Routledge
Taylor & Francis Group

Norsk Geografisk Tidsskrift - Norwegian Journal of Geography

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/sgeo20

Field analysis of industrial development in a peripheral region of Norway

Roger Normann, Mikaela Vasstrøm & Hans Chr Garmann Johnsen

To cite this article: Roger Normann, Mikaela Vasstrøm & Hans Chr Garmann Johnsen (2022) Field analysis of industrial development in a peripheral region of Norway, Norsk Geografisk Tidsskrift - Norwegian Journal of Geography, 76:2, 69-81, DOI: 10.1080/00291951.2022.2065356

To link to this article: https://doi.org/10.1080/00291951.2022.2065356

Norsk Geografisk Tidsskrift–Norwegian Journal of Geography
2022, VOL. 76, NO. 2, 69–81
https://doi.org/10.1080/00291951.2022.2065356

Field analysis of industrial development in a peripheral region of Norway

Roger Normann[1], Mikaela Vasstrøm[2] & Hans Chr Garmann Johnsen[3]

[1]School of Business and Law, University of Agder, Kristiansand, Norway;
[2]Department of Global Development and Planning, University of Agder, Kristiansand, Norway;
[3]Department of Working Life and Innovation, University of Agder, Kristiansand, Norway

ABSTRACT

The paper explores how industrial development can occur in a peripheral region through the gradual development of strategic coherence between organisations, materiality, and agency. In a longitudinal case study of how the mechatronics industry became a main area for regional development spanning 50 years in the region of Agder in Norway, the authors have followed how national and regional innmovation policies, individual actors, and organisational strategies eventually flow together and influence organisations and firms to collaborate towards new and shared aims. In the paper, the authors perform field theory analysis, with emphasis on the significance of the development of reciprocal relations between institutions, understood as authorities, businesses, and universities, and strategic agency within and between strategic action fields. They question how industrial development in a peripheral region can be understood through a strategic action fields framework. The findings reveal that development of the industry spanned the evolution from small-scale entrepreneurial engineering activities in the 1960s to a regional innovation system and National Centre of Excellence with global knowledge hub ambitions in the 2010s. In conclusion, the analysis shows how mechatronics achieved a central role in regional development through common action between previously decoupled academic and industrial strategic action fields.

ARTICLE HISTORY
Received 29 September 2021
Accepted 8 April 2022

EDITORS
Arnt Fløysand; Catriona Turner

KEYWORDS
industrial development, innovation policy, peripheral region, strategic action fields, strategic agency

Normann, R., Vasstrøm, M. & Garmann Johnsen, H. Chr. 2022. Field analysis of industrial development in a peripheral region of Norway. *Norsk Geografisk Tidsskrift–Norwegian Journal of Geography* Vol. 76, 69–81. ISSN 0029-1951.

Introduction

One of the fundamental problems in our understanding of spatial economies is how economic development occurs. In recent decades, academic work in fields such as innovation studies, entrepreneurial research, economics, and geography has provided a wide range of dimensions that are known and proven to be important for stimulating economic development. However, the research has shown that there are no context-independent paths to success (Tödtling & Trippl 2005). Understanding the drivers and mechanisms of industrial development and economic growth has been an enduring matter of interest in policy formation and research on different scales and across different disciplines for centuries. Today, one of the fundamental problems in our knowledge of spatial economies is how to understand and unpack the complexity of how desired developments occur in practice. Literature in the field provides examples of how regions and nations that have succeeded in stimulating economic development often have a particular mix of policies, regulations, culture, history, human and social capital, agency (leadership), resources, technology, industrial structure, spatial environments, and entrepreneurial activity that is difficult to replicate through policy intervention. The complexity this represents means that to determine ex ante the drivers of economic growth and development in and for any national and regional economy is still a fundamental research problem (Stoica et al. 2020).

Within both economic geography and research on regional innovation systems there is an ongoing search for understandings of regional development. Boschma (2015) argues that the central task in economic geography is to identify the determinants of a region's ability to

CONTACT Mikaela Vasstrøm mikaela.vasstrom@uia.no

develop new growth paths. Following Martin (2012), who argues that the long-term adaptive capacity of regions is still largely unresearched, Isaksen & Trippl (2017) emphasise that such processes and capacities differ in relation to the regional institutional thickness and proximity. Peripheral regions are characterised by less diverse and more dispersed industrial and governmental structures and institutions than other regions. Such regions lack key development assets related to knowledge specialisation and organisational capacities to further innovation and growth of new industrial paths (Isaksen & Trippl 2017). Thus, regional development is not only a generic term in a fertile theoretical landscape but also a deeply contextually (and historically) embedded empirical matter.

Within economic geography a renewed focus argues for the need and advantage of empirical grounding and contextual approaches for both theoretical development and societal relevance (Asheim 2020). This requires theoretical approaches that are context-sensitive and acknowledge the importance of particularities, differences, and contingency but that should also be able to theorise and retheorise empirical findings (Gong & Hassink 2020).

If we leave large-scale state interventions out of the equation, it is rare that economic growth and industrial developments in a region can be traced back to a single actor, institution, or decision. In retrospect, such developments can often seem organic, emergent, and even random when actors and organisations in a region 'suddenly' started to develop and utilise competences and resources in new and novel ways, and that later that attracted private investment, policy support, and labour. In this respect, industrial development should be understood as contextually embedded processes that require network development, governance, sustained effort, and strategic collaboration between agency and across institutional spheres and administrative borders (Normann 2013).

In the regional development and innovation literature there is an ongoing debate on how to conceptualise and understand the role of agency. We understand agency as an 'action or intervention by an actor to produce a particular effect' (Isaksen et al. 2019, 4). Institutional entrepreneurship and the role of agency have gained much attention in relation to new path development (Sotarauta et al. 2012; Beer 2014; Beer & Clower 2014; Sotarauta 2014; Audretsch 2015). Furthermore, the role of institutions and different types of institutional agency have been conceptualised as influential in regional development and path transformation (Isaksen et al. 2019; Miörner 2020a; 2020b).

In this paper we employ a field theory approach to understand the dynamics of how, in a peripheral region, strategic action fields emerge, evolve, and change, and how they provide the region with new industrial development trajectories. We ask: *How can industrial development in a peripheral region be understood through a strategic action fields framework?* The field analytical approach enables an understanding of critical events that influence changes in regional fields, understood here as the contextually embedded and historically contingent industrial development processes. It also allows us to understand the dynamics between microlevel and macrolevel processes.

