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Coping with Economic Crises—The Role of Clusters

ASGEIR SKÅLHOLT* & TARAN THUNE**,*

*Nordic Institute for Studies in Innovation, Research, and Education (NIFU), Oslo, Norway, **Centre for Technology, Innovation and Culture, University of Oslo, Oslo, Norway

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ABSTRACT *The paper analyses the role clusters can play in coping with the impacts of economic crises, specifically by addressing how cluster organizations have acted to meet the challenges following the economic crises in Norway in the period 2008–2010. The paper investigates whether cluster maturity influences how the cluster acts in response to a crisis. To shed light on these questions, survey data from Norwegian cluster organizations were collected in two waves (spring 2009 and autumn 2010), and case studies of four cluster organizations provide further detail. The data indicate that clusters play a role in reducing uncertainty and improving access to necessary resources in crises periods. The data indicate that these advantages are not only due to increased collaboration between firms within the cluster, but that cluster organizations engage in considerable lobbying on behalf of their firms in regards to regional and national policy makers and public funding bodies. When comparing the impact experienced by mature and emerging clusters and their adaptation strategies, the data show that more mature clusters adapted to recent crises by implementing new innovation strategies and increasing collaboration and competence-building activities, to a greater extent than emerging clusters.*

Introduction

The worldwide economic crisis that commenced in late 2007 and was still on-going in 2013 in several countries, has led to a new interest in the relationship between innovation, economic growth and the impact of economic recession on innovation. Established theories of economic growth provide alternative hypotheses about the impact of economic crises on innovation: on the one side, economic recessions are expected to have a negative impact on innovation activities in firms due to decreased demand and decreased access to capital and other resources; on the other hand, economic recessions might represent new opportunities and a fertile environment for innovation (Filippetti & Archibugi, 2011). Historical analyses illuminate the relationship between economic crises and long-term developments

Correspondence Address: Taran Thune, Centre for Technology, Innovation and Culture, University of Oslo, Postboks 1108, Blindern N-0317 Oslo, Norway. Email: taranmt@tik.uio.no

in techno-industrial paradigms (Perez, 2002, 2009). According to Perez, an economic crisis often marks the “beginning of the end” of a given techno-industrial paradigm. The economic crisis represents both the destruction of an established paradigm and new opportunities and new solutions, through adaption to new contexts and markets, and so-called creative destruction (Schumpeter, 1942; Huttunen *et al.*, 2006). According to this theory, it would be possible to realize growth through crisis, for example, by creating favourable conditions for innovation. At the same time, crises represent a high degree of uncertainty and instability that might deter firms from investing in risky and costly innovation activities.

National governments and international organizations such as the EU and the OECD have all been preoccupied with finding solutions to avoid the collapse of economies and national and global financial systems. There is also high awareness of the importance of fostering innovation for long-term growth in the face of a short-term decline in investments in innovation at the firm level (Guellec & Wunsch-Vincent, 2009). The OECD has documented that investments in innovation decreased after the worldwide financial crisis in most OECD countries, along with decreased access to venture capital, global markets and highly qualified human capital, all input factors relevant to innovation (Guellec & Wunsch-Vincent, 2009). Filippetti and Archibugi's (2011) analyses of the impact of the economic recession on innovation in European countries demonstrate that this impact has been highly uneven across European countries, and has mainly had a negative impact on innovation investments in so-called catching-up countries among the new EU member states (compared to investments in the 2006–2008 period). According to the authors, the characteristics of the national innovation system may explain the uneven impact of the economic crisis on innovation to a larger extent than the extent of any drop in demand. Policy responses have been concerned with supporting innovation systems and developing innovation capacity, for example, through improvements to infrastructure, public investments in research and development (R&D) and innovation, investment in education and training at all levels, as well as demand-oriented innovation policies, including public procurement, financial support to SMEs, venture capital and cluster policies (Guellec & Wunsch-Vincent, 2009). In Norway, cluster programmes were seen as a part of the national strategy for coping with the effect of the financial crisis, partly because the industries involved in the national cluster programmes represent industries oriented towards global markets most affected by the crisis, and partly because the cluster programmes were regarded as effective, firm-oriented innovation support tools (St.prop. nr.37, 2008–2009).

Bearing in mind the wide range of policy tools implemented to support innovation, and possibly stimulate growth through the crisis period, this paper addresses the role of clusters and cluster programmes in this context. Literature searches revealed few studies addressing the issue of clusters and crises in particular. There were a few studies focusing on regional innovation and economic crises more generally. This research indicated that regions' ability to sustain innovation activities throughout crises depends on the innovation system properties of each region. Regions which had well-developed innovation systems prior to the crisis had higher innovation performance regardless of major drops in demand (Filippetti & Archibugi, 2011). At the firm level, an Italian study found that firms' ability to sustain innovation as a way of handling the crisis depended on the firms' industrial relations, innovation activities prior to the crisis, ties to the science-based sector and good human resource policies (Antonioli *et al.*, 2011). Both of these studies indicate a relationship between pre-crisis innovation capability and innovation performance during and after the crises.

The purpose of the paper is to investigate the impact of the economic crisis in the period 2008–2010 on a number of clusters in Norway. Looking at the different imprints the crisis left on the clusters, we address the role of cluster organizations in terms of their role in managing the uncertainty and negative impacts of the economic crisis, and whether cluster organizations stimulated innovation activities in the clusters in the acute crisis period. To do so, the paper draws on data from an empirical investigation of 28 clusters involved in two Norwegian cluster programmes—the Norwegian Centres of Expertise (NCE) programme and the Arena programme. These programmes represent the two most important policy initiatives for developing and supporting regional clusters in Norway, and were perceived by the government as important demand-oriented policy tools to support industry during the economic crisis. The NCE programme is directed towards mature clusters with potential for growth in international exports. The Arena programme, on the other hand, is aimed at emerging and less-developed clusters with potential for further development.

