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Evaluation of Norwegian Innovation Clusters

Report 76-2017

Preface

Innovation Norway has commissioned Samfunnsøkonomisk analyse AS to evaluate the Norwegian Innovation Clusters programme. The programme is organised by Innovation Norway, in a joint effort with Siva (the Industrial Development Corporation of Norway) and the Research Council of Norway. The Norwegian Innovation Clusters (NIC) programme was launched in 2014 and aims to increase growth by promoting and improving collaboration activities in the clusters.

Seven cluster projects were completed in 2016. These are evaluated as part of the commissioned programme evaluation. The seven projects consist of four Norwegian Centres of Expertise (NCE) projects and three Arena projects.

Technopolis Group has contributed to the evaluation with an international comparison using three case studies of cluster programmes in Germany, Denmark and France.

We would like to thank everyone who kindly took the time to answer all our questions. We would also like to thank the members of the reference group for interesting discussions and useful feedback.

The evaluation was conducted during the period from March to October 2017. Samfunnsøkonomisk analyse AS is responsible for all the content of this report.

Oslo, 8 December 2017

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Summary

Since the early 2000s, Norway has had a strategy to strengthen industry clusters through a national cluster programme. The Arena programme was launched in 2002, since when it has supported nearly 70 cluster projects. Norwegian Centres of Expertise (NCE) was launched in 2006 to further strengthen interaction in the Norwegian innovation system. NCE has supported 15 projects. In 2014, Arena and NCE were merged into one programme: the Norwegian Innovation Clusters programme (NIC). At the same time, Global Centres of Expertise (GCE) was initiated as a third level. GCE supports three cluster projects.

Arena targets clusters of newly established and/or immature collaboration initiatives. Arena clusters can be relatively small and primarily have a regional position, or be larger with a national position. Arena offers support for cluster projects with a duration of three years (phase 1). In addition, there is an opportunity to apply for a two-year extension of the project (phase 2). The grant per project is normally within NOK 1.5-3 million per year.

NCE targets clusters with a well-established national position and further national and international growth potential. NCE offers support for up to ten years. The grant per project is normally within NOK 4-6 million per year.

GCE targets clusters with a well-established position within global value chains. GCE does not offer financial support for cluster development. The current cluster programme limits GCE projects to maximum ten years. The grant per project is normally within NOK 8-10 million per year.

Norwegian Innovation Clusters has grown to become an important industry policy instrument over the years. The cluster programme had a total budget of NOK 166 million in 2016. The introduction of GCE increased the size of the programme by about 25 per cent.

Innovation Norway has commissioned Samfunnsøkonomisk analyse AS to conduct this evaluation of the Norwegian Innovation Clusters programme, as well as an evaluation of seven completed cluster projects.

The main objective of this evaluation is to assess the extent to which the programme meets the needs of the target group, whether the operation and organisation of the programme are appropriate and whether the effects are in accordance with the objectives.

The evaluation assessed the following:

- The extent to which the market or system failure constituting the rationale for the programme still exists, and whether and which alternative measures are available to compensate for these failures (relevance).
- Whether the cluster projects have achieved their stated objectives and whether they collectively contribute to achieving their programme level's objectives and the programme's shared objectives (effectiveness).
- The organisation and operation of the cluster programme, including an assessment of whether changes to the organisation and operation have contributed to the programme's relevance, effectiveness and efficiency.

A total of 47 cluster projects are included in the current evaluation. Of these, 29 are Arena projects, 15 are NCE projects and three are GCE projects. The first projects started up in around

2005, while the latest started up in 2016. Without distinguishing between type of membership or degree of involvement, these clusters have almost 2,600 members.

For analytical purposes, we have limited the sample of cluster members to limited liability companies (LLC). Furthermore, we have limited the selection of members in each cluster to LLCs located in the economic region we consider to be the cluster's geographical location. As we wish to focus on firms' performance, we have chosen to exclude research institutes organised as limited liability enterprises.

