development. Status and financing is given for three to five years.

Moreover, the Norwegian Centre of Expertise (NCE) programme, initiated in 2006, is designed for mature clusters with a strong international position. Financing is granted for up to 10 years. The intention of the programme is to 'enhance sustainable innovation and internationalization processes in the most dynamic and growth-oriented Norwegian clusters' (http://www.nceclusters.no/). In May 2015[1] there were 12 active NCE cluster projects in operation, and these are the projects included in our analysis (see Table A1 in Appendix A). Recently (2014), another cluster level was initiated: Global Centres of Expertise (GCE). There are two GCE projects running in Norway (May 2015), both of which were previously NCE projects. Status and financing is granted for up to 10 years.

The focus of this discussion is the NCE programme. This programme aims to develop the most mature and dynamic clusters in Norway, i.e., those that have the strongest probability of contribution to regional development. We start by discussing the profile of the programme before providing an overview of its project portfolio and describing how this is linked to dimensions of scale, scope and regional path renewal. The discussion is based on available documents such as programme descriptions, cluster projects' webpages and, most importantly, midway evaluations of the cluster programme and nine of the cluster projects. See Appendix A for a description and categorization of the projects.

Scale and scope of the NCE programme

The Norwegian Innovation Clusters framework emphasizes that the programme will 'better the conditions for increasing value creation and strengthen [the clustered firms'] position in national and global value chains' (Norwegian Innovation Clusters, 2014, p. 2; authors' translation), a condition that is emphasized by the NCE programme. Among other measures, NCE projects are required to encompass 'a clear concentration of firms, both SMEs and large specialized suppliers and a large share of globally oriented firms'. Furthermore, they must represent a 'specialized, attractive labor market in the cluster's regional area of impact' (Norwegian Innovation Clusters, n.d., p. 2). Moreover, it is required that the 'cluster has an established position as an important national, and usually an international value creation environment within its value chain or technology base' (Norwegian Innovation Clusters, 2014, p. 2; authors' translation). In the document entitled *New Integrated Cluster Programme – Framework for Content and Organization* (2012), the cluster programme owners, Innovation Norway, SIVA and the Research Council of Norway stress how important it is that 'connections between different suppliers and connections to buyers and users are crucial for well-functioning systems and solutions'. Accordingly, the projects are required to have an established position in a market or knowledge frontier (Norwegian Innovation Clusters, 2014, p. 21), and the programme highlights the importance of coordination and strengthening of vertical integration in value chains as one of the key characteristics of dynamic clusters. Hence, it can be claimed that the NCE programme emphasizes that a narrow scope is important for the development of clusters.

The 'value chain thinking' leads to a strong focus on further developing international markets as a source of cluster evolution. The programme highlights the importance of both global pipelines and local buzz, but the former dimension – scale – has been especially emphasized. Internationalization is expected to encourage cluster evolution and innovation through developing international market linkages (i.e., market-pull thinking; e.g., Brem & Voigt, 2009), while in practice there has been less emphasis on developing linkages with international knowledge hubs (Econ Pöyry, 2009; Jakobsen,

Iversen, et al., 2012; Norwegian Innovation Clusters, 2014). This has been noted by other scholars, and in a study of Norwegian NCEs, Isaksen (2009) claims that 'the [cluster] firms' value chains are […] to a large extent global, which entails that firms find many of their most important innovating partners (among customers and suppliers) internationally'. Findings from the evaluations reveal that the firms have strong international networks a priori to NCE status. Further, they show that activities have mainly nurtured the existing value chains in which the firms operate. Thus, the rationale of the cluster projects appears to support interaction in value chains between relatively homogenous actors. Moreover, it has been shown that new members to cluster projects are recruited from within existing niches (Oxford Research, 2013, p. 29), further strengthening processes of path extension, while at the same time evaluations have pointed to a lack of innovative output and a need to strengthen innovation activities in the cluster projects (Econ Pöyry, 2009, 2011).

Hence, the NCE programme has a strong focus on the internationalization of regional environments with strong value chains, i.e., the programme emphasizes the hubbing strategy. However, in practice, there are variations to this programme-level strategy, as exemplified by the current portfolio of NCE projects (see Tables A1 and A2 in Appendix A). While several of the projects emphasize the hubbing strategy, there are also examples of both monocropping and blending, although the latter two represent a clear minority. The NCE Systems Engineering project is one example of the blending strategy. The project's home page states: 'NCE Systems Engineering aims to contribute to developing Kongsberg and Norway as one of the world's most attractive places for development and industrialization of high-tech products to be used in demanding applications' (see http://nce-se.no/index.php/om_nce/C29; authors' translation). However, generally speaking, the hubbing strategy predominates among the current projects, which is stated by NCE Media: 'We are a unique collaboration of global technology industry, national broadcasters, regional newspapers, academia and small, forward-leaning mediatech companies and entrepreneurs' (see http://ncemedia.no/nce-media-a-world-class-mediatech-cluster/). This is also prominent in other projects, such as NCE Instrumentation, which aims to become 'strong within its very specialized niche', and NCE Subsea, an initiative that highlights that 'the Bergen area in Norway constitutes a world-leading cluster in subsea technology – focusing on the markets for maintenance, modification and operation, as well as innovative and cutting edge technical products' (see http://ncesubsea.no/page/5624/About_us). Not surprisingly, the framework of the NCE programme has an observable impact on cluster projects, where specialization of regional industry clusters complemented with extra-regional linkages is the dominant practice.