The characteristics of the context of development, the region, are important because they tell us something about the resources and institutional capabilities that are either exogenous or endogenous to that region. They also tell us something about the collaborative patterns in the regional governance system. In peripheral regions most of the resources must be aligned towards a shared goal in order to succeed with industrial development results, such as those discussed here. In thicker and more diversified regions, several development trajectories can be supported simultaneously, due to a broader knowledge base and absorptive capacity (Trippl et al. 2018).

Our study is based on a case from the county of Agder, which also forms the southernmost administrative region in Norway. Agder is an example of a rural region with a less developed research and innovation system than other regions in the country (Isaksen & Trippl 2017). Therefore, we call it a peripheral region. In our study, we explore how strategic action fields composed of regional actors and organisations (in our case, public government, higher education and research institutions, multinational and national companies, and entrepreneurs, among others) initiate, promote, and adapt to changes, thereby enabling a new development trajectory. Our analysis reveals relational dynamics within and between these strategic action fields. We trace the development of mechatronics as an emerging competitive competence that is influencing the development and renewal of a petroleum and gas supply chain industry in the region. The analysis also reveals how divergent and initially disconnected regional strategic action fields merged into a coherent regional industrial development.

Strategic agency in regions

In a regional governance system, power and decision-making authorities, as a typology, share features in common with the network and to a lesser degree with a hierarchy or a market (Powell 1990). This means that the basic organising principle in a region is

horizontal and non-hierarchical. It has been argued that leadership in regions differs in nature from conventional modes of leadership developed for the corporate world, as the means to power are mainly indirect (Sotarauta 2014). Therefore, the role of agency in regions can be understood as 'a role involving steering, coordination, and the influencing of societal developments across social spheres and administrative-, sectorial-, territorial-, and institutional borders' (Normann 2013, 25). It follows that regional leaders are skilled social actors (Normann et al. 2017; Pinheiro & Normann 2017; Miörner 2020a). Fligstein & McAdam (2012) state that socially skilled actors are individuals who possess a highly developed cognitive capacity for reading people and environments, framing lines of action, and mobilising people in the service of broader conceptions of the world and themselves to fashion shared worlds and identities. Understanding agency in regions in this way refers to management of one specific organisation that is able to influence developments in *strategic action field* that can transcend institutional and organisational borders.

Field theory

Fields are constructed social orders in which actors interact with one another based on a shared (not necessarily consensual) understanding of their purpose (Fligstein & McAdam 2012). In this paper we use a field theoretical framework to approach the relationship and dynamics between macrolevel institutional change and microlevel agency-led processes. Field theory has been used in similar ways in a broad range of societal, institutional, and organisational studies since the early 1960s. The seminal and original contribution is the study of force field analysis in action research by Lewin (1951). However, it should also be noted that research on social fields can be found in anthropological studies (Grønhaug 1978) and in the work of Bourdieu (1977). It was reinterpreted and developed by new institutionalists as institutional sectors (Scott & Meyer 1983), organisational fields (DiMaggio & Powell 1983), and networks (Powell et al. 2005). Field is also an analytical component in regional innovation studies (Fløysand & Jakobsen 2010) and the study of the emergence of regional leadership (Normann et al. 2017). However, it is through the works of Neil Fligstein and Doug McAdam that field theory has been operationalised as a comprehensive sociological theory that accounts for macrolevel, mesolevel, and microlevel dynamics through the concept of *strategic action fields* (Fligstein & McAdam 2011; 2012).

Fields are representations of a social system that has a given scale and complexity. Scale is a designation of the size of an institutional unit (the field) and its extension in social space. Complexity refers to the number of roles and the combination and permutation of roles (Grønhaug 1978). A field's scale and complexity are dimensions that can be indicative of the extent to which the actions of individual actors can be transformative and can influence systems change. Fields are institutional spaces, meaning they are domains with associated knowledge, skills, and norms that influence and/or coordinate actor behaviour. Fields are connected to other proximate fields that they can be influenced by and/or influence or develop interdependence with, and with which it is possible for them to converge. This means that interactions between actors in social relations can turn into a new field, given that they are sustained and reach a certain level of influence and new interdependency. Fields can only be said to exist when they have the strength to influence actor behaviour (Grønhaug 1978). Fløysand & Jakobsen (2010) argue that social fields are a product of repetitive interaction of a certain historic duration, and that they are different from networks and social capital in that they pay attention to the time-spatial scale of social relations. Fields as emergent social networks and/or systems influence actor behaviour, and it is actor interactions and practices in a field that produce new intersubjective knowledge, which becomes the field-specific knowledge, which in turn influences actor behaviour. Such continued reciprocations between actors, organisations, and knowledge both sustain and mould the domain of a given field. In this sense, fields are not directly negotiated, nor do they consist of stable discourses, but they are in continuous motion and continuously morphing. Fields represents constraints and opportunities for agency action and consist of both dominated and dominating elements. Fligstein & McAdam (2012) label such elements as incumbents and challengers. Incumbent power in strategic action fields is closely connected to control of what Fligstein & McAdam (2012) label 'internal governance units', which can be understood as control over some type of resource administrative that often naturalises the logic and rules of the field. Internal governance units represent organisational resources that are both controlled by and aid incumbents. Incumbent power also stems from some measure of control of both informal and formal knowledge production. Fields are embedded in a complex web of other fields. We can distinguish between distant non-influencing fields, independent fields, and proximate dependent and interdependent fields. In this paper, we understand incumbent field positions as positions held by actors or organisations that influence resource and knowledge

flow and influence the development of discourses in proximate fields.

Exploring relations between microlevel and macrolevel processes is a fundamental problem in social science. There are many approaches to this question in the literature (Coleman 1990). A social situation represents some situational mechanisms, constraints, and opportunities, which actors – given their intentions, values, knowledge, and resources – can be influenced by and/or can act in relation to them. Put simply, such actions can be transformative and lead to systems change. In this paper, we operationalise such actions as those taken by agency in incumbent field positions. This entails strategic actions to chart relevant actors and organisations at both national and regional level, and to develop reciprocal and interdependent relations across actors in existing regional fields. When sustained, such actions can be transformative and lead to systems change, such as the emergence of new fields. The material effects can be observable through changes in power, leadership, institutional strategies, and public discourse.

Based on the above-presented theoretical foundation, we apply a model that holds that actors at microlevel in a region can together form a strategic action field at mesolevel. Furthermore, coherence between several strategic action fields can enforce regional development (i.e. macrolevel change).