The cluster projects are located all over Norway, but the number of projects per region varies. Arena targets cluster projects with a regional position and a significantly larger proportion of clusters at this level are in more rural regions, compared to NCE and GCE clusters, which are all located in central regions. However, there is a tendency for a larger proportion of new Arena clusters to be in central regions.

Looking at which industries account for the largest proportion of members in the different clusters, it is apparent that professional, scientific and technical activities and ICT are the largest industries in most clusters, regardless of the cluster projects' objectives. In relative terms, manufacturing represents a significant share of employment across the three cluster levels, compared to the rest of the economy. Employment shares within selected manufacturing industries show a clear orientation towards the petroleum industry among the cluster projects. It also appears that Arena and NCE clusters have a relative advantage within ICT and professional, scientific and technical activities. The relative advantage within ICT has become clearer in recent years.

Looking at the evaluation questions mentioned above, we conclude as follows:

The rationale for the programme is still present

Our review of different theories concerning how clusters occur and how cluster dynamics can be stimulated shows that the Norwegian Innovation Clusters programme has developed an instrument that is adapted to strengthening dynamic effects in Norwegian clusters.

It is important to distinguish between cluster effects, i.e. effects resulting from collaboration in clusters, and effects of the cluster programme. The cluster programmes' role is to stimulate cluster development, or more specifically to *trigger collaboration-based development* which would not otherwise have happened, and *to reinforce and accelerate existing collaboration*. This concerns stimulating collaborative potential (relational basis), as well as specific collaboration processes.

It is our assessment that the Norwegian Innovation Clusters programme is based on a solid academic foundation and that there is reason to assume that the programme activities should result in more collaborative activities, enhanced innovation, and subsequently increased value added, than would otherwise have been the case.

However, we do not find a theoretical justification for a cluster programme with three levels, potentially supporting cluster projects for 20 years.

Cluster status enhances visibility and pride

On applying for admission to the programme, firms develop better knowledge of each other and search for new opportunities for collaboration. As a result, firms identify more with each other than

before, and wish to develop new meeting places, while the number of collaboration projects increases and pride in belonging to an acknowledged industry environment is clear among the firms themselves and in their local community.

Interviews reveal that this positive attention contributes to an internal sense of pride, which in turn creates an interest in contributing to the further development of the cluster project.

The cluster programme's impact on clusters' visibility, pride and identity is, in our opinion, primarily an argument that supports the continued uptake of new clusters to the programme. However, the argument is conditional on the existence of positive effects on firms' performance. If not, recognition and visibility could have been achieved in other and simpler ways (e.g. award ceremonies).

Significant growth in collaboration

In this evaluation, we have analysed whether participation in a cluster project has had an impact on the participating firms' R&D collaboration networks. Since our available data comprises detailed information about firms and research institutions that are engaged in different R&D projects, we have been able to construct an R&D collaboration network for each cluster firm by counting direct links between them and other R&D project collaborators. We have also constructed cluster networks, i.e. links between all firms and research institutions participating in the given cluster.

The results are striking. When we compare collaboration links before and after enrolment in a cluster, the collaboration between cluster firms in the same cluster has doubled in the Arena projects. Similar collaboration has more than doubled in the NCE projects. We also find a significant increase in collaboration between cluster firms and R&D institutions in the same cluster.

Based on the above, it is our clear conclusion that Norwegian Innovation Clusters contributes to more innovation-oriented collaboration between members of the cluster projects, and between members and R&D institutions. There is further reason to assume that this collaboration contributes to greater innovation than would otherwise have been the case, although this conclusion requires a separate analysis.

Increased innovation activity

We have no data that directly measures the extent of firms' innovation activity before and after enrolment in a cluster project with support from the cluster programme. However, the development in the number of R&D projects with support from the Norwegian R&D tax credit scheme SkatteFUNN is closely linked to changes in firms' innovation projects. SkatteFUNN is intended to stimulate R&D within all industries. All firms with an approved innovation project are eligible for tax credit. A firm with an actual innovation project thus has no reason not to apply for tax credit.