In order to collect information about the development of the clusters through the financial crisis period (2008–2010), two Web-based surveys were conducted with managers of cluster organizations at two different points in time. Case studies of four clusters were also conducted, based on interviews and analysis of written documentation. Before presenting data and results from the empirical investigations, a review of relevant theoretical and empirical research on why and how clusters are relevant for coping with crises is presented, and propositions to guide the empirical analysis are outlined.

Theoretical Framework

Environmental Instability, Resource Needs and Collaborative Behaviour of Firms

From the theory of economic organization, there is a well-developed theoretical basis and rich empirical evidence on why and how firms enter into inter-organizational relationships. This literature, based on an open systems perspective on organizations, shows that firms collaborate to handle turbulent environments, to get access to resources and new markets, to reduce risks and manage costs and to promote learning (Dyer & Singh, 1998; Barringer & Harrison, 2000; Child *et al.*, 2005). Cooperation between firms is often seen as an intentional response by firms to cope with uncertain environments and dependence on other organizations for survival and success. According to Child *et al.* (2005) the main reason for alliance formation is changes in environmental conditions that reveal firms' internal resource inadequacies. Increased competition, high economic uncertainty and rapid technological changes tend to occur simultaneously and jointly act as powerful drivers for collaborative behaviour among firms. Resource dependence, risk limitation, learning and access to markets represent firm-internal motivations for seeking partnerships with other firms. Particularly in situations of environmental instability (due to technological, market or regulatory factors), firms are particularly prone to collaborate as a way of managing uncertainty. Handling uncertainty and risk reduction has been found to be of particular importance in research and innovation alliances because R&D and innovation activities represent inherently risky and high-cost activities (Haagedorn, 1993; Child *et al.*, 2005). Sharing of costs for R&D and innovation might be a particularly important driver in periods of economic and market turbulence.

Interdependence is a general factor that explains why firms establish collaborative relationships. "Interdependence exists whenever one actor does not entirely control all of the conditions necessary for the achievement of an action or for obtaining the outcome desired from the action" (Pfeffer & Salancik, 1978, p. 40). Since organizations are not self-sufficient, they must rely on the environment to provide support and engage in exchanges with other organizations for resources needed (Gulati & Gargiulo, 1999). Forming ties with other organizations is a way for firms to attempt to manage uncertainty by procuring needed resources, gaining access to markets, creating stability in supply and/or gaining power. Within the literature on inter-organizational relationships, access to resources that are needed and are seen as strategic for the firm is seen as a key driver for inter-organizational relationships (Haagedorn, 1993; Eisenhardt & Schoonhoven, 1996; Katila *et al.*, 2008). These resources can be tangible, such as technology, financial resources or specific skills embodied in human capital, or intangible, such as market understanding, access to social and political networks, reputation or market position.

The exact resources in question will vary, but in general, resources accessed through alliances are typically complementary rather than core resources, which are more likely accessed through market transactions or integration, to achieve a higher degree of control over resource acquisition than is offered in alliances (Teece, 1986; Eisenhardt & Schoonhoven, 1996; Katila *et al.*, 2008). The strategic position of the firm influences its resource needs and expected payoff from collaborating. The degree of competition, maturity of industry and degree of innovation are all seen as factors that influence the strategic environment of the firm. Firms in industries with a high competition, in emerging or early growth phases of industrial development and with a high degree of investment in R&D, have weaker strategic positions and are more dependent on other firms for resources, and are thus more likely to collaborate. According to Katila *et al.* (2008), inter-organizational partnerships are particularly common for small and newly established firms that need quick access to a variety of resources, particularly when the resources needed are complex and cannot be bought off the shelf.

On the other hand, firms who are not in a weak strategic position also enter into partnerships, to capitalize on opportunities, to diversify product portfolios or to develop competences in areas new to the firm. Collaborative behaviour is not only explained by resource needs or risk reduction motives, however, recognizing, creating and taking advantage of opportunities are also seen as drivers for collaborative behaviour (Ahuja, 2000). This means that a firm might be involved in a partnership or a network of limited strategic importance in terms of immediate needs, but which might lead to information sharing or opportunities to capitalize on future situations that arise from that collaboration. The argument is that partnership-specific resources, including social and cognitive capital (Nahapiet & Ghosal, 1998), accrue by repeated interaction between partners, and that such non-strategic resources can be instrumental if a strategic opportunity of forming a new partnership arises.

Clusters as Resource Pools

The literature on inter-organizational relationships has addressed these issues looking at formal partnerships between a set of organizations, such as joint ventures and alliances (Child *et al.*, 2005). However, firms also engage in informal networks, such as industry associations and clusters that represent informal and more loosely coupled modes of

collaboration. Clusters are often defined as spatial concentrations of interconnected firms and associated institutions in related fields (Menzel & Fornahl, 2010). Firms in clusters are linked by both commonalities and complementarities, these links can be both horizontal and vertical, and firms in the cluster both collaborate and compete (Porter, 1998).

Compared to the literature on inter-organizational relationships, the literature on clusters has been less preoccupied with explaining drivers and motivation for clustering by firms, and has been more preoccupied with describing properties of clusters and how clustering influences innovation and growth at the industrial or regional levels (Asheim *et al.*, 2006; Simmie, 2006; Hervás-Oliver, 2011). However, a recent paper by Pitelis (2013) has attempted to bridge the cluster literature and more generic theories of inter-organizational behaviour at the firm level, arguing that the two perspectives need to be linked to understand cluster formation and development. The cluster literature is substantial, and in discussing this literature, an emphasis is placed on arguments made in papers that focus on the function of clusters as resource pools and on the relationship between industrial life cycles and clusters, as they are most relevant for the research question explored.

