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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, & Zyglidopoulos, 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 & Tripl, 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 & Trippel, 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 2015¹ 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 (Crescenzi 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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Note

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.

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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 Culimology	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: <ul style="list-style-type: none"> • 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 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 markets [sic] are automotive [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.' ⁸	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, automotive, 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: <ul style="list-style-type: none"> Expand the regional network to enhance the synergies offered by the cluster 	Hubbing

<p>institutions/regional development agencies/ public institutions)</p>	<p>[information and communication technology] fields'</p>	<ul style="list-style-type: none"> • 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.⁹⁾ 	<p>•</p>
<p>NCE Smart Energy Markets</p>	<p>2009</p>	<p>Halden, Østfold</p>	<p>42</p>
<p>NCE Maritime CleanTech West</p>	<p>2014</p>	<p>Stord, Hordaland</p>	<p>47</p>

(Continued)

Table A1. (Continued).

Cluster project	Status project given organization	Location of cluster organization Members (per December 2015)	Description ^a	Scale and scope	Development strategy
NCE Media	2014	Bergen, 80 Hordaland	‘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

^aCluster project descriptions can be found at the NCE webpage (<http://nce.no/no/Om-NCE/About-NCE/>).

^bSee <http://www.nceaquaculture.com/wips/568,630,571/>.

^cSee <http://ncei.no/strategi/>. – authors’ translation.

^dSee <http://www.fjordnorway.com/no/NCE-Tourism/Om-oss/Om-NCE-Tourism—Fjord-Norway/Malene/>. – authors’ translation

^eSee http://ncesubsea.no/page/5624/About_us.

^fSee <http://www.maalfidetshus.no/nce-culinology-mission-and-objectives-1>.

^gSee <http://www.nceraufoss.no/en/>.

^hSee <http://oslocancercluster.no/a-dedicated-oncology-cluster/>.

ⁱSee http://nce-se.no/index.php/about_nce/C132.

^jSee <http://www.nce-mnt.no/our-strategic-priorities/>.

^kSee <http://www.ncesmart.com/info-english/>.

^lSee <http://mctw.axentaweb.no/content.aspx?page=106294>.

^mSee <http://ncemedia.no/our-vision/>.

Table A2. Structural characteristics of host regions.

Host region (county)	NCE project	Typology	Regional employment, total	Agriculture, forestry and fishing	Industry, including energy	Construction	Construction activities	Food serv. activities	Accommodation, transport, trade, repairs	Distributive trade, repairs, transport, accommodation, food serv. activities	Information and communication activities	Real estate activities	Financial and insurance activities	Professional, scientific, technical activities, administration, support service activities act.	Public compulsory secondary education, school, human health	GDP per capita, index (national GDP per capita = 100) – services (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%		
Sør-Trøndelag	NCE Instrumentation	Intermediate	160 000	4 400	14 600	12 600	33 400	5 800	3 800	1 900	19 200	5 700	97	2.4%	10.4%			
Hordaland	NCE Tourism	Intermediate	256 000	4 800	35 100	19 700	56 400	7 400	2 900	3 600	27 500	85 000	105	2.3%	9.1%			
Rogaland	NCE Culinary	Intermediate	249 000	7 300	54 000	19 600	53 700	6 700	2 300	1 200	10 700	69 200	106	2.2%	8.9%			
Oppland	NCE Raufoss	Predominantly rural remote	87 000	4 800	8 700	7 400	19 200	2 100	1 100	0 800	10 800	27 800	81	2.2%	4.8%			
Oslo	NCE Oslo Cancer Cluster	Predominantly urban	462 000	360	18 800	30 000	105 700	41 100	1 800	6 300	68 300	144 600	122	3.4%	18.3%			
Buskerud	NCE Systems Engineering	Predominantly rural remote	130 000	3 000	18 000	12 100	30 000	2 200	4 100	1 300	11 700	43 000	92	2.9%	6.7%			
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	90	3.2%	6.0%			
Østfold	NCE Smart Energy Markets	Predominantly rural remote	120 000	2 600	16 000	11 300	26 800	2 400	0 900	1 300	9 900	43 300	86	3.8%	4.9%			

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.