Methods

We have participated in a series of research projects and governmental programmes related to the regional development of the county of Agder (Johnsen et al. 2016). In this paper we employ a single case-study research design (Yin 1994) with several data sources. We collected various types of current documents and archival records: national White Papers and Green Papers related to industrial development, regional strategy and/or planning and policy documents, university strategies, and industry cluster strategy documents, and annual grant summaries from the largest regional development fund (Sørlandets Kompetansefond n.d.). The main data source is 15 structured interviews held in person, in Norwegian, with key regional stakeholders in spring 2015: regional engineering entrepreneurs (some of whom were pioneers), mechatronics industry CEOs, university academic leadership, university administrators, university mechatronics researchers (some of whom were pioneers), regional funding representatives, regional politics representatives, and cluster managers. The participants were selected and grouped such that they were representative of and could tell their stories of the academic mechatronics field and the industrial mechatronics field. In addition, we identified participants who could inform about the current situation but who were also actors within the different fields that were part of the earliest developments in industry and academia, and who had knowledge about the history in full. The interviews were based on an interview guide concerned with the history and growth of mechatronics in the region, collaborations across organisations, important actors, barriers, drivers, turning points, and future perspectives. Each interview lasted c.1 hour and all interviews were transcribed in full and translated by the authors. The transcriptions were compared with written sources and strategy documents (Agder University College 2001; Universitetet i Agder 2012; Brautaset 2014; *Regionplan Agder* 2020; Sørlandets Kompetansefond n.d.).[1] The collected data allowed us to trace the development from the mid-1960s until 2015. Based on our theoretical understanding of region, agency, and strategic action fields, the initial empirically grounded analysis enabled us to identify two distinct and proximate strategic action fields in the Agder region. We have labelled these the *academic* mechatronics field and the *industrial* mechatronics field. The evolution of the macrolevel and microlevel dynamics of these fields is presented in the next section.

Mechatronic field developments in the Agder region in the period 1965–2015

The Agder region is located at the southern tip of Norway c.200 km south-west of Oslo and c.200 km south-east of Stavanger. Several industrial sites are dispersed along the entire coastline. The petroleum-related supply industry is located mainly in the vicinity of the regional capital of Kristiansand. The university is currently divided into two campuses, located 40 km apart: the main campus in Kristiansand, and the Faculty of Engineering and Science and emerging technology laboratories located in Grimstad.

National policy context

In December 1969, the operators of the drilling rig Ocean Viking found commercial oil deposits in Ekofisk, 320 km south-west of Stavanger, and the

[1]Additionally, an unpublished document was used for comparison, with the title '"Felles mål på Agder":Et tiltaksprogram for Sørlandet' edited by V.D. Norman, J.P. Knudsen, and H. Røed, and dated October 1994.

event marked the start of the Norwegian oil adventure. Ekofisk production started in 1971 and the field became one of the largest fields on the Norwegian continental shelf. Over the next 40 years the petroleum sector became Norway's largest industry, measured in terms of value creation, revenues to the state, and export value.

The significance of the Norwegian oil and gas industry is evident from the way that Norway developed from one of the poorest nations in Europe in the 19th century to become one of the richest nations per capita in the world at the beginning of the 21st century. The UK, Denmark, and the Netherlands all started to exploit oil and gas resources in the North Sea in the 1960s and 1970s. However, Fagerberg et al. (2009a) argue that the transformative effect was most significant in the Norwegian economy. They explain this by pointing to how public policy in Norway successfully facilitated the development of a huge market for manufacturing and services, which Norwegian firms successfully exploited. Consequently, Norwegian firms in shipbuilding, engineering, and ICT were able to develop and expand. One of the industrial pioneers in the Agder region emphasised the importance of the national policy as having given Norwegian industry actors the ability to take risks and develop new products and services for the emerging industry. Fagerberg et al. (2009a) contrast the situation in the Norwegian economy to the Dutch economy, where oil and gas exploits have led to increased public expenditures, de-industrialisation, and loss of competitiveness – the 'Dutch disease'. In Norway, the mainland economy grew more rapidly than would otherwise have been the case (Larsen 2005). The rapid increase in income also enabled Norway's government to pursue more expansionary fiscal and monetary policies than other Western European governments during the economic hardships of the late 1980s and early 1990s, with the consequence that labour force participation and economic growth were consistently higher than in Western Europe as a whole. Thus, Norway succeeded in developing a competitive petroleum-related supply industry (Fagerberg et al. 2009b).

Throughout the 1980s, the Norwegian Government continued its attempts to stimulate related parts of the Norwegian economy. The rapid fall in oil prices in the 1980s both increased the oil and gas industry's focus on costs in development projects and stimulated them to develop new and more cost-effective technologies. However, it also spurred the Norwegian Government to prioritise R&D in oil and gas related activities. Already in 1986, 20% of all Norwegian R&D was directly related to the oil and gas industry (Brundtland 1987).

Development of an industrial mechatronics field

In the late 1960s the emerging oil industry represented a new opportunity for Norwegian firms and entrepreneurs, even though at the time they lacked specific competence and experience in the oil and gas industry. The opportunity for industrial development was initially related to technologies for hydraulic systems and electronic steering of drilling and rigs. This led to the emergence of mechatronics, which can be defined as a comprehensive system for sensor control of different types of mechanical operations:

> The field of mechatronics is not clearly defined. The word originates from Japan in the early 1970s. However, today, mechatronics refers to the mechanical and electrical components in a system to be controlled and regulated in a desired pattern. Therefore, sensor technology, programmable microprocessors, and control technology are important. Very basically, mechatronics is an interdisciplinary area of engineering science that combines mechanical engineering, electrical engineering, and information technology. (Mechatronics pioneer, University of Agder)[2]

In the Agder region, the small firm Hydralift, which had competence in oil hydraulics in the late 1960s, started to orient itself towards the new and emerging market. The firm struggled to gain access to the market in the beginning, with only a handful of employees, but gradually gained trust and entered the market for cranes, winches, and rigs, and eventually equipment for oil drilling (Brautaset 2014). One of the entrepreneurs who was central in that development described how the firms collaborated with customers, as follows: 'During those early decades the industry developed knowledge "on the ground" between engineers' and customers' learning by doing. The goal was to see whole system solutions and to improve those systems incrementally' (Regional (pioneer) engineering entrepreneur). The efforts of the regional actors were also supported directly via an umbrella company (Oil Industry Services A/S), that was set up by the Norwegian Government to support Norwegian firms' efforts to gain contracts in the new industry. In the early 1970s, Maritime Hydraulics A/S, a spin-off company from Hydralift emerged (Brautaset 2014). The company developed in the 1970s and 1980s through a series of acquisitions, mergers, and organic growth. Most notably, national corporations acquired positions in the late 1980s and multinational corporations followed suit in the early 2000s.