Pitelis (2013) argues that the cluster literature tends to explain clusters as a phenomenon by pointing to the “absolute advantages” of clustering. According to cluster literature, clusters have characteristics such as co-location, concentration of skilled human resources, social embeddedness and untraded interdependencies, that are seen as beneficial for innovation and competitiveness by providing access to complementary resources, creating a favourable environment for innovation, increasing the innovation pressure, and stimulating knowledge spillovers and localized learning (Maskell, 2001; Porter, 1998; Bathelt *et al.*, 2004; Pitelis, 2013).

A prevalent argument is that clusters represent a knowledge infrastructure or pool of relevant but varied knowledge that firms can tap into, and that clustering enables access to such resources more effectively than if a firm was located outside a regional cluster (e.g. Maskell, 2001; Bathelt *et al.*, 2004). Access to knowledge resources and ease of transfer of such resources are therefore reasons why firms enter or become active members of clusters. At the same time, there is historical and contemporary evidence that clustered sectors are not particularly competitive or innovative, and that clustering does not prevent decline or extinction of clustered industries (Simmie, 2006). According to Simmie (2006) cluster theory is based on an assumption that clustering is causally related to increased innovation and productivity, which according to him is false. Clustering can rather be seen as an effect of innovative activities in firms, because innovative firms require access to resources and support available in the local innovation system as well as links outside the regional agglomeration of firms. Stated differently, one could argue that firms in clusters not only gain access to complementary knowledge resources, but gain access to other kinds of resources on which firms depend. For example, Henry *et al.* (2006) argue that clusters should be seen as “financial spaces” which represent a social structure that is relevant to firms’ access to financial resources. One could also argue that clusters are “political spaces” and that they represent a social structure that is mobilized to improve regulatory or other framework conditions for firms. Innovative firms, particularly those that are involved in radical innovations, require access to external capital from private and public sources, to fund innovative activities and to distribute risk; clustering can therefore also be seen as a way of reducing risks which are associated with innovative activities, if being clustered increases the chances of gaining access to external (private or public) resources.

These perspectives are also addressed within evolutionary theories of clusters, such as cluster lifecycle theory (Audretsch & Feldman, 1996; Menzel & Fornahl, 2010). According to cluster life cycle theory, the formation and development of clusters follow development patterns akin to industrial life cycles; they emerge, grow, reach maturity and eventually decline. Audretsch and Feldman (1996) argue that in early stages of industrial development, where variety and uncertainty are high, emerging clusters are important because of their role in promoting learning and creating synergies between (relatively heterogeneous) firms. Innovative activity is expected to be higher in clusters in the early stages of industry life cycles, and then to decline as the industry matures. However, Menzel and Fornahl (2010) argue that as clusters grow in size (number of firms and volume of employment) and mature, they develop systemic qualities. For instance, a larger and more mature cluster is probably perceived as more important by external constituencies and able to get better support from policy makers. Increased visibility means that the cluster has more bargaining power, better capabilities for collective action and can therefore negotiate terms and satisfy the needs of the firms in the cluster. Over time, as industries mature and clusters become highly specialized, the benefits of being clustered for innovation activities probably diminish, but other resources channelled through clusters remain, such as power, visibility and financial resources. Firms' ability to use mature clusters to mobilize political support and financial resources from public sources is probably important for understanding their capacity for coping with market turbulence and crises.

Propositions for further research

Based on resource-based arguments for collaborative behaviour of firms, we make the following proposition about the role of clusters in economic crises:

- We expect clusters, as a collective organization, to be important for how firms cope with economic crises because collaboration reduces uncertainty, can ensure access to scarce resources and improves access to new opportunities.

Based on the reviewed literature on clusters as resource pools and cluster life cycle theory, the following proposition is made regarding the role of clusters during economic crises:

- We expect that the economic crisis will have a more severe impact on emerging clusters than on mature clusters. Emerging clusters are probably harder hit by drops in demand and decreased productivity during, and after, an economic crisis. Therefore, we expect that cluster organizations play a key role in reducing uncertainty and supporting innovation activities in emerging clusters.

An Empirical Investigations of Clusters and Crises

The Context: Norwegian Clusters and Cluster Programmes

The data on clusters and economic crises were collected from clusters receiving funding through two Norwegian cluster programmes, the NCE and Arena programmes. It is important to stress that the "clusters" and the "cluster organizations" that get funding from public programmes are not necessarily the same. To receive funding, there must be an established cluster with a cluster organization in place, consisting of firms and research

institutions of relevance to the actual value chain and field of technology. Each cluster has a project organization, with a project leader, a project team and member organizations, which can be businesses, public sector organizations, higher education institutions or research institutions. Even though it is the project organizations that are funded, and the coupling between the project and the firms affiliated with the clusters varies, earlier research shows how the project organization is tightly woven into the activities in the clusters (Econ Pöyry, 2009; Skålholt *et al.*, 2010; Jakobsen *et al.*, 2011).