We find that the cluster members in our sample have higher growth in the number of innovation projects within the SkatteFUNN scheme than other firms. However, it is not clear whether this can be attributed to their participation in clusters.

Significant economic growth

Comparing cluster members in our sample with a matched control group, we find significant positive effects on employment, sales revenues and value added in the first three years after enrol-

ment in a cluster project. We do not find significantly higher growth among the cluster members in the second three-year period after enrolment.

Our econometric results are in line with what we would expect from the theory of public cluster support, the rationale for Norwegian Innovation Clusters and the previous evaluations of effects on firms' performance of participation in the Norwegian cluster programme.

Our interpretation is that the cluster projects trigger unresolved dynamic processes in the respective cluster projects.

Based on the above, it is our clear recommendation that Norwegian Innovation Clusters continues to support both new and existing cluster projects. However, it is our interpretation that the cluster projects primarily have a "kick-off" effect. Thus, we recommend a more limited period of public funding of cluster projects than today, e.g. the termination of Arena projects after three years and NCE projects after seven (3+4) years.

Positive changes in organisation and operation

With the implementation of Norwegian Innovation Clusters (NIC) and in the years thereafter, several organisational changes have been made. We consider these to be a professionalisation of the operation of the programme and an efficiency improvement.

Compared to the number of firms supported, the programmes' annual budget is relatively modest. Given our results for firms' performance from participating in a cluster project, we find that the additional value added exceeds the programme's social costs after only two years.

Despite mostly positive organisational changes, one challenge remains. The cluster programme is not clear on how public funding of different cluster projects should or will be ended, i.e. the exit strategies are unclear.

It is our assessment that the programme will benefit from making it clear from the start that funding beyond the agreed number of years is impossible at NCE level, and only exceptionally for Arena clusters. Our recommendation not to allow for continuation after an ended NCE project follows our assessment of GCE.

The three existing GCE projects have clearly shown that they initiate many relevant activities that are likely to be important for the further development of the clusters, and – not least – have been very important for the clusters' conversion process. The latter has been important because the current GCE clusters are very closely linked to the rapid restructuring of the oil and gas sector. However, we have not been able to find theoretical arguments for supporting cluster projects beyond the ten years of support possible within NCE.

Ignoring the GCE clusters' (important) conversion efforts, only the development of common-good projects, to enhance their knowledge infrastructure, really justifies the long-term support, but this can be supported through other, more targeted schemes.

Alternative use of funds

Even though we do not find support for the long-term funding of cluster organisations in themselves, our evaluation reveals a need for more long-term support in situations where cluster organisations initiate larger common-good projects that are of a size and complexity that takes a long

time to achieve. Examples of such common-good projects are the development of new knowledge or research institutions and testing or laboratory facilities available to the entire cluster.

It is our assessment that both established and new clusters, outside or within the cluster programme, can help to reveal which knowledge infrastructures do not work optimally and what can be gained from establishing a long-term collaborative project to strengthen the development of these common goods. If Norwegian Innovation Clusters establishes application-based funding

schemes for such activities, the cluster programme will help to promote activities that firms are rarely able to promote on their own.

The advantage of restricting eligible applicants to clusters (with or without support from the cluster programme) is that this increases the likelihood that the project will be relevant to a large group of firms that have revealed their growth potential. Over time, it will probably be the clusters which continuously work to strengthen the dynamics of their own cluster that will win in such application-based competitions.

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1 Introduction

Localisation of industries have several explanations. However, the main explanations throughout history have been physical conditions, such as climate conditions and quality of the soil, the existence of mines and quarries, or within easy access by land or water (Marshall 1920). The benefits of industry agglomeration ultimately reflect gains that occur when proximity reduces transport costs, such as the costs of moving goods, people and ideas (Ellison, Glaeser and Kerr 2010).