In the Agder region it took the oil supply industry 35 years to grow from 0 to 1800 employees and to reach EUR 625 million in turnover (1968–2003), and only

[2]The authors of this article are responsible for all translations of quotations into English.

eight more years to reach 10,000 employees and EUR 5625 million in turnover in 2011. The main reason for the rapid growth was the sharp rise in oil prices in the first decade of the 2000s, a rise that historically has been matched only two times (BP 2021, 28).

Firms in the Agder region were not equally positioned to utilise the rise in oil prices. The largest of the multinational corporations (MNCs) that enter the region in the early 2000s was National Oilwell Varco (today, NOV Inc.). NOV introduced a new business model for the oil and gas supply industry in the region. When NOV bought Hydralift in 2002 and established itself in the Agder region it was approximately the same size as the Norwegian firm Aker, which had established itself in the same region a decade earlier. By 2012, NOV was the dominating firm in the region and ten times bigger than Aker. The explanation is that it was able to utilise large global networks, value chains, and industrialisation competence. Whereas other firms primarily make one-off customised products, NOV's business model is mass production and to sell their wares in bulk.

Another important organisational development in the early 2000s was the establishment of the NODE cluster in 2005. NODE (Norwegian Offshore & Drilling Engineering) is a business cluster within the oil and gas industry. The cluster manager succeeded in ensuring commitment from the largest MNCs in the Agder region. Early on, the NODE cluster, in collaboration with the industrial partners, identified mechatronics as a common dominator for the development of the firms in the cluster. The cluster also developed a knowledge base and R&D competence in the region, primarily through influencing the strategies of the newly formed University of Agder. Additionally, NODE lobbied for national and regional policy support for its strategy.

Development of an academic mechatronics field

Agder engineering and district college (Agder ingeniør- og distriktshøgskole) was established in 1967 as a technical school. In 1994, as part of a national reform, it became a faculty at Agder University College. In 2007, Agder University College gained status as university. Courses in oil hydraulics had been provided at the college in 1971 and later in 1977 they were institutionalised as an optional course for a bachelor's degree in engineering. In the late 1980s mechatronics became a specialisation in the bachelor's degree programme in mechanical engineering. K. Brautaset, one of the pioneers and driving forces behind that development wrote a textbook on oil hydraulics (Brautaset 1983). Just after 2007, when the university status was secured, a master's degree programme in mechatronics was developed, and later mechatronics became a topic in the PhD programme at the University of Agder (Brautaset 2014). However, developing mechatronics engineering was not a core strategy of the university until the late 2000s, and Agder University College had not prioritised mechatronics as a discipline in the process of developing the first four PhD programmes to gain university status. In the Faculty of Engineering and Science, ICT was supported and developed into a PhD programme, not mechatronics.

Agder University College and the mechatronics industry in the region had only limited collaboration prior to the establishment of the NODE cluster. Key actors at the university and in the industry did not even know each other: 'There was very little collaboration with the university until the 2000s. There was no platform for collaboration. The industrial development was done in the industry, buy now with the SFI [Centre for Research-based Innovation],[3] this is changing' (CEO, mechatronics industry). The NODE cluster increased the university's capabilities in mechatronics by influencing the teaching programmes. From having a generic approach to mechatronics, the programmes became more oriented towards the oil and gas industry. When representatives from the NODE cluster first addressed the university, there were relatively few mechatronics students (8–12) and the university struggled to fill the 20 available student places. Four renowned professors in mechatronics were recruited and offered part-time positions in firms within the NODE cluster. At the same time, there was institutional integration between the NODE cluster and the university. When mechatronics developed into a prioritised R&D area at the university, firm representatives were given positions on the board of the Faculty of Engineering and Science, and university representatives were given positions on NODE's board of directors. The initial regional success of the NODE cluster, combined with the rapid growth of the firms in the cluster on a national and global scale, underpinned the rise of the cluster organisation in the Norwegian cluster hierarchy. NODE gained National Centre of Excellence (NCE) status in 2009 and Global Centre of Excellence (GCE) status in 2014. In 2015, the University of Agder and industrial partners applied and received funding for a national centre for research-based innovation – SFI

[3]SFI Offshore Mechatronics (2015–2023), which has the goal of developing industry-relevant components within motion compensation, hydraulics, robotics, and automation and monitoring techniques (Universitet i Agder 2015).

Offshore Mechatronics – worth approximately EUR 25 million, as well as national funding for a mechatronics innovation lab worth c. EUR 13 million (Universitet i Agder n.d.). The dean of the Faculty of Engineering and Science, who was also the project manager stated on the SFI application in 2015, later became the rector of the University of Agder. Thus, it seems that the University of Agder, has benefited at least in some form from the collaboration with the mechatronics industrial field. One of the participants in our study described the relationship between University of Agder and the regional clusters as follows:

> The cluster projects in the region have made it easier for the university to collaborate with regional firms when they agree on common themes such as mechatronics. […] The close ties with industry also give the university a bargaining position with the Research Council of Norway compared with the 'old' universities with larger academic milieus. (Research manager, University of Agder)

Mechatronics development and the regional policy context

Regional development policies and government in the Agder region paid little or no attention given to the emerging industry and its potential for industrial development in the first 40 years of the industry's presence in the region: 'In the seventies and eighties there was no regional collaboration. There was nobody to collaborate with' (Mechatronics entrepreneur). This was contrary to the regional development policies and to regional and municipal agency in the neigbouring county of Rogaland. In the late 1960s, the mayor of Stavanger, the main city in the Rogaland region, fought hard with authorities in the cities of Bergen and Trondheim (respectively the second and third largest cities in Norway) and succeeded in establishing Stavanger as the oil capital of Norway. The situation in the city of Kristiansand in the Agder region was different. Even though the city was sited nearer to the oil fields and had very good harbour facilities, the city council at the time declared that the city was not interested in the oil industry (Sandvik 1999; Hidle & Normann 2013).

In 1994, the first regional planning document for the Agder region was developed (see footnote 1). The 14-page document contained a description of the challenges facing the region, and suggested solutions to those problems. It became the key foundation for policy development in the region in the next 10 years. Three main policy areas were identified in the document: *competence* (as in learning economy), *culture* (as in place attractiveness), and *communication* (as in physical infrastructure and ICT) (Normann 2007). Furthermore, the document predicted that the regional industry would be outcompeted due to increased globalisation and competition from Asia and Eastern Europe: 'One should expect decline in employment within many of the traditional industrial enterprises in the region – especially within energy-intensive industries' (p. 2 in the unpublished document referred to in footnote 1).