By 2011, there were 12 clusters that received funding through the NCE programme. The programme is jointly owned by the three main Norwegian innovation agencies: Innovation Norway, the Research Council of Norway and the Industrial Development Corporation of Norway, and is administrated by Innovation Norway. The cluster programme owners aim for the clusters is that the clusters are further developed as motors for industry development. They must speed up creation in regional business environments, through cooperation between companies, researchers, colleagues and public authorities. In addition, they must be internationally oriented. The clusters can receive funding for up to 10 years. In 2011, there were 22 clusters that received funding through the Arena programme for emerging clusters. Compared to the NCE clusters, these are less mature in terms of the characteristics set out by Antonioli *et al.* (2011) (firms' industrial relations, innovation activities, ties to the science-based sector and good human resource policies) but most of them are also highly specialized and regionally concentrated. The Arena clusters also represent a wider spectrum of industries than the NCE clusters, with several clusters representing the service sector, for example, via tourism and creative industries, and many of these clusters are more oriented towards a national market than the NCE clusters (Jakobsen *et al.*, 2011).

Data Sources and Methodology

The findings presented are based on interviews with cluster organization leaders, two surveys and documentary analysis of applications, reports and information material provided by each cluster. The surveys were sent to the leaders of each cluster organization, and so reflect these leaders' impression and opinions about the status of the clusters. This is problematic in at least two ways. First, the cluster managers can have an interest in portraying "their" cluster in specific ways. This is especially important when asking questions regarding the role of the cluster organization during the financial crisis. Second, the cluster managers may only have secondary knowledge of the status of the firms.

In the first survey, carried out in March 2009, we received answers from 24 cluster leaders (an 86% response rate), in the October 2010 survey, we received 19 responses (80% response rate) (Skålholt *et al.*, 2010).¹ The first survey was sent out about half a year after the crisis emerged, at a time when the long and medium time consequences of the crisis were uncertain. The last survey, autumn 2010, was at a time when the most acute part of the crisis was over in Norway.²

Four Case Studies

In order to further develop insights into the role of the cluster organizations and how they respond to environmental changes such as an economic crisis, we also carried out case studies on four cluster organizations: the Oslo Cancer Cluster (cancer treatments and diagnostics), NCE Raufoss (automated production of lightweight materials), NCE Maritime

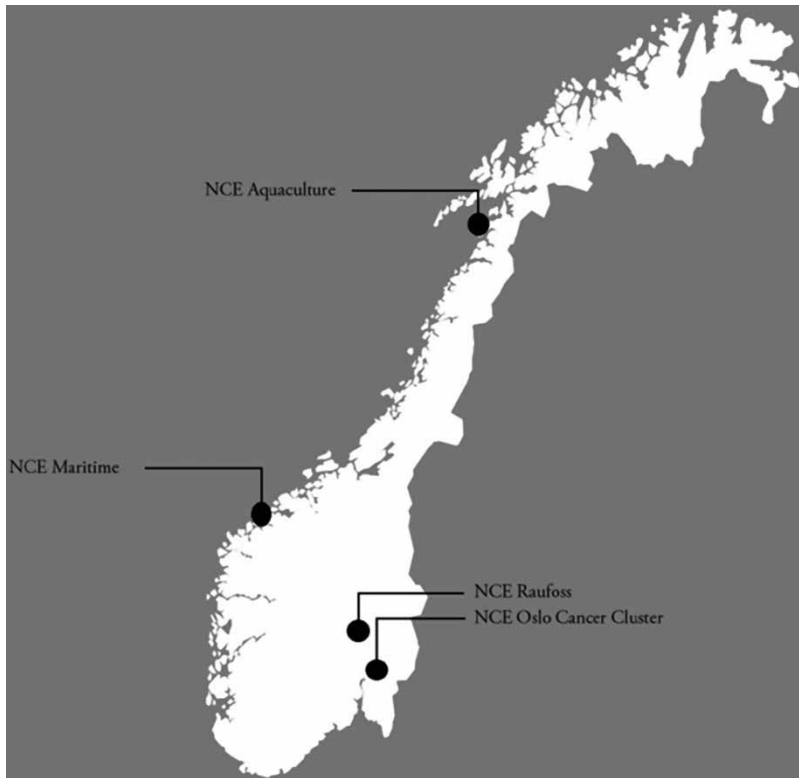


Figure 1. Geographical location of case clusters in Norway.

(designing, building, equipping and operating advanced vessels for the global offshore oil industry) and NCE Aquaculture (fish farming). All four case clusters are oriented towards global markets, and as a consequence, were expected to be hard hit by the economic crisis in 2008–2009, because of a drop in demand and because of decreased access to external capital. The four clusters were therefore seen as suitable cases for further investigation. Key characteristics of the clusters included in the case study are found in Table 1 and a map of their location in Figure 1. The clusters became a part of the NCE programme in 2006–2007. In the following section, we use examples of how the case study clusters handled the financial crisis to illustrate general tendencies emerging from the survey material.

Results of the Surveys and Case Studies

The presentation of data from the three investigations focuses on three main issues. (1) The impact of the economic crisis on the development of the clusters in the 2008–2010 period, in terms of short- and longer-term adaptations as a result of the crisis, and particularly in terms of the impact on innovation activities. (2) The role and activities of the cluster organizations during the economic crisis. (3) The similarities and differences in impacts due to the economic crisis, and the adaptation strategies implemented by the more mature NCE clusters and emerging Arena programme clusters.