Discussion and conclusions

Framed according to the hubbing strategy, the Norwegian NCE programme seek to structure relatively specialized industry environments where extra-regional linkages to international markets serve as sources of cluster evolution and regional development. However, from a theoretical point of view, this narrowness in cluster scope may constrain innovation but also may act as a source of regional path extension (by supporting a predefined industry structure) (e.g., Desrochers & Sautet, 2004). Hence, the evolution of strong and dynamic clusters in Norway is based on strategies emphasizing the market-pull rationale, where industry actors within relatively well-defined value chains contribute to increased specialization of mature material clusters. Internationalization has

been emphasized as the main source of renewal in such constellations, and less focus has been placed on regional renewal through the utilization of scope, i.e., relatedness among diversified cluster actors. Hence, the RIS thinking and stimulation of (regional) branching has been given less priority in the strategies of the NCE programme and in the practice of NCE projects. Thus, we argue that in terms of stimulating regional renewal and long-term regional development (e.g., Boschma, 2014), such blending strategy has the greatest potential.

Cluster projects should not only be treated as instruments for optimizing value chains but operationalized as sources of regional innovation platforms where both markets and technology serve as drivers of innovation. For this, it is necessary to emphasize the importance of both customers and R&D, rather than one or the other, to stimulate cluster evolution in a desired direction. At present, the cluster projects are understood as market-driven entities underpinning (specialized) value chains. Linked to this is the perceived importance of related variety in a cluster value chain's horizontal structure, suggesting, for example, that R&D should support adaptation to market needs. By structuring cluster projects based on related variety as an integrated, holistic dimension of clustering, combinations of market pull and technology push (Berg Jensen et al., 2007) can be better integrated as drivers of innovation. However, this approach requires new innovation platforms/models, for example, to capture conjunctions of knowledge bases and modes of innovation (Isaksen & Karlsen, 2013; Njøs et al., 2014), which reflects the view of regional innovation platforms (Cooke et al., 2010). This is linked to Menzel and Fornahl's (2010) argument that heterogeneity within a cluster and between related clusters provides a foundation for development. It also reflects more recent trends in thinking on policy platforms for regional development and innovation (Asheim et al., 2011; Cooke et al., 2010) and the idea of combined innovation policy, intended to combine knowledge and modes of innovation (Asheim & Parrilli, 2011; Isaksen & Karlsen, 2012; Isaksen & Nilsson, 2013; Njøs et al., 2014). Moreover, and importantly, it also implies that cluster projects should not be studied and understood in isolation from wider regional industry structures. In short, it requires regions to be treated as integrated in clusters, not vice versa. This is reflected in the ideal-typical strategies for cluster evolution and regional development outlined in this paper, as noted by, for example, Crescenzi et al. (2007, p. 31), innovation activity in European countries is characterized by *proximity to other innovative areas and to the capacity to assimilate and transform inter-regional knowledge spillovers into innovation.* Clusters are not regionally isolated, and should be treated accordingly.

In line with the above propositions raised, we argue that cluster policy should resemble the blending strategy in encouraging the development of strong and dynamic material clusters. This suggests that policies for the utilization of regional specificities should be defined more widely than belonging to a particular industry/value chain. This is linked to the concept of related variety, and the rationale for our argument is that related variety may also affect the opportunities of regions to diversify into new industries over time (Asheim et al., 2011). Innovation is not linked only to 'closed' regional agglomerations; they also include the wider regional setting through complex interlinkages (Cresenzi et al., 2007).

By setting the framework conditions for cluster projects, cluster policy not only can contribute to the evolution of mature clusters but also can have an important role in contributing to regional path renewal and a possible development of new related industries. However, this requires a broader approach. After all, at their core, cluster policies are intended to stimulate innovation and long-term (regional) adaptability. Furthermore,

the rationale for public involvement in cluster projects is systemic failure, indicating a role for policy not only in facilitating clusters but also in treating cluster projects as a tool to contribute to broader-based processes of regional path renewal through the wider perspective of related variety and long-term regional development. Thus, strategies for cluster evolution should emphasize trust-building (developing a cluster identity), development of innovation infrastructure and platforms, and strengthening of competence and knowledge development, and should assist with systematizing technology and market trends for clustered actors. However, the most important task is to stimulate and facilitate linkages between traditional sector divisions, and to prioritize activities and projects that are not immediately prioritized by single firms or R&D institutions. Rather than optimizing/strengthening existing value chains, which may be considered to be a short-term strategy, cluster policy should represent a broader approach relying on ideas and theories that at the core are regional – such as regional innovation systems and regional innovation platforms, nurturing regional branching and cross-industry innovations. This has theoretical implications, as it requires us to move beyond the political perception of clusters as specialized entities, instead refining categories and concepts that are also related to adjacent contributions within the innovation literature, hence underlining the importance of geography.