However, after the NODE cluster was established in 2005, regional policymakers were able to observe an exponential growth in the oil and gas supply industry in the Agder region. The growth resulted in increased political and economic support, both to firm projects and for cluster development initiatives. The NODE cluster gained increased funding from regional funds. Figure 1 has been compiled on the basis of annual statements for the years 2005–2014 inclusive and grant summaries from the largest regional development fund, Sørlandets Kompetansefond (n.d.), and it illustrates how economic support from this major regional funding agency developed in the same period.

A couple of trends are worth noting based on the yearly funding reports (2005–2014) of Sørlandets Kompetansefond. First, the funding for R&D organisations was primarily aimed at supporting the University of Agder in its efforts to obtain status as a university. Support for R&D organisations was reduced from EUR 3.6 million in 2005 to EUR 75,000 in 2014; other areas that were reduced in the period were ICT and culture, which were respectively supported by EUR 820,000 and EUR 168,000 in 2005, and by 2014 that support was reduced to EUR 0 and EUR 62,000 respectively. Second, the industries that gained support in the period 2005–2014 were process industries and mechatronics. Process industries increased from EUR 167,000 in 2005 to EUR 707,000 in 2014, while mechatronics increased from EUR 235,000 in 2005 to EUR 886,000 in 2014.

The NODE cluster was instrumental in developing an academic mechatronics field and, arguably, it played a similar role in developing increased policy attention to the mechatronics field in the region. One study participant described the role of the cluster manager as follows:

> [The cluster manager] was brilliant when he formed NODE. It created a platform for collaboration between companies and for speaking to the politicians. It also led the way for the SFI. NODE is an important entity that has created a regional force and shown the politicians that we are world leading, and it has shown the international actors that this region is world leading and that they cannot afford to move out of this region. (CEO, industry)

It is worth noting that the NODE cluster also played a mediatory role between national and regional innovation policies, where it first gained national recognition through advances in the national cluster programme

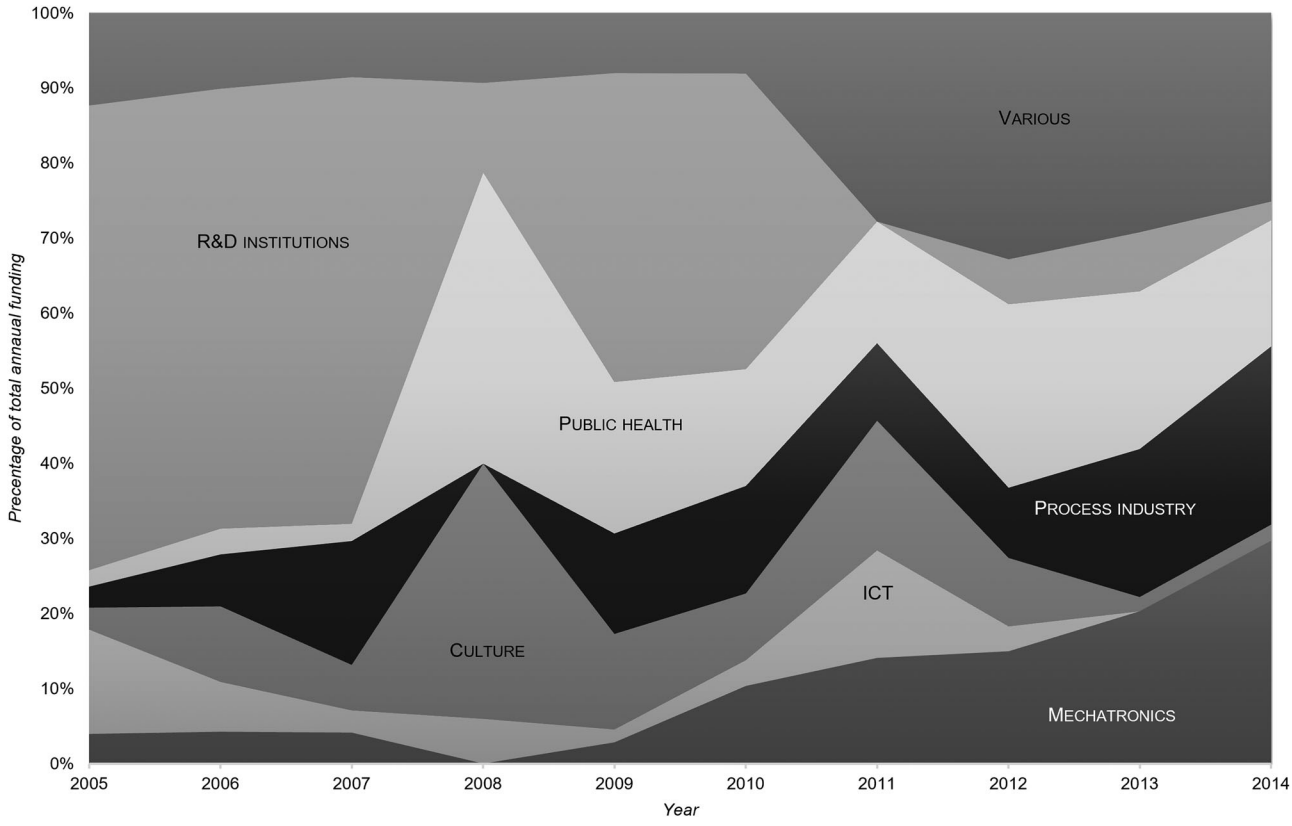

Fig. 1. Regional funding development in the Agder region in the period 2005–2014 (based on 10 annual reports by Sørlandets Kompetansefond for the years 2005–2014 (Sørlandets Kompetansefond n.d.))

hierarchy, which in turn was used to increase regional funding and political attention.

Field analysis of industrial development

Regional development in the Agder region has previously been explained with emphasis on the regional innovation system, including national innovation policies (Isaksen & Trippl 2017). Our focus is on how *strategic action fields* evolve and converge over time as they adapt to changes in markets, technology, and policy. Based on this we identify three phases (I–III) with particular characteristics and critical events that induced transitions between phases and led to regional development.

Phase I, 1965–1989: state-supported entrepreneurship

The critical event in Phase I was the discovery of commercial oil deposits in the North Sea in combination with interventionist state policies that enabled Norwegian entrepreneurs and industries to take risks and develop the necessary competence and know-how. At that time, the industry was characterised by entrepreneurial activities, start-ups, and established mechanical engineering firms that reoriented themselves towards the emerging oil and gas market. In the industrial mechatronics field, the entrepreneurs were incumbents and set the development agenda. The mechatronics industry was relatively small, and we do not have any data describing the activities of challenger groups within the field in the period 1969–1989. The academic mechatronics field was small in the same period and was only represented by limited teaching activities at the engineering and district college (Agder ingeniør- og distriktshøgskole) and the research interests of a few academics. Also, some of the students who had taken courses in mechatronics were hired in the regional industry. However, there was little or no contact between the academics and people in the industrial mechatronics field. The regional policymakers did not take any active part in supporting the development of the mechatronics industry and no regional policymaking was of significance for the development of mechatronics-related industries.