Table 1. The four cluster case studies

Name	Type of industries	Number of firms	Other institutions	Geographical concentration	History
Oslo Cancer Cluster	Cancer treatments and diagnostics	60 ^a	Hospitals, universities, public health authorities, technology transfer offices, financial institutions	Geographically located throughout Norway, but mainly in the Oslo metropolitan area	Established late 1990s–early 2000
NCE Raufoss	Automated production of lightweight materials	17 ^a	Higher education institutions, research institute, regional authorities	Geographically close; mainly localized within one industrial park	Long history, from late nineteenth century
NCE Maritime	Designing, building, equipping and operating advanced vessels for the global offshore oil industry	70 ^a	Higher education institutions, regional authorities	Geographically relatively close (one county, Møre og Romsdal)	Long history, mainly developed after 1945
NCE Aquaculture	Fish farming, salmon, cod and other seafood	23 ^a	University, research institutes, public authorities, financial institutions	Geographically located throughout Norway, but the NCE organization is based in Nordland	Established 1970s

^aMembers in the cluster organization.

Impact of the Crisis

The crisis in Norway was primarily a “financial crisis”, affecting banks first and foremost. Still, access to capital is essential for firms, both for innovation and research and for covering operational costs. The sudden disappearance of a functional credit marked therefore quickly led to consequences in the “real” economy. A clear majority of the project leaders reported generally worsened access to capital during and after the crisis; this includes access to capital from banks, the capital marked and venture capital, as seen in Table 2.

As stated above, a majority reported worsened access to capital after the crisis. In the 2009 survey, more than 90% of the clusters that responded reported worsened access to capital from banks. In 2010, almost 70% reported the same. In both 2009 and 2010, no

one reported an improved access to capital. The access to short time credit, such as operating credit, however, improved from 2009 to 2010. In 2009, 91% reported a decrease in access to operational credit, in 2010, 56% reported the same.

Even though the majority of the clusters reported a difficult capital situation in both 2009 and 2010, some also reported “improved” access to capital after the acute crisis. This was mainly due to access to capital from public sources. The Norwegian government invested 20 billion NOK into the economy via different stimulus packages in 2009.³ Norway has a relatively well-developed innovation system that could absorb and make use of this money. Our informants confirmed this, and the Norwegian policies have overall been assessed as a success (Guellec & Wunsch-Vincent, 2009).

The lack of available capital was especially important for two of our case study clusters. For the Oslo Cancer Cluster, the problem was not failing markets, but a declining credit market that threatened the existence of several of the firms in the clusters. In NCE Aquaculture, we saw a similar consequence of the financial crisis. The firms in this cluster are mainly concentrated on two products: farmed salmon and farmed cod. Salmon farming has a relatively long history in Norway, with capital strong owners and a well-developed market. Cod farming, however, is still at an early stage, with on-going R&D. The sudden breakdown of the credit market led to the closure of several of the R&D projects concerning cod farming. The existing owners were unable to take on further risk, and the access to fresh capital had disappeared.

When we look at the differences between the more mature NCE clusters and the emerging Arena clusters, we find that they report about the same decrease in access to capital (about 70%). Generally, the informants reported a drop in demand, along with several other, immediate consequences of the crisis such as lower prices on products, changed procurement strategies from customers and changed strategies from sub-contractors. While the overall trends in market situation facing the clusters showed an improvement from 2009 to 2010, failing markets remained a major part of the picture in 2010. It was manufacturing clusters that reported the biggest impacts of the financial crisis, such as the Raufoss cluster, whose companies mainly produce lightweight materials for the automotive industry. For the maritime sector, the situation was somewhat different. The maritime sector often operates with backlogs of at least 2 years of production, in contrast to the “leaner” production in Raufoss. The short-term effect was therefore smaller in the maritime cluster, but the maritime industry experienced cancelled contracts and the long-term prospects for the sector in

Table 2. Access to capital 2009 and 2010 (per cent of respondents)

	Worsened		No change		Improved	
	2009	2010	2009	2010	2009	2010
Capital from banks	95	69	5	31	0	0
Capital, credit via public sources	17	6	30	47	52	47
Operational credit	91	56	9	17	0	28
Credit for innovation	64	53	23	35	14	12
Capital from the capital market	86	67	14	33	0	0
Access to venture capital	79	64	14	36	7	0
Access to capital from existing owners	62	27	33	53	5	20
Access to capital from new owners	89	50	11	50	0	0

2009 were thought to be dire (Hervik *et al.*, 2009). In terms of failing markets, both Arena and NCE clusters reported a similar degree of impact, in both the 2009 and 2010 surveys.

Adapting to a Changed Economic Context

Because of the financial crisis, the clusters reported having to change their short-term priorities and strategies. Although the survey data indicate that the short-term consequences for the clusters varied greatly, the direction of the change from 2009 to 2010 is interesting. In 2009, almost 70% of the clusters reported lay-offs (of some sort) of employees. In 2010, just over 40% reported the same. Another consequence of the crisis was an increased focus on core activities; this typically involves outsourcing or liquidating areas of activity, one example being for firms to discontinue their R&D activity completely. The tendency to focus on core activity actually “increased” from 2009 to 2010; it was, in other words, not just a short-term adaptation to the crisis but an on-going response by clusters attempting to maintain vital production throughout a challenging situation (Figure 2).

The cluster organizations in our case studies thought it especially important to maintain competence within the cluster. In 2009, more than 20% of the survey respondents reported that the crisis had drained the region/cluster of qualified labour. Several of the clusters in the case studies and in the survey reported having implemented tools to consolidate and build competencies during the crisis period, and that the cluster organization had a key role in this. For NCE Raufoss and NCE Maritime, for example, it was of central importance to prevent highly qualified labour leaving the companies. The labour marked for highly qualified people and engineers in these largely rural regions is small; cluster organizations were afraid that if engineers were laid off, their competence would be lost to the region (Nilsen & Skålholt, 2010). Both NCE Raufoss and NCE Maritime increased contact with regional research institutes and higher education institutions, facilitating formal training and starting up new R&D activities—hoping to use slack resources resulting from the declining market to increase the overall competencies in the cluster and to keep important competence within the clusters and the region. Thus, a majority of the respondents reported that they initially believed that the financial crisis would lead to increased innovation activities in the clusters (Figure 3).