Innovation takes place in interaction between people, organisations and businesses. Individual companies can, however, hardly keep track of, hold or deal with all relevant knowledge and are consequently dependent on interaction with other companies and research institutions (St.meld. nr. 20 (2004-2005)).

Information and knowledge spill-overs can give clustered firms a better production function than isolated producers (Krugman 1991a). Thus, countries seek to strengthen or replicate the success factors that have encouraged the concentration of innovative firms associated with the knowledge economy. A clear rationale for public support of clusters concerns the transaction costs and coordination costs of bringing the appropriate actors together (OECD 2007).

Several public schemes aimed at networks and clusters are intended to facilitate knowledge spill-overs between firms and research and education institutions. They include a variety of activities justified by theories of how innovation takes place in interaction between different operators (Meld. St. 27 (2016-2017)).

Cluster policies are an expression of political commitment and a set of specific government policy interventions aimed at strengthening existing clusters or facilitating the emergence of new ones. Modern cluster policies aim to put in place a favourable business ecosystem for innovation and entrepreneurship in which new winners can emerge, thereby supporting the development of emerging industries (European Comission 2015).

Norway has had a strategy to strengthen industry clusters through a national cluster programme since the beginning of the 2000s. The Arena programme was launched in 2002 and has since supported nearly 70 cluster projects. Norwegian Centres of Expertise (NCE) was launched in 2006 to further strengthen interactions in the Norwegian innovation system. NCE has supported 15 projects. In 2014, Arena and NCE were merged into one programme: the Norwegian Innovation Clusters programme. At the same time, Global Centres of Expertise (GCE) was initiated as a third level. GCE supports three cluster projects.

1.1 Evaluation of the programme

Innovation Norway, the Research Council and Siva[1] have commissioned this evaluation of the Norwegian Innovation Clusters programme, as well as an evaluation of the following seven completed cluster projects:

- Arena Biotech North
- Arena Lønnsomme vinteropplevelser
- Arena Smart Water Cluster
- NCE Instrumentation
- NCE Micro- and Nanotechnology
- NCE Raufoss

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[1] The Industrial Development Corporation of Norway.

- NCE Systems Engineering

The government has expressed a desire to develop the current cluster policy. Different schemes intended to increase innovation and value creation by stimulating collaboration in clusters are managed by different agencies and need to be seen in context. They also need to be seen in the context of other innovation and research schemes (Meld. St. 27 (2016-2017)).

As set out in the agreements between the cluster programme and the individual cluster projects, an external evaluation of each completed project should also be conducted.

The main objective of this evaluation is to assess the extent to which the programme meets the needs of the target group, whether the operation and organisation of the programme are appropriate, and whether the effects are in accordance with the objectives.

The evaluation is organised according to the OECD's criteria for evaluating development assistance.[2] This means that the evaluation is structured around three main criteria: relevance, effectiveness (including impact) and efficiency.

This evaluation will assess the following:

- The extent to which the market or system failures constituting the rationale for the programme are still present and whether alternative measures exist to compensate for these failures (relevance).

- Whether the cluster projects have achieved their stated objectives and whether they collectively contribute to achieving their programme level's objective and the cluster programme's common objectives (effectiveness).
- The organisation and operation of the cluster programme, including an assessment of whether changes to organisation and operation have contributed to the programme's relevance, effectiveness and efficiency.

To assess the abovementioned, we have reviewed programme and project descriptions, relevant policy documents and research papers and previous evaluations. Furthermore, we have interviewed relevant stakeholders, participating firms in the seven clusters subject to evaluation, and the project managers of each of the seven clusters.

We have analysed effects on firms' performance from participating in a cluster project by comparing growth in selected performance indicators (e.g. employment, revenues and productivity) for core members of the clusters with growth in similar firms not participating in a cluster project.[3]

In addition, we have mapped the firms' R&D networks by analysing their R&D collaboration in projects with public funding. Data and the empirical concept are described in more detail below.