Phase II, 1990–2004: national and multinational industry actors

The critical event in Phase II was the rapid fall in oil prices in the late 1980s (BP 2021, 28). The fall made regionally owned oil and gas supply firms the target of

national acquisitions. It also meant that new types of competence and resources supplemented the local knowledge bases. Several firms expanded their activities and established themselves in the Agder region in the period 1990–2004. Firms that remained regionally owned positioned themselves in the supply chain of larger firms. There was little or no contact between Agder University College and the mechatronics industry. At the university college, mechatronics was developed further as an academic discipline and became a specialisation in the bachelor's degree programme in engineering. However, both internal and external funding at the college were being funnelled towards ICT, management, linguistics, and mathematics, which were the first fields in which University of Agder offered PhD programmes. At national level, there was strong support for oil and gas related industries. National funding for research and tax incentives to support the continuous development of the mechatronics industry were prioritised. Given Norway's increased dependence on oil and gas revenues, the relationship between the oil and gas related industries and the national policy level can be described as interdependent. Active regional policymaking emerged but was not focused on industrial development; rather, its focus was on what has been popularised as the three C's – competence, culture, and communication – in anticipation of a future regional economy driven by the ICT industry and tourism (Normann 2007).

Phase III, 2005–2015: regional collaboration and cohesion

The critical events in Phase III were firstly the rise in crude oil prices from USD 20–30 in the 1990s to USD 100–120 in the first decade of the 2000s (BP 2021, 28), and secondly the establishment of the NODE cluster. In practice, the NODE cluster came to act as what Fligstein & McAdam (2012) call a governance unit. Several multinational corporations entered the Agder region. The academic mechatronics field was characterised by the transition of a university college to a university. The field strengthened its position through the recruitments of several mechatronics academics, the development of master's and doctoral degree programmes, and by its staff obtaining formal positions as dean of the Faculty of Engineering and Science, and rector of the University of Agder. The national policies during the period (2005–2015) were characterised by the development of innovation policies that targeted cluster development, national centres for research-based innovation (including SFI), and funding for the development of full-scale testing facilities in the region. Regional policymaking started to support the development of the mechatronics industry. Thus, the national and regional policies coincided in their increasing attention paid to the development of the mechatronics industry. This can be seen most notably through regional funding being provided on a sufficient scale to support the various national innovation policy instruments that were activated in the region. Regional policy and funding organisations gained legitimacy from supporting the fast growing industry, while the industry and the cluster organisation gained monetary support in return.

Internal field dynamics

Thus far in this paper we have described how macrorelations between fields developed in the period 1965–2015. There were also interesting and significant changes within the strategic action fields and the policy context in that period. The industrial mechatronics field was initially dominated by regionally owned firms, start-ups, spin-offs, and entrepreneurial activities. In the 2000s, the larger firms set the agenda and gave the NODE cluster project backing and legitimacy to initiate expansive strategies. It also ensured that the cluster project strategies were aligned with the interests of the largest firms. One example of this was when one of the spin-offs from the large firms sought to join the cluster, but the cluster denied it membership. Thus, large firms blocked potential competitors from developing in the region. The spin-off firm was only able to enter the cluster organisation when the management of the cluster changed.

The significant internal field dynamics between incumbent and challenger groups in the three phases are summarised in Table 1, from which it can be seen that the actor groups holding incumbent positions evolved over time within the two mechatronics fields. It can also be seen that the scale of the fields evolved over time. For instance, the scale of the industrial field developed from the regional to the national to the global. Also, the scale of the academic mechatronics field grew from almost nothing to spearheading the development of the University of Agder. Common to both fields was that their inherent complexity also grew as larger numbers of actors and agendas became involved. Furthermore, complexity increased because the fields developed dependencies and interdependencies. The most radical development was in Phase III, when mechatronics ended up holding incumbent positions within both academic and industrial fields, as well as within the regional policy strategies. This led to strong interdependencies between the mechatronics fields and their related organisations. In Phase III, fields that earlier were disconnected and separate became fused and

Table 1. Analysis of internal field dynamics between incumbent and challenger groups

Phase	Industrial mechatronics field	Academic mechatronics field
Phase I, 1965–1989	Incumbents: Mechatronics entrepreneurs Challengers: none identified	Incumbents: Mechanical engineering study programmes Challengers: Mechatronics faculty
Phase II, 1990–2004	Incumbents: National corporations Challengers: Regional corporations, entrepreneurs	Incumbents: ICT, management, linguistics, and mathematics Challengers: Mechatronics as a specialisation in a bachelor's degree programme in mechanical engineering
Phase III, 2005–2015	Incumbents: Multinational corporations Challengers: National corporations, regional corporations, entrepreneurs	Incumbents: Mechatronics Challengers: Other

formed one strategic action field supported by regional and national policies.

Even though the transitions between Phases I–III were driven by events and decisions that were exogenous to the region, strategic agency in incumbent positions was able to utilise those opportunities. Therefore, we see our case not as development that was necessary and organic but as a result of conscious actions, entrepreneurial activities, and policymaking by strategic agency.

Strategic agency

The mechatronics industry field in the Agder region benefited from national policymaking and support, but it did not develop interdependencies with academic fields and regional actors before strategic agency in the cluster project initiated such processes. The cluster management saw and utilised an opportunity to create shared meaning and direction between related actors and organisations in the region. The exponential growth of the industrial mechatronics field made it possible for strategic agency to be increasingly effective in transforming both the regional policy strategies and the academic field into their rationality and interests. What strategic agency did in relation to regional industrial development was not to develop industry, academic institutions, or particular innovation policies per se, but to develop interdependent relations between them.

Conclusions

Field theory analysis is complementary to other theories that are used to explain economic growth, such as neoclassical studies that emphasise investments in physical capital and labour as the main factors (Swan 1956), endogenous growth theories that emphasise the significance of knowledge (Acs et al. 2012), entrepreneurial theories that emphasise not only the role played by entrepreneurial activity but also the importance of promoting a culture of competition and competitiveness (Audretsch 2007), and innovation theory that emphasises the significance of context and knowledge bases related to network coupling (Asheim 2020). Field theory analysis is complementary because it emphasises the importance of power dynamics and the role played by agency in incumbent field positions, as well as the relational dimensions of development within a given context and time. The power of agency in incumbent positions stems not primarily from their institutional roles, but from their ability to communicate shared visions and understandings across institutional and administrative boarders. Industrial economic development is determined and executed ultimately by key decisions within firms. Agency prepares the ground for development through the mobilisation of resources and networks, and it creates collective meaning for new development agendas across fields and within firms. Understanding the practical role of agency in industrial development in peripheral regions in this way can foster better adapted innovation policies.