The respondents expected that the crisis could lead to a stimulation of cooperation between research and educational institutions, and that the crisis could revitalize cooperation on competence building. In 2009, more than 60% anticipated an increase in cooperation on competence development in the cluster. In 2010, this was reduced to 40%. The same tendency can be seen in terms of cooperation between the firms in the cluster and higher education institutions. In 2009, almost 80% of the cluster managers anticipated that the crisis could lead to new innovation strategies among the firms; by 2010, less than 70% thought so. By 2010, the proportion of respondents that thought the crisis would lead to reduced innovation opportunities had increased slightly.

The Role of the Cluster Organization in Coping with Crisis

The section above looked into whether the crisis led to changed priorities towards networking and collaboration within the cluster. A further focus is to establish whether the crisis has had an impact on the role and activities of the cluster organization.

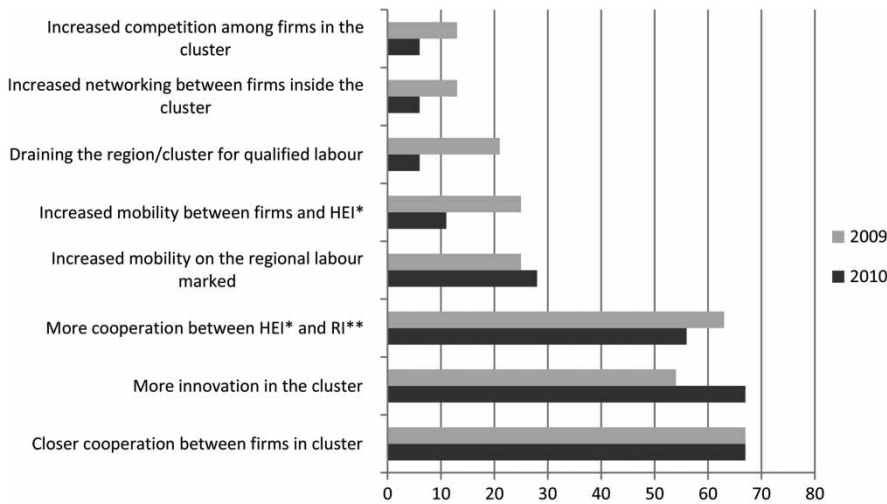


Figure 2. Consequences of the crisis for the cluster (percentage of responses).

*Higher education institution; **research institute.

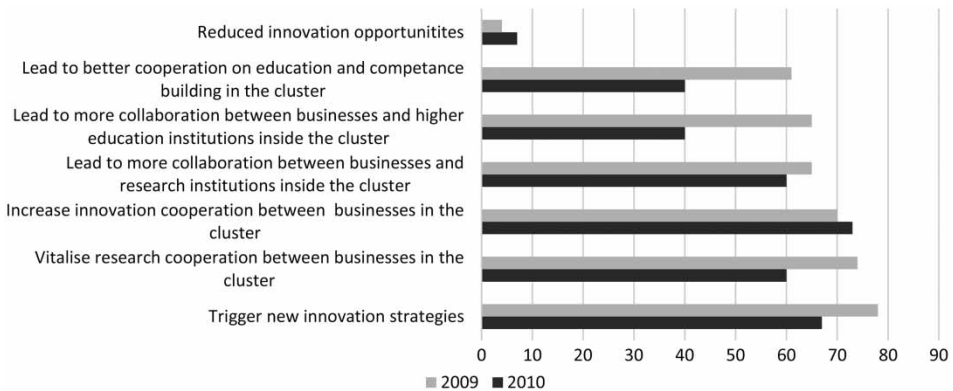


Figure 3. Consequences of the crisis for innovation activities (percentage of respondents).

In 2010, 40% of the cluster organizations said the crisis had not led to any shift in strategy or activities; this was down from over 70% in 2009. The mature NCE clusters changed their focus as a response to the crisis to a greater degree than the emerging Arena clusters. In 2010, 80% of the NCE clusters reported that they had changed some of their projects' focus as a consequence of the crisis, but only around 20% of the Arena clusters reported the same (Figure 4).

No cluster organizations perceived their cluster projects to have become less relevant after the crisis, and about 70% in 2009 and 60% in 2010, thought that the crisis could strengthen the cluster organizations. When asked to concretize how and why the cluster organizations were important in coping with the crisis, the following examples were given:

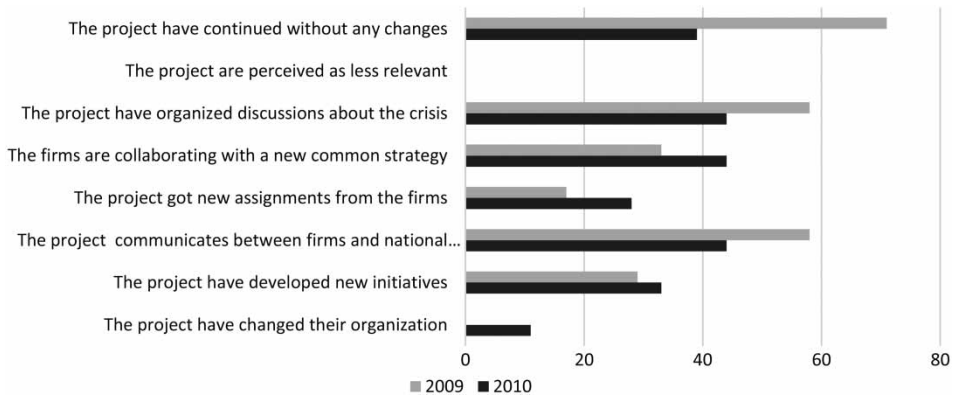


Figure 4. Perceived changes in the role of the cluster organization (percentage of respondents).