Cluster projects are important entities in restructuring regional economies in Norway, as is evident from the increased media and political attention given to cluster facilitators and projects. It is also evident in the literature on systems of innovation, where such constellations are considered to be key for generating innovation and economic growth. Our argument is that clusters should be treated as *regional* constellations of *related* actors with multilevel linkages, as 'in sum, related variety is a concept that links knowledge spillovers to economic renewal, new growth paths and regional growth' (Asheim et al., 2011, p. 896). Such 'complex adaptive systems' evolve regionally and are based on a logic that is not necessarily reflected by a priori industry categorizations and demarcations (Martin & Sunley, 2011). Practically, this suggests that clusters should be considered from a wider perspective, for example, in line with the platform policy rationale (e.g., Asheim et al., 2011; Cooke, 2007, 2012a) rather than industry-specific value chain constructs (e.g., Sölvell, Lindqvist, & Ketels, 2003; Humphrey & Schmitz, 2002; Reve & Sasson, 2012).

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1. In late June 2015, NCE status was granted to two more clusters (the NCE Eyde and NCE Seafood Innovation Cluster), while NCE Subsea was upgraded to GCE status.

References

Aarset, B., & Jakobsen, S.-E. (2015). Path dependency, institutionalization and co-evolution: The missing diffusion of the blue revolution in Norwegian aquaculture. *Journal of Rural Studies, 41*, 37–46.

Aarstad, J., Kvitastein, O.A., & Jakobsen, S.-E. (2016). Related and unrelated variety as regional drivers of enterprise productivity and innovation: A multilevel study. *Research Policy (2016)*, http://dx.doi.org/10.1016/j.respol.2016.01.013

Asheim, B. T., Boschma, R., & Cooke, P. (2011). Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional Studies, 45*, 893–904.

Asheim, B. T., & Gertler, M. S. (2005). The geography of innovation: Regional innovation systems. In J. Fagerberg, D. C. Mowery, & R. R. Nelson (Eds.), *The Oxford Handbook of Innovation* (pp. 291–317). Oxford: Oxford University Press.

Asheim, B. T., & Parrilli, M. D. (2011). *Interactive Learning for Innovation: A Key Driver within Clusters and Innovation Systems*. Basingstoke: Palgrave Macmillan.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography, 28*, 31–56.

Berg Jensen, M., Johnson, B., Lorenz, E., & Lundvall, B. A. (2007). Forms of knowledge and modes of innovation. *Research Policy, 36*, 680–693.

Birkinshaw, J., & Hood, N. (2000). Characteristics of foreign subsidiaries in industry clusters. *Journal of International Business Studies, 31*, 141–154.

Boschma, R. A. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*, 61–74.

Boschma, R. (2014). Towards an evolutionary perspective on regional resilience. *Regional Studies, 49*, 733–751.

Boschma, R., & Frenken, K. (2011). Technological relatedness, related variety and economic geography. In P. Cooke, B. Asheim, R. Boshcma, R. Martin, D. Schwartz, & F. Tödtling (Eds.), *Handbook of regional innovation and growth* (pp. 187–198). Cheltenham: Edward Elgar.

Boschma, R., & Iammarino, S. (2009). Related variety, trade linkages, and regional growth in Italy. *Economic Geography, 85*, 289–311.

Brem, A., & Voigt, K.-I. (2009). Integration of market pull and technology push in the corporate front end and innovation management – insights from the German software industry. *Technovation, 29*, 351–367.

Breschi, S., & Malerba, F. (2001). The geography of innovation and economic clustering: Some introductory notes. *Industrial and Corporate Change, 10*, 817–833.

Chapman, K., MacKinnon, D., & Cumbers, A. (2004). Adjustment or renewal in regional clusters? A study of diversification amongst SMEs in the Aberdeen oil complex. *Transactions of the Institute of British Geographers, 29*, 382–396.

Coenen, L., Moodysson, J., & Martin, H. (2014). Path renewal in old industrial regions: Possibilities and limitations for regional innovation policy. *Regional Studies, 49*, 850–865.

Cooke, P. (1992). Regional innovation systems: Competitive regulation in the new Europe. *Geoforum, 23*, 365–382.

Cooke, P. (2007). To construct regional advantage from innovation systems first build policy platforms. *European Planning Studies, 15*, 179–194.

Cooke, P. (2012a). *Complex Adaptive Innovation Systems*. London: Routledge.

Cooke, P. (2012b). Transversality and transition: Green innovation and new regional path creation. *European Planning Studies, 20*, 817–834.

Cooke, P. (2012c). Knowledge economy spillovers, proximity, and specialization. In B. T. Asheim & M. D. Parrilli (Eds.), *Interactive learning for innovation: A key driver within clusters and innovation systems* (pp. 100–114). Basingstoke: Palgrave Macmillian.

Cooke, P., De Laurentis, C., & Macneil, S. (2010). *Platforms of innovation*. Cheltenham: Edward Elgar.

Cooke, P., Gomez Uranga, M., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research Policy, 26*, 475–491.

Crescenzi, R., Pietrobelli, C., & Rabellotti, R. (2013). Innovation drivers, value chains and the geography of multinational corporations in Europe. *Journal of Economic Geography, 14*, 1053–1086.