We have observed that agency cannot be effective in working across fields before those fields reach a certain threshold of shared rationality (cognitive proximity) of values and ideas. In our case, this cognitive proximity was represented by mechatronics as not only a development metaphor but also a shared knowledge domain across fields. Agency must work from a platform that provides legitimacy to approaching and working with other related fields. Our study is illustrative of how a cluster project organisation could provide such institutional legitimacy. Successful agency is associated with actors holding incumbent positions and even influencing developments in other proximate fields. It is a role that can be claimed to hold significant power and influence at the regional level. This type of agency is not necessarily subject to forms of democratic accountability and transparency that we expect from bureaucratic organisations in the Western liberal tradition. Probably, the type of agency we have discussed in this paper is best viewed as champions of a particular development agenda. It is probable that challenger groups or other fields that are not part of this agenda will lose attention and strategic interest. In conclusion, our analysis of a peripheral regional development in Norway shows how mechatronics achieved a central role through common action between previously decoupled academic and industrial strategic action fields.

The merger of previously decoupled fields gave momentum and capability for the field of mechatronics

to transcend from an entrepreneurial and engineering-driven industrial development towards a more research-based regional development trajectory. The emergence of such new and major industrial investment in a peripheral region such as Agder illustrates how collaboration across actors and organisations can further new developments. However, it also shows that in a peripheral region such process may disable competing interests and strategic goals of development. In our study this was particularly visible when viewing changes in field dynamics in the academic and public fields. As such, the notion of strategic action fields can improve analytical understandings of how industrial development occurs in peripheral regions that are characterised by low levels of research and thin structures of knowledge and support organisations (Isaksen & Trippl 2017).

In thicker and more diverse regions (as opposed to thinner and peripheral regions), many of the development results, such as those discussed here, could have manifested. However, we argue that the industrial development process in a peripheral region such as Agder has some distinct characteristics. One difference is that actors in the Agder region in the first phase (1969–1985) were dependent upon resources and collaboration with strategic agency exogenous to the region. That actors within different relevant strategic action fields oriented themselves outwards is probably part of the explanation behind the loosely coupled governance structure in the first phases. Another difference to consider is that when the strategic action fields align and enter an incumbent position, they dominate the development trajectory of the region and as such they can generate swift changes. In thicker and more diverse regions, a development trajectory such as the one discussed here would have to compete with other equally promising strategic action fields for attention. The developments in the Agder region can also be contrasted with smaller and even institutionally thinner regions. In such regions, development would probably have been more dependent on exogenous knowledge, process capacity, and decision-making (Trippl et al. 2018).

Since 2015, the Agder region has been affected by global changes in the price of oil and the increased policy focus on green industrial development. While the mechatronics field was until 2015 influenced mainly by oil-related industrial actors, it has since received renewed interest from process industry related actors. These actors use the technology and organisational competence and know-how from the mechatronics academic field to further strategies for battery development, among other purposes. It would be interesting to study how this development is furthered in reciprocation with other strategic fields in the region, such as those related to renewable energy production.

Understanding the dynamics of strategic actions fields may be particularly relevant for peripheral regions without the institutional thickness and redundant capacities to pursue multiple development trajectories with equal force simultaneously. In a more generic perspective, the analytical frame of strategic action fields can serve to grasp complexities between macrolevel and microlevel conditions, and it can allow for a non-deterministic evolutionary analysis of regional development. Understanding strategic action fields is particularly important in the emerging regional strategies of Industry 4.0 (the Fourth Industrial Revolution) related to, for example, hydrogen, batteries, and carbon capture and storage (CCS), in which such an analysis can trace reciprocal generation of relations and spaces of opportunities generated by different types of individual and organisational agency.

Acknowledgements

This research was funded by the Research Council of Norway and the counties of Finnmark, Hordaland, Rogaland, and Agder in the Council's Programme for Regional R&D and Innovation (VRI), as part of the research project 'Path development in different regional settings. Regional policy approaches in the global economy'.

References

Acs, Z.J., Audretsch, D.B., Braunerhjelm, P. & Carlsson, B. 2012. Growth and entrepreneurship. *Small Business Economics* 39(2), 289–300.

Agder University College. 2001. *Strategisk plan 'Mot år 2006'*. Kristiansand: Agder University College.

Asheim, B.T. 2020. Economic geography as regional contexts' reconsidered – implications for disciplinary division of labour, research focus and societal relevance. *Norsk Geografisk Tidsskrift–Norwegian Journal of Geography* 74 (1), 25–34.

Audretsch, D.B. 2007. Entrepreneurship capital and economic growth. *Oxford Review of Economic Policy* 23(1), 63–78.

Audretsch, D.B. 2015. *Everything in Its Place: Entrepreneurship and the Strategic Management of Cities, Regions, and States*. New York: Oxford University Press.

Beer, A. 2014. Leadership and the governance of rural communities. *Journal of Rural Studies* 34, 254–262.

Beer, A. & Clower, T. 2014. Mobilizing leadership in cities and regions. *Regional Studies, Regional Science* 1(1), 5–20.

Boschma, R. 2015. Towards an evolutionary perspective on regional resilience. *Regional Studies* 49(5), 733–751.

Bourdieu, P. 1977. *Outline of a Theory of Practice*. Trans. R. Nice. Cambridge: Cambridge University Press.