1.2 Outline of the report

The following chapter gives a detailed presentation of the cluster programme and briefly describes the seven cluster projects which are subject to evaluation. These are described in more detail in separate reports.

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[2] http://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.html

[3] That is applying a matched difference-in-differences procedure.

Chapter 3 describes the theoretical foundation of cluster programmes both internationally and in Norway and assesses whether the current Norwegian programme can be justified in theory.

Chapter 4 maps the interaction with other public schemes. Chapter 5 analyses network effects for the participating firms. Chapter 6 analyses the effects of participation in a cluster project on firms' performance. Chapter 7 discusses the clusters' regional ripple effects. These chapters cover the assessment of the programme's effectiveness.

Chapter 8 assesses the organisation and operation of the programme, while Chapter 9 assesses the programme's costs. Chapter 10 presents selected international cluster programmes.

In Chapter 11, we conclude with the main results, their implications and policy recommendations.

2 The Norwegian Innovation Clusters programme

The Norwegian Innovation Clusters (NIC) programme was launched in 2014. The programme is a continuation of the Arena programme launched in 2002 and targeting immature clusters, and Norwegian Centres of Expertise (NCE) launched in 2006 and targeting mature clusters with a national position. With the introduction of NIC a third, and new level, Global Centres of Expertise (GCE) was also introduced, to target mature clusters with a global position.

Norwegian Innovation Clusters aims to promote and enhance collaboration activities in clusters. The government supports the cluster activities by financing cluster facilitators and common activities in each cluster within the framework of the programme. The goal is to increase the cluster's dynamics and attractiveness, and the individual company's innovativeness and competitiveness.[4]

2.1 Prelude to the current cluster programme

In a report from 2002, the Norwegian Ministry of Trade and Industry[5] discussed the need for a renewal of government-funded industrial policy schemes.[6] The report discusses, among other things, the trade-off between industry-neutral schemes and schemes targeting selected industries, technologies and fields of knowledge. The report concludes that the principles of neutrality should be maintained, but practised more flexibly than before, and that this can be achieved by prioritising efforts towards clusters or industries in an early development phase.

"(…) A public contribution to the development of clusters can, among other things, secure clusters that otherwise would not have been developed and help establish a sustainable critical mass. Developing clusters seems to be of great importance for value creation and the localisation of foreign businesses in Norway. It is therefore desirable to contribute to the development of both new and existing clusters and business environments in Norway."

The report addresses the challenge of choosing policy instruments that effectively contribute to promoting key business environments, without making the efforts ineffective and preserving the existing industry structure. However, it was emphasised that *"the most important thing is that the programme targets cluster mechanisms to promote knowledge transfers, increased interaction, collaboration, networking and learning."*

These ideas and references to theory first constituted the rationale for Arena and later NCE, which started as two separated programmes with similar objectives, but different target groups (see below). The establishment of NIC in 2014 continued the basic ideas and objectives of the two programmes, but included Arena and NCE as levels in a common cluster programme.

The change in the programme structure came as a result from earlier evaluations of the Arena programme (Jakobsen, Iversen, et al. 2011) and the NCE programme (Econ Pöyry and Damvad 2011). Jacobsen and Røtnes (2011) summed up these evaluations and recommended that the two existing cluster programmes should be continued and scaled up. Furthermore, the evaluation of NCE suggested that a stronger and more formal link between Arena and NCE would contribute to significant simplification and improvement in selecting new NCE projects.

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[4] http://www.innovationclusters.no/english/
[5] Merged into Ministry of Trade, Industry and Fisheries on 1 January 2014.