Crescenzi, R., Rodríguez-Pose, A., & Storper, M. (2007). The territorial dynamics of innovation: A Europe-United States comparative analysis. *Journal of Economic Geography, 7*, 1–37.
David, P. A. (1985). Clio and the Economics of QWERTY. *The American Economic Review, 75*, 332–337.
De Martino, R., Reid, D. M., & Zygliodopoulos, S. C. (2006). Balancing localization and globalization: Exploring the impact of firm internationalization on a regional cluster. *Entrepreneurship & Regional Development, 18*, 1–24.
Desrochers, P., & Sautet, F. (2004). Cluster-based economic strategy, facilitation policy and the market process. *The Review of Austrian Economics, 17*, 233–245.
Dicken, P. (2007). *Global Shift. Mapping the changing contours of the world economy*. London: Sage.
Econ Pöyry (2009). *Evaluering av seks NCE-prosjekter* [Evaluation of six NCE projects]. Econ-report nr. 2009-045, Econ Pöyry, Oslo.
Econ Pöyry (2011) *Evaluering av NCE-programmet* [Evaluation of the NCE programme]. ECON-report nr. R-2011-036. Econ Pöyry, Oslo.
Engstrand, A., & Stam, E. (2002). Embeddedness and economic transformation of manufacturing: A comparative research of two regions. *Economic and Industrial Democracy, 23*, 357–388.
Enkel, E., & Gassmann, O. (2010). Creative imitation: Exploring the case of cross-industry innovation. *R&D Management, 40*, 256–270.
European Commission. (2006). *Constructing regional advantage: Principles, perspectives, policies*. Brussels: DG Research.
Fagerberg, J. (2003). Schumpeter and the revival of evolutionary economics: An appraisal of the literature. *Journal of Evolutionary Economics, 13*, 125–159.
Feldman, M. P., & Audretsch, D. B. (1999). Innovation in cities: Science-based diversity, specialization and localized competition. *European Economic Review, 43*, 409–429.
Fitjar, R. D., & Rodríguez-Pose, A. (2013). Firm collaboration and modes of innovation in Norway. *Research Policy, 42*, 128–138.
Fløysand, A., & Jakobsen, S.-E. (2011). The complexity of innovation: A relational turn. *Progress in Human Geography, 35*, 328–344.
Fløysand, A., Jakobsen, S.-E., & Bjarnar, O. (2012). The dynamism of clustering: Interweaving material and discursive processes. *Geoforum, 43*, 948–958.
Fornahl, D., & Tran, A. C. (2010). The development of local–global linkages in the biotech districts in Germany: Local embeddedness or distance learning? In F. Belussi & A. Sammarra (Eds.), *Business networks in clusters and industrial districts* (pp. 332–356). London: Routledge.
Fosse, J. K., & Norman, R. (forthcoming). Management strategies in cluster projects – Cases and discussion. In R. Hassink & D. Fornahl (Eds.), *Cluster policies from a life cycle perspective*. Cheltenham: Edward Elgar.
Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies, 41*, 685–697.
Garcia-Vega, M. (2006). Does technological diversification promote innovation? An empirical analysis for European firms. *Research Policy, 35*, 230–246.
Giblin, M. (2011). Managing the global–local dimensions of clusters and the role of 'lead' organizations: The contrasting cases of the software and medical technology clusters in the west of Ireland. *European Planning Studies, 19*, 23–42.
Hassink, R. (2005). How to unlock regional economies from path dependency? From learning region to learning cluster *European Planning Studies, 13*, 521–535.
Hassink, R. (2010). Locked in decline? On the role of regional lock-ins in old industrial areas". In R. Boschma & R. Martin (Eds.), *The Handbook of Evolutionary Economic Geography* (pp. 450–468). Cheltenham: Edward Elgar.
Hoover, E. H. (1954). *Location Theory and the Shoe and Leather Industries*. Cambridge, MA: Harvard University Press.
Humphrey, J., & Schmitz, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters? *Regional Studies, 36*, 1017–1027.
Ingstrup, M. B., & Damgaard, T. (2013). Cluster facilitation from a cluster life cycle perspective. *European Planning Studies, 21*, 556–574.
Innovation Norway, SIVA, & The Research Council of Norway (2012). Nytt helhetlig klyngeprogram- Rammeverk for innhold og organisering [New Integrated Cluster Programme -