- Mapping new collaboration opportunities in new business areas
- Development of new marked possibilities
- Maintaining core competence
- Securing knowledge and competence acquired prior to the crisis
- Helping firms apply for public support for R&D

The cluster organizations' role as a point of contact between the industries and the national and regional authorities, during and after the crisis, was also emphasized in four cases. About half of the survey respondents stated that the cluster organization increased communication between firms and national government agencies. For example, in the Oslo Cancer Cluster, the cluster organization had the ability, and the knowhow, to influence and inform politicians about the situation facing their firms. A similar role was described regarding the lightweight materials industry at Raufoss, where it was important that the firms in the cluster could speak with "one voice" to the government, stating that whole industries were in danger, not only specific companies. This form of collective bargaining on behalf of the cluster seemed to be a common approach to coping with uncertainty and resource dependence.

The Impact of Crisis and Adaptation Strategies in Mature and Emerging Clusters

The data collected in this study provide insight into the expected impact and experienced effects of the financial crisis on Norwegian clusters. In general, the impact of the crisis at the onset was expected to be greater—in terms of both negative and positive consequences—than the impacts experienced after the most acute part of the crisis. Although the impact for most of the clusters turned out to be less dramatic than they expected in 2009, the crisis affected all clusters in different ways, and the cluster organizations took different steps to cope with the crisis.

Based on the survey and case material, our data indicate that the consequences of the financial crisis were particularly great in the early phase of the crisis, both for the emerging and the more mature clusters, and with relatively equal impact on both types of clusters. Nonetheless, there are some indications that the consequences were especially acute for

some clusters with a high degree of R&D activities. According to informants, the severe short-term impact was due to the severely constrained or non-existent opportunities to take on risk and lack of access to fresh capital. The main challenge for these clusters was to secure access to external capital to fund on-going and planned innovation activities.

Some of the more mature clusters with a strong dependence on global markets faced a sudden drop in demand, leading to decreased production and lay-offs. This was especially true for suppliers of car-parts in the Raufoss cluster, but was widely expected in the maritime cluster. The threatened loss of key competences was the immediate concern in these clusters, along with maintaining and developing competence and R&D capacity in the region. In these clusters, the crises represented both a challenge in terms of potential loss of key competence and an opportunity for investing slack resources in competence development and innovation activities, and key adaption strategies emerged that focused on innovation and support to develop regional innovation systems.

The case studies suggest that the clusters with global markets were harder hit as the demand dropped. We do not see that the emerging Arena clusters report a greater degree of failing markets or degree of bankruptcies or access to capital after the crisis than in the mature NCE clusters, as was expected by cluster life cycle theory. Rather, the mature and the emerging clusters report similar impacts of the crisis. However, the mature clusters report more actions and activities being taken by the cluster to cope with the longer-term impact of the crisis. For instance, more than 80% of informants in the NCE clusters report that the crisis led to new innovation strategies, as well as having revitalized the innovation collaboration in the cluster. In the emerging Arena clusters, only about 40% of the cluster organizations reported that the crisis had led to new innovation strategies, and 60% reported revitalized innovation collaboration within the cluster. The more mature NCE clusters also reported a higher degree of revitalized cooperation between companies and research institutions. There was, however, a drop in reported R&D cooperation as a consequence of the crisis from 2009 to 2010. For the more mature NCE clusters, around 60% reported revitalized cooperation between companies and R&D institutions in 2010, down from almost 90% in 2009. For the less-mature Arena clusters, the equivalent results were 40 and 60%, respectively. Data from the cases studies indicate that as production again increased after 2009, the extra capacity used in research activities and supplementary training was no longer available. The supply of crisis-related government funding for such activities also decreased.

The second question concerned the role and activities of cluster organizations during the crises and how they potentially acted to support innovation through the crisis. According to the informants, the cluster organizations kept their main goals and strategies, and did not change their focus and main activities to accommodate new demands. Stimulating learning among the members in the cluster still remained the main focus. At the same time, it is apparent that the cluster organizations also acted purposively to improve the conditions for the firms in the clusters. Although the clusters are fairly loose networks of firms, the cluster organizations used their collective bargaining position to communicate and influence the policy agenda both regionally and nationally, to win support for their industries. This "spokesman" role was more or less explicit, but was apparent in all cases, as is also shown in the survey. The cluster organizations worked on the regional level with public agencies, innovation support agencies and higher education institutions to keep competences and R&D capacity in the region, and nationally, with ministries and the parliament, to attempt to influence the national crises management strategy and the stimulus packages

in particular. Collective bargaining with public authorities seems to have been a central approach in the clusters' attempts to reduce uncertainty, and the importance of collective bargaining strategies seems to depend on the extent of the uncertainty that the crisis represented for the clusters. The automotive cluster and the cancer cluster represent very different clusters, but collective bargaining was important for both, as they faced the most dramatic prospects of a prolonged financial crisis.