BP. 2021. *Statistical Review of World Energy 2021*. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-full-report.pdf (accessed 20 November 2021)

Brautaset, K. 1983. *Inføring i olje hydraulikk*. Aurskog: Universitetsforlaget.
Brautaset, K. 2014. Styring av store krefter ga grunnlag for viktig klynge. Jahr, E.H., Nossum, R.T. & Storesletten, L. (eds.) *Agder Vitenskapsakademi Årbok 2013*, 120–133. Kristiansand: Portal Forlag.
Brundtland, G.H. 1987. *Tale til Norwegian Rig Consultants*. https://www.regjeringen.no/globalassets/upload/smk/vedlegg/taler-og-artikler-av-tidligere-statsministre/gro-harlem-brundtland/1987/tale_til_norwegian_rig_consultants.pdf (accessed 30 March 2022).
Coleman, J.S. 1990. *Foundations of Social Theory*. Cambridge, MA: The Belknapp Press of Harvard University Press.
DiMaggio, P.J. & Powell, W.W. 1983. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review* 48(2), 147–160.
Fagerberg, J., Mowery, D.C. & Verspagen, B. 2009a. The evolution of Norway's national innovation system. *Science and Public Policy* 36(6), 431–444.
Fagerberg, J., Mowery, D.C. & Verspagen, B. 2009b. Introduction: Innovation in Norway. Fagerberg, J., Mowery, D.C. & Verspagen, B. (eds.) *Innovation, Path Dependency and Policy: The Norwegian Case*, 1–29. Oxford: Oxford University Press.
Fligstein, N. & McAdam, D. 2011. Towards a general theory of strategic action fields. *Sociological Theory* 29(1), 1–26.
Fligstein, N. & McAdam, D. 2012. *A Theory of Fields*. New York: Oxford University Press.
Fløysand, A. & Jakobsen, S.-E. 2010. The complexity of innovation: A relational turn. *Progress in Human* Geography 35 (3), 328–344.
Gong, H. & Hassink, R. 2020. Context sensitivity and economic-geographic (re)theorising. *Cambridge Journal of Regions, Economy and Society* 13(3), 475–490.
Grønhaug, R. 1978. Scale as a variable in analysis: Fields in social organization in Herat, Northwest Afghanistan. Barth, F. (ed.) *Scale and Social Organization*, 78–121. Oslo: Universitetsforlaget.
Hidle, K. & Normann, R. 2013. Who can govern? Comparing network governance leadership in two Norwegian city regions. *European Planning Studies* 21(2), 115–130.
Isaksen, A. & Trippl, M. 2017. Exogenously led and policy-supported new path development in eripheral regions: Analytical and synthetic routes. *Economic Geography* 93 (5), 436–457.
Isaksen, A., Jakobsen, S.-E., Njøs, R. & Normann, R. 2019. Regional industrial restructuring resulting from individual and system agency. *Innovation: The European Journal of Social Science Research* 32(1), 48–65.
Johnsen, H.C.G., Hauge, E.S., Magnussen, M.-L. & Ennals, R. (eds.) 2016. *Applied Social Science Research in a Regional Knowledge System: Balancing Validity, Meaning and Convenience*: London: Taylor & Francis.
Larsen, E.R. 2005. Are rich countries immune to the resource curse? Evidence from Norway's management of its oil riches. *Resources Policy* 30(2), 75–86.
Lewin, K. 1951. *Field Theory in Social Science: Selected Theoretical Papers*. New York: Harper.
Martin, R. 2012. Regional economic resilience, hysteresis and recessionary shocks. *Journal of Economic Geography* 12(1), 1–32.
Miörner, J. 2020a. Contextualizing agency in new path development: How system selectivity shapes regional reconfiguration capacity. *Regional Studies* 56(4), 592–604.
Miörner, J. 2020b. The road towards autonomous driving – A differentiated view of institutional agency in path transformation. *Norsk Geografisk Tidsskrift–Norwegian Journal of Geography* 74(5), 283–295.
Normann, R. 2007. *Democracy in Development – A Critical View on Regional Governance*. PhD thesis. Theses at NTNU nr. 88. Trondheim: Norges teknisk-naturvitenskapelige universitet.
Normann, R. 2013. Regional leadership: A systemic view. *Systemic Practice and Action Research* 26, 23–38.
Normann, R., Johnsen, H.C.G., Knudsen, J.P., Vasström, M. & Johnsen, I.G. 2017. Emergence of regional leadership – a field approach. *Regional Studies* 51(2), 273–284.
Pinheiro, R. & Normann, R. 2017. Agency, networks and complexity: The many roles of academic institutions in regional development coalition building. *Ekonomiaz* 92 (2), 68–85.
Powell, W.W. 1990. Neither market nor hierarchy: Network forms of organization. *Research in Organizational Behavior* 12, 295–336.
Powell, W.W., White, D., Koput, K. & Owen-Smith, J. 2005. Network dynamics and field evolution: The growth of interorganizational collaboration in the life sciences. *American Journal of Sociology* 110(4), 1132–1205.
Regionplan Agder. 2020. *Regionplan Agder 2020: Med overskudd til å skape*. https://distriktssenteret.no/wp-content/uploads/2020/03/Regionplan-Agder-2020.pdf (accessed 7 April 2022).
Sandvik, P.T. 1999. *Kristiansands Historie 1945–1999*. Kristiansand: Sparebanken Pluss.
Scott, W.R. & Meyer, J. 1983. The organization of societal sectors. Meyer, J. & Scott, W.R. (eds.) *Organizational Environments: Ritual and Rationality*, 129–153. Beverly Hills, CA: SAGE.
Sørlandets Kompetansefond. n.d. *Årsrapport 2005 – Årsrapport 2014* [10 reports]. https://www.kompetansefond.no/dokumenter/?fid=1752 (accessed March 2016).
Sotarauta, M. 2014. Territorial knowledge leadership in policy networks: A peripheral region of South Ostrobothnia, Finland as a case in point. Rutten, R., Benneworth, P., Irawati, D. & Boekema, F. (eds.) *The Social Dynamics of Innovation Networks*, 42–59. Abingdon: Routledge.
Sotarauta, M., Horlings, L. & Liddle, J. (eds.) 2012. *Leadership and Change in Sustainable Regional Development*. Abingdon: Routledge.
Stoica, O., Roman, A. & Rusu, V.D. 2020. The nexus between entrepreneurship and economic growth: A comparative analysis on groups of countries. *Sustainability* 12(3): Article 1186.
Swan, T.W. 1956. Economic growth and capital accumulation. *Economic Record* 32(2), 334–361.
Tödtling, F. & Trippl, M. 2005. One size fits all? Towards a differentiated regional innovation policy approach. *Research Policy* 34(8), 1203–1219.
Trippl, M., Grillitsch, M. & Isaksen, A. 2018. Exogenous sources of regional industrial change: Attraction and absorption of non-local knowledge for new path development. *Progress in Human Geography* 42(5), 687–705.

Universitetet i Agder. 2012. *Strategi for Universitetet i Agder 2010–2015: vedtatt av universitetsstyret 14. oktober 2009, revidert 18. september 2012*. https://www.uia.no/content/download/52348/489839/file/UiAStrategi2012.pdf (accessed 30 March 2022).

Universitet i Agder. n.d. *SFI Offshore Mechatronics*. https://www.uia.no/en/centres-and-networks/sfi-offshore-mechatronics (accessed 30 March 2022).

Yin, R.K. 1994. *Case Study Research: Design and Methods*. Thousand Oaks, CA: SAGE.