Framework for Content and Organization]. Available from http://spotidoc.com/doc/2861208/nytt-helhetlig-klyngeprogram-rammeverk-for-innhold (Accessed 25.01.16)
Isaksen, A. (2009). Innovation dynamics of global competitive regional clusters: the case of the Norwegian Centres of Expertise. *Regional Studies, 43*, 1155–1166.
Isaksen, A. (2011). Cluster evolution. In P. Cooke & B. T. Asheim (Eds.), *Handbook of regional innovation and growth* (pp. 293–302). Cheltenham: Edward Elgar.
Isaksen, A., & Karlsen, J. (2012). Combined and complex mode of innovation in regional cluster development – analysis of the light-weight material cluster in Raufoss. In B. T. Asheim & M. D. Parilli (Eds.) *Interactive learning for innovation: A key driver within clusters and innovation systems* (pp.115–136). Basingstoke: Palgrave Macmillian.
Isaksen, A., & Karlsen, J. (2013). Can small regions construct regional advantages? The case of four Norwegian regions *European Urban and Regional Studies, 20*, 243–257.
Isaksen, A., & Nilsson, M. (2013). Combined innovation policy: Linking scientific and practical knowledge in innovation systems. *European Planning Studies, 21*, 1919–1936.
Jakobsen, S.-E., Byrkjeland, M., Båtevik, F. O., Pettersen, I. B., Skogseid, I., & Yttredal, E. R. (2012). Continuity and change in path dependent regional policy development: The regional implementation of the Norwegian VRI programme. *Norwegian Journal of Geography, 66*, 133–143.
Jakobsen, E., Iversen, L., Jordell, H., & Røtnes, R. (2012). *Hovedrapport – Evaluering av seks NCE-prosjekter høst 2012 [Main report – evaluation of six NCE projects autumn 2012]* Report nr. 40/2012, MENON Business Economics and DAMVAD.
Klepper, S. (2007). Disagreements, spinoff and the evolution of Detroit as the capital of the US automobile industry. *Management Science, 53*, 616–631.
Kogler, D. F. (2015). Editorial: Evolutionary economic geography – Theoretical and empirical progress. *Regional Studies, 49*, 705–711.
Kramer, J.-P., & Diez, J. R. (2011). Catching the local buzz by embedding? Empirical insights on the regional embeddedness of multinational enterprises in Germany and the UK. *Regional Studies, 46*, 1303–1317.
Lagendijk, A. (2011). Regional innovation policy between theory and practice. In P. Cooke, B. Asheim, R. Boschma, R. Martin, D. Schwartz, & F. Tödtling (Eds.), *Handbook of regional innovation and growth* (pp. 597–608). Cheltenham: Edward Elgar.
Larsson, S., & Malmberg, A. (1999). Innovations, competitiveness and local embeddedness: A study of machinery producers in Sweden. *Geografiska Annaler: Series B, Human Geography, 81*, 1–18.
Malecki, E. J. (2012). Regional social capital: Why it matters. *Regional Studies, 46*, 1023–1039.
Malerba, F. (2002). Sectoral systems of innovation and production. *Research Policy, 31*, 247–264.
Malmberg, A., & Power, D. (2006). True clusters. A severe case of conceptual headache. In B. Asheim, P. Cook, & R. Martin (Eds.) *Clusters and regional development. Critical reflections and explorations* (pp. 50–69). London: Routledge.
Markusen, A. (1996). Sticky places in slippery space: A typology of industrial districts. *Economic Geography, 72*, 293–313.
Marshall, A. (1890). *Principles of Economics*. Düsseldorf: Wirtschaft und Finanzen.
Martin, R. (2010). Roepke Lecture in economic geography – Rethinking regional path dependence: Beyond lock-in to evolution. *Economic Geography, 86*, 1–27.
Martin. (2012). Regional economic resilience, hysteresis and recessionary shocks. *Journal of Economic Geography, 12*, 1–32.
Martin, R., & Sunley, P. (2003). Deconstructing clusters: Chaotic concept or policy panacea? *Journal of Economic Geography, 3*, 5–35.
Martin, R., & Sunley, P. (2006). Path dependence and regional economic evolution. *Journal of Economic Geography, 6*, 395–437.
Martin, R., & Sunley, P. (2011). Conceptualizing cluster evolution: Beyond the life cycle model? *Regional Studies, 45*, 1299–1318.
Menzel, M. P. & Fornahl, D. (2010). Cluster life cycles - dimensions and rationales of cluster evolution. *Industrial and Corporate Change, 19*, 205–238.
Montagnana, S. (2010). The internationalisation of the 'footwear agglomeration' of Timisoara: How deeply embedded are local firms? In F. Belussi & A. Sammarra (Eds.), *Business networks in clusters and industrial districts* (pp. 186–213). London: Routledge.

Nadvi, K., & Halder, G. (2005). Local clusters in global value chains: Exploring dynamic linkages between Germany and Pakistan. *Entrepreneurship & Regional Development: An International Journal, 17*, 339–363.

Neffke, F., Henning, M., & Boschma, R. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography, 87*, 237–265.

Njøs, R., Jakobsen, S.-E., Fosse, J. K., & Engelsen, C. (2014). Challenges to bridging discrepant knowledge bases: A case study of the Norwegian centre for offshore wind energy. *European Planning Studies, 22*, 2389–2410.

Norwegian Innovation Clusters. (2014). Programbeskrivelse Norwegian Innovation Clusters [Programme description Norwegian Innovation Clusters], Innovation Norway, The Research Council of Norway, SIVA, dated 18.12.14. Retrieved from http://www.innovasjonnorge.no/PageFiles/345849/Programbeskrivelse%2018.12.14.pdf

Norwegian Innovation Clusters. (n.d.). Selection criteria for NCE, 2015. Retrieved from http://www.innovasjonnorge.no/PageFiles/344932/Utvelgelseskriterier%202015%20%28NO%29.pdf

OECD. (2010). Regional Development Policies in OECD Countries. OECD Publishing.

Østergaard, C. R., & Park, E. (2015). What makes clusters decline? A study on disruption and evolution of a high-tech cluster in Denmark. *Regional Studies, 49*, 834–849.