Discussion and Conclusion

The theoretical framework of the study started out by analysing clusters as a form of collaborative firm behaviour from a resource-dependence perspective. This perspective is based on the premise that firms require access to resources held by other organizations to survive, and that resource needs (degree and type of resources needed) depend on the characteristics of firms (innovation strategy, strategic position, position in social network) and industries (degree of competition, industrial life cycle phase). Further, it was expected that resource needs motivate firms to enter into collaborative relationships, including partnerships, clusters, networks, etc. This perspective was compared to the literature on clusters which has been more preoccupied with describing advantages of clustering than explaining cluster formation in itself. However, research on clusters' functions or roles directly or indirectly emphasizes how clusters act as resource pools (financial resources, knowledge or political power) and that clusters that differ in maturity have different degrees and types of resource needs. As a consequence, clusters have different roles to play in supporting firms in different stages of the cluster life cycle. According to Pitelis (2013) there are theoretical gains to be made by combining firm-level and cluster-level theories of collaborative behaviour, and this paper aimed to make such a contribution, by combining a micro- and meso-level perspective on firm collaborative behaviour and clusters.

Based on a review of these different but related research traditions, two propositions were set out regarding the role of clusters in crises: (1) that clusters would be important for crisis adaptation, in providing access to resources and risk reduction; and (2), that clusters would be particularly important for emerging clusters in crisis adaptation situations, due to their greater vulnerability and resource needs.

The data only partially support these propositions. In terms of the first proposition, both the survey and case study data indicate that clusters reduce uncertainty and provide access to necessary resources (financial capital and competence/knowledge) in crises periods. The data also indicate that this is not only due to increased collaboration between firms in the cluster, but also due to the "spokesman role" and increased bargaining with regional and national policy makers and public funders on behalf of cluster firms. Clusters with firms which have the highest degree of dependence on external resources, in this case firms with a high degree of R&D requiring external funding, were particularly active in lobbying for access to resources for their. This fits with Simmie's (2006) view that firms form clusters as a response to dependence on external resources, due to their high innovation efforts, and also illustrates the notion of clusters as "financial spaces" as discussed by Henry *et al.* (2006). In these findings, this study also contributes to the understanding of clusters as political organizations, and illustrates how cluster organizations can, in certain situations function as mechanisms for generating public attention and public resources, a function of clusters less often described in the literature.

In terms of the second proposition, the data provide little support for the expectation that cluster organizations' support of innovation activities being particularly important for emerging clusters. Some of the findings are broadly in line with these expectations; clusters where firms are involved in extensive R&D activities, with high demands on external capital and high risks—such as in the cancer cluster—show the cluster organization to play a strategic role in crisis management. However, the data also show that clusters work in two ways, supporting both more mature and emerging sectors. For the mature industries, the clusters represented an opportunity to invest in new competence building and research activities, when demand for their products dropped. For firms in emerging industries, with high investments in innovation and product development, clustering is a way to ensure access to resources necessary to continue on-going R&D in the firms (Audretsch & Feldman, 1996). This pattern does not seem to reflect the experiences of emerging clusters more generally. Comparing the experienced impact and adaptation strategies of mature and emerging clusters funded by two Norwegian cluster programmes, it is clear that the mature NCE clusters have adapted to crisis by implementing new innovation strategies, and by increasing collaboration and competence-building activities, and less so the emerging Arena clusters. This might be due to the differences in demand facing firms in the respective clusters, since many of the Arena clusters have a national market and depend less on external resources for R&D, but it might also be due to differences in opportunities or capabilities in the cluster organizations to initiate activities for coping with economic crises. These findings provide some support to Menzel & Fornahl's (2010) argument that, as clusters grow in size (number of firms and volume of employment) and mature, they develop systemic qualities, which make them better at capitalizing on new opportunities such as those presented by the crisis. The findings also suggest that certain kinds of strategies were more important to the mature NCE clusters than the emerging Arena clusters, in particular when it came to bargaining power—in terms of lobbying for better financial support during the crisis—and improved capabilities and resources for collective actions in terms of starting new innovation projects within the cluster.

In general, the conclusion of this study is that clusters, as a form of collective organization, are important for coping with the immediate impact of the financial crisis, first and foremost by ensuring access to needed resources but also for some of the clusters as a way of stimulating innovation. Second, the mature clusters appear to have been particularly able to capitalize on the opportunities that the crisis represented. To capitalize on the creative potential of a crisis, as argued by Schumpeter, requires that firms are able to support and accelerate innovation activities in crisis periods by utilizing slack resources and gathering support and external resources from external sources for new innovations. This requires not only the ability to see new opportunities but having a well-developed capacity for utilizing those opportunities; the mature clusters are clearly in a more favourable position to do so. The data therefore provide micro-level insights into the conclusion made by Guellec and Wunsch-Vincent (2009), Filippetti and Archibugi (2011) and Antonioli *et al.* (2011) about the relationship between innovation capabilities before the crisis and innovation performance during and after the crisis.

The analysis does, however have limitations since the data was collected from existing cluster organizations, that might over-estimate the role of the cluster organization, and conclusions need to be checked against more unobtrusive measures and larger data sets, as well as data collected from firms rather than cluster organizations. Further research should look at the longer-term impact of the economic crisis, and the potential roles

that clusters play to accommodate longer-term crises. It is also important to consider that, in the Norwegian case, the Government used large sums of public money to assist firms in the financial crisis period, distributed through several public programmes, which is of relevance to understand the role of the clusters in ensuring access to external funding. In the current economic crisis in Europe, where state funds for research and innovation are being cut, clusters might act differently. Thus, a comparative approach would also be needed to investigate the role of clusters in crises in different economic, political and regional contexts.

Notes

1. The numbers of clusters varies, and some clusters not responding in 2009 was excluded from the 2010 survey.
2. In their Global Financial Stability Report, IMF reported in October 2009 that “the recovery has started, and the challenge is to sustain it”.
3. St.prp.nr.37 (2008–2009), Innovasjon Norge, Forskningsrådet og Nav.

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