Owen-Smith, J., & Powell, W. W. (2004). Knowledge networks as channels and conduits: The effects of spillovers in the Boston biotechnology community. *Organization Science, 15*, 5–21.

Oxford Research. (2013). Evaluering av NCE-prosjekter etter seks år. Evaluering av tre NCE-prosjekter – hovedrapport [Evaluation of NCE projects after six years. Evaluation of tre NCE projects – main report]. Oxford Research, Kristiansand.

Perkmann, M. (2006). Extraregional linkages and the territorial embeddedness of multinational branch plants: Evidence from the South Tyrol Region in Northeast Italy. *Economic Geography, 82*, 421–441.

Phelps, N. A., Mackinnon, D., Stone, I., & Braidford, P. (2003). Embedding the multinationals? *Institutions and the development of overseas manufacturing affiliates in Wales and North East England, Regional Studies, 37*, 27–40.

Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, November-December, 77–99.

Raines, P., Turok, I., & Brown, R. (2001). Growing global: Foreign direct investment and the internationalization of local suppliers in Scotland. *European Planning Studies, 9*, 965–978.

Reve, T., & Sasson, A. (2012). *Et kunnskapsbasert Norge* [A knowledge-based Norway]. Oslo: Universitetsforlaget.

Rosenfeld, S. A. (1997). Bringing business clusters into the mainstream of economic development. *European Planning Studies, 5*, 3–23.

Sassen, S. (2001). *The global city: New York, London, Tokyo*. Princeton: Princeton University Press.

Schamp, E. W. (2010). On the notion of co-evolution in economic geography. In R. Boschma & R. Martin (Eds.) *The handbook of evolutionary economic geography* (pp. 432–449). Cheltenham: Edward Elgar.

Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*, University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship. Urbana, IL, USA.

Sölvell, Ö., Lindqvist, G., & Ketels, C. (2003). *The cluster initiative greenbook*. Stockholm: Ivory Tower.

Sydow, J., Windeler, A., Müller-Seitz, G., & Lange, K. (2012). Path constitution analysis: A methodology for understanding path dependence and path creation. *Business Research, 5*, 155–176.

Tödtling, F., & Trippl, M. (2013). Transformation of regional innovation systems: From old legacies to new development paths. In P. Cooke (Ed.) *Re-framing regional development. Evolution, innovation and transition* (pp. 297–317). Abingdon: Routledge.

Tödtling, F. & Trippl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy, 34*, 1203–1219.

Turok, I. (1993). Inward investment and local linkages: How deeply embedded is 'Silicon Glen'? *Regional Studies, 27*, 401–417.

Uyarra, E., & Ramlogan, R. (2012). *Cluster Policy: A Review of the Evidence, Compendium of Evidence on the Effectiveness of Innovation Policy Intervention*. Manchester. University of Manchester.

Vatne, E. (2011). Regional agglomeration and growth: The classical approach. In P. Cooke, B. Asheim, R. Boschma, R. Martin, D. Schwartz, & F. Tödtling (Eds.), *Handbook of regional innovation and growth* (pp. 54–67). Cheltenham: Edward Elgar.

White, M. C. (2004). Inward investment, firm embeddedness and place. *European Urban and Regional Studies, 11*, 243–260.

Wolfe, D. A., & Gertler, M. S. (2004). Clusters from the inside and out: Local dynamics and global linkages. *Urban Studies, 41*, 1071–1093.

Zucchella, A. (2006). Local cluster dynamics: Trajectories of mature industrial districts between decline and multiple embeddedness. *Journal of Institutional Economics, 2*, 21–44.

Appendix

Table A1. Strategies for ongoing NCE projects in 2015.

Cluster project	Status given	Location of cluster project organization	Members (per December 2015)	Description[a]	Scale and scope	Development strategy
NCE Aquaculture	2007	Bodø, Nordland	27 (17 firm members, six research and development (R&D) members, four public institutions) (2013)	'This aquaculture cluster focuses on value creation and innovation associated with commercial production of farmed fish and seafood for the global market'	'NCE Aquaculture's objective is to become a locomotive in the further development of Norwegian aquaculture, and related activities.'[b]	Hubbing
NCE Instrumentation	2006	Trondheim, Sør-Trøndelag	55	'Situated in Trøndelag, NCE Instrumentation represent cutting edge expertise within the field of sensor technology and advanced control and communication solutions'	Aims to become 'strong in its very specialized niche'[c]	Hubbing
NCE Tourism – Fjord Norway	2009	Bergen, Hordaland	n.a.	'The goal is to make the Fjord Norway region the world's leader in adventure tourism, facilitating strength and the ongoing growth of tourism in Western Norway'	'Based in the four counties of Western Norway, NCE Tourism-Fjord Norway facilitates for innovation in the tourism cluster in collaboration with R&D institutions and public development agencies'[d]	Monocropping
NCE Subsea	2006	Ågotnes, Hordaland	About 130	'The Bergen area in Norway constitutes a world-leading cluster in subsea technology – focusing on the markets for maintenance, modification and operation, as well as innovative and cutting edge technical products'	'Our goal is to promote further development of the Norwegian subsea industry by increasing innovation.'[e]	Hubbing
NCE Culinology	2007	Stavanger, Rogaland	25	'The food cluster in Rogaland's main objective is to strengthen the knowledge platform and capacity for innovation in the field of gastronomy and culinary differentiation for the benefit of Norwegian food production'	'Strategy: • Develop a knowledge platform that focuses on the link between culinary arts and industrial food production. • Apply the knowledge platform innovatively in the development and refinement of products and production methods for the purpose of gastronomic/culinary differentiation • Mobilize the knowledge and ability to innovate to increase added-value and profitability for players along the entire value chain: raw materials, processing, finished products, and sale to end-user.'[f]	Hubbing (Isaksen & Nilsson, 2013)

(*Continued*)

Table A1. (*Continued*).

Cluster project	Status given	Location of cluster project organization	Members (per December 2015)	Description[a]	Scale and scope	Development strategy
NCE Raufoss	2006	Raufoss, Oppland	17 + 41 (17 members including a network consisting of 41 member firms)	'The cluster's core area of activity is the manufacturing of products in lightweight materials by automated production. Today, the main markedts [*sic*] are automative [*sic*] and defence, and the goal is to develop a national resource centre for manufacturing'	'NCE Raufoss is an industrial cluster with the role as the national competence center for light weight materials and automated production in Norway.The main markets for the clusters companies are the global automotive industry, the defence markets and B2B electronics, and strong niches within water & gas distribution, gas tanks, aluminium profiles, mobility aids etc.'[g]	monocropping
NCE Oslo Cancer Cluster	2007	Oslo (capital)	About 70	'This cluster focuses on developing new cancer treatments and diagnostics for the benefit of cancer patients all over the world'	'Oslo Cancer Cluster has core expertise in the field of Immuno-Oncology. The cluster is building an exciting pipeline of novel cancer immunotherapies in preclinical and clinical development – and is well positioned to contribute to the global race in this area.'[h]	Hubbing
NCE Systems Engineering Kongsberg	2006	Kongsberg, Buskerud	32 (16 partners (of which eight are higher education institutions, regional development agencies and public institutions), 16 members)	'The Kongsberg cluster comprises knowledge-based companies, several of which are world leading in demanding industries like subsea, maritime, automotive, aircraft, defence and aerospace industries'	'The group of global technology companies in Kongsberg makes up an industrial expertise cluster. The companies operate in a range of different industries – from maritime, subsea, energy and oil technology to defence, automotives, air and aerospace. The main task of NCE Systems Engineering (NCE SE) is to strengthen the industrial expertise cluster through enhanced technical collaboration, common commitment to innovation, joint research projects, shared skills development and inter-company collaboration within and outside the cluster.'[i]	Blending
NCE Micro and Nano Technology	2006	Horten, Vestfold	57 (23 partners, 14 incubator firms, seven incubator service providers, two cluster network organizations, 10 higher education	'The companies in the cluster comprise the most important commercial arena for micro- and nanotechnology in Norway, and play a leading role in the Norwegian electronics and ICT	'Our strategic priorities: • Expand the regional network to enhance the synergies offered by the cluster	Hubbing

			institutions/regional development agencies/ public institutions)	[information and communication technology] fields'	• Assist cluster companies entering international markets • Expand the domestic and international networks to cultivate collaboration with international experts • Help position the cluster as a leading force nationally and globally • Strengthen the role of product development as a foundation for commercialization • Perform strategic trend and market analyses in collaboration with the cluster company • Establish new educational offerings, industry-focused research centers and infrastructure, after the public private partnership collaboration model.'[j]	
NCE Smart Energy Markets	2009	Halden, Østfold	42	'This cluster develops smart and sustainable energy solutions through innovation and business development. This is achieved through development of expertise by research and development activities as well as close cooperation with the industry and academia'	'The hub is a network of businesses, government bodies and research institutions that cooperate around energy and ICT related activities. Emphasis is on techno-economic models, business intelligence, prosumers and user flexibility.'[k]	Blending
NCE Maritime CleanTech West	2014	Stord, Hordaland	47	'Formerly an Arena Cluster. The Cluster is engaged in building arenas and networks for creating forward-looking, innovative and competitive solutions in the maritime sector that reduce environmentally harmful emissions to air and sea. The activities seek to increase the competitiveness of the petro-maritime cluster in the Bergen/Sunnhordland/Haugesund region'	'Maritime CleanTech West (MCTW) is an independent organisation engaged in building arenas and networks for creating forward-looking, innovative and competitive solutions in the maritime sector that reduce environmentally harmful emissions to air and sea. MCTW's activities seek to increase the competitiveness of the petro-maritime cluster in the Bergen/ Sunnhordland/Haugesund region.'[l]	Hubbing

(*Continued*)

Table A1. (*Continued*).

Cluster project	Status given	Location of cluster project organization	Members (per December 2015)	Description[a]	Scale and scope	Development strategy
NCE Media	2014	Bergen, Hordaland	80	'Formerly an Arena Cluster named "MediArena." The Cluster is a unique collaboration project between global technology corporations, national broadcasters and small, forward-leaning meditech entrepreneurs – all situated in Bergen'	'Vision: The cluster will be a leading international environment for innovation and knowledge within the field of media, with a special focus on visualization technologies for digital media.'[m]	Hubbing

[a]Cluster project descriptions can be found at the NCE webpage (http://nce.no/no/Om-NCE/About-NCE/).
[b]See http://www.nceaquaculture.com/wips/568,630,571/.
[c]See http://ncei.no/strategi/. – authors' translation.
[d]See http://www.fjordnorway.com/no/NCE-Tourism/Om-oss/Om-NCE-Tourism—Fjord-Norway/Malene/. – authors' translation
[e]See http://ncesubsea.no/page/5624/About_us.
[f]See http://www.maaltidetshus.no/nce-culinology-mission-and-objectives-1.
[g]See http://www.nceraufoss.no/en/.
[h]See http://oslocancercluster.no/a-dedicated-oncology-cluster/.
[i]See http://nce-se.no/index.php/about_nce/C132.
[j]See http://www.nce-mnt.no/our-strategic-priorities/.
[k]See http://www.ncesmart.com/info-english/.
[l]See http://mctw.axentaweb.no/content.aspx?page=106294.
[m]See http://ncemedia.no/our-vision/.

Table A2. Structural characteristics of host regions.

				ISIC rev. 4											
Host region (county)	NCE project	Typology	Regional employment, total	Agriculture, forestry and fishing	Industry, including energy	Construction	Distributive trade, repairs, transport., accommodation, food serv. activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific, technical activities, administration, support service act.	Public administration, compulsory secondary school, education, human health	Other services	GDP per capita, index (2012) (national GDP per capita = 100) – (2012)	Unemployment rate (2014)	Percentage of inhabitants above 16 years with a long university or university college education (four years or above)
Nordland	NCE Aquaculture	Predominantly rural remote	113 000	5.000	11.000	9.700	25.600	1.900	1.200	900	6.300	45.500	3.600	87	2.9%	4.7%
				4.4%	9.7%	8.6%	22.7%	1.7%	1.1%	0.8%	5.6%	40.3%	3.2%			
Sør-Trøndelag	NCE Instrumentation	Intermediate	160 000	4.400	14.600	12.600	33.400	5.800	3.800	1.900	19.200	57.300	5.700	97	2.4%	10.4%
				2.8%	9.1%	7.9%	20.9%	3.6%	2.4%	1.2%	12%	36%	3.6%			
Hordaland	NCE Tourism Fjord Norway, NCE Media, NCE Subsea, NCE Maritime Clean Tech West	Intermediate	256 000	4.800	35.100	19.700	56.400	7.400	5.800	3.000	27.500	85.000	8.800	105	2.3%	9.1%
				1.9%	13.7%	7.7%	22%	2.9%	2.3%	1.2%	10.7%	33.2%	3.4%			
Rogaland	NCE Culinology	Intermediate	249 000	7.300	54.000	19.600	53.700	6.700	2.800	1.900	26.800	69.200	7.400	106	2.2%	8.9%
				2.9%	21.7%	7.9%	21.6%	2.7%	1.1%	0.8%	10.8%	27.8%	3%			
Oppland	NCE Raufoss	Predominantly rural remote	87 000	4.800	8.700	7.400	19.200	2.100	900	680	5.100	33.100	3.300	81	2.2%	4.8%
				5.5%	10%	8.5%	22%	2.4%	1%	0.8%	5.9%	38%	3.8%			
Oslo	NCE Oslo Cancer Cluster	Predominantly urban	462 000	360	18.800	30.000	105.700	41.100	18.900	6.300	68.300	144.600	26.400	122	3.4%	18.3%
				0.1%	4.1%	6.5%	23%	8.9%	4.1%	1.4%	14.8%	31.3%	5.7%			
Buskerud	NCE Systems Engineering Kongsberg	Predominantly rural remote	130 000	3.000	18.000	12.100	30.000	2.200	1.400	1.300	11.700	43.000	4.600	92	2.9%	6.7%
				2.3%	13.8%	9.3%	23.1%	1.7%	1.1%	1%	9%	33.1%	3.5%			
Vestfold	NCE Micro and Nano Technology	Intermediate	105 000	2.000	13.300	9.000	25.600	2.700	900	1.200	9.200	36.900	3.500	90	3.2%	6.0%
				1.9%	12.7%	8.6%	24.4%	2.6%	0.9%	1.1%	8.8%	35.1%	3.3%			
Østfold	NCE Smart Energy Markets	Predominantly rural remote	120 000	2.600	16.000	11.300	26.800	2.400	1.300	1.200	9.900	43.300	3.900	86	3.8%	4.9%
				2.2%	13.3%	9.4%	22.3%	2%	1.1%	1%	8.3%	36.1%	3.3%			

Notes: The most appropriate spatial level for demarcating cluster projects is the county level. The table illustrates regional industry structures through absolute employment numbers (2013) in ISIC (International Standard Industrial Classification of All Economic Activities, rev. 4) industry categorizations and also includes some contextual variables on regional gross domestic product (GDP) per capita, unemployment rate and level of higher education. The regions are classified according to the Organisation for Economic Co-operation and Development's (OECD) typology of regions. All Norwegian regions (counties) are classified as 'small region' by the OECD. Data sources: OECD Statistics: data sources are regional gross domestic product (GDP) per capita and education level data. Statistics Norway: employment in different categories is given as absolute numbers and as the percentage of total regional employment.

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VI

VII

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