[6] https://www.regjeringen.no/no/dokumenter/virkemidler-for-morgendagens-naringsliv/id105778/?q=en%20helhetlig%20innovasjonspolitikk

Reve and Sasson (2012) later argued that there was a need for a third level in the range of network programmes, and suggested that a Global Centre of Expertise should be introduced. The reasoning behind the proposal was that industry clusters with the ambition to develop better knowledge dynamics would normally start at Level 1 (Arena), and then qualify for Level 2 (NCE), but that the network development should not end there. Hence, the suggested Level 3 (GCE), where the number of firms in the network would be expanded, and the number of knowledge links increased, with collaboration between several NCE clusters and with the network establishing links to global partners.

In June 2012, a project group appointed by the board of owners of Arena and NCE was commissioned to develop a framework for a comprehensive new cluster programme. The project group consisted of representatives from the owners of Arena and NCE: Innovation Norway, the Research Council of Norway and Siva. They submitted their proposal, including a possible framework for Global Centres of Expertise as a third level, to the board in October 2012, and the proposal was approved.

Innovation Norway, the Research Council and Siva sent their input on a new cluster programme to the Ministry of Trade and Industry and the Ministry of Local Government and Modernisation in March 2013. The proposed framework for a new programme was finalised in the first programme description dated 10 June 2013, when a new offer for mature clusters with a global position was introduced: Global Centres of Expertise.
A budgetary increase was allocated to the new cluster programme in the National Budget for 2014 and Norwegian Innovation Clusters was implemented through a call for proposals and the selection of new cluster projects in the first half of 2014.

2.2 Stakeholders and organisation[7]

Norwegian Innovation Clusters is jointly owned by Innovation Norway, the Research Council of Norway and Siva. This implies that all strategic decisions regarding the programme's development, involvement in cluster projects and monitoring of these are taken jointly by the three owners. A team from Innovation Norway and advisers from the Research Council and Siva are responsible for the programme's operational activities.

The programme is funded by the Ministry of Trade, Industry and Fisheries and the Ministry of Local Government and Modernisation.

An *advisory board* has been established to ensure a sound foundation for the programme. The council consist of eight representatives from different industries, knowledge institutions and regional development agencies, as well as the three abovementioned owners. The council advises the owners on the programme's strategic development and dispositions, including which cluster projects should be included in the programme and the approval of extensions or discontinuation in cases where the project is assessed to no longer be eligible for public funding.

Innovation Norway has the main operational responsibility, including managing grants and contracts with the cluster organisations (beneficiaries). This means that formal decisions regarding financing and contractual terms are taken by Innovation

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[7] This and the next section are based on the third programme instruction, dated January 12th, 2016.

Norway, which also reports on the programme's activities to the owners and financiers. Furthermore, there is programme management in Innovation Norway that develops strategies for the programme, which are approved by the programme owners.

The main responsibility for administration and management of the programme lies with two *programme managers,* one for Arena and one for NCE/GCE, both employed by Innovation Norway. The programme managers serve as sparring partners and oversee the monitoring of cluster projects in line with the agreements between the programme and the individual cluster project.

Innovation Norway's regional offices allocate an *account manager* to each cluster project. The account managers offer advice and guidance during the application process and are responsible for funding and payments throughout the project period, as well as monitoring the projects' progress and serving as strategic advisers.

The Research Council is responsible for developing the programme and cluster projects' engagement in R&D initiatives. The Research Council's regional representatives also participate in the ongoing dialogue with the cluster projects.

Siva is responsible for developing the programme and cluster projects' engagement in enhanced innovation efforts, especially through incubation.

2.3   Selection of cluster projects

The programme normally has an annual call for new projects. The programme is implemented as a national programme, so that all new cluster projects, at all levels, are assessed according to national criteria and procedures.

2.3.1   Requirements for applicants and application

There are no restrictions on who can apply for admission to the cluster programme. However, applicants for all levels (see the detailed description below) must meet a set of requirements for how the cluster project is organised, e.g. a legal entity as the formal applicant, a defined partnership between actors in the cluster, a board representing the partnership and an operational management.

The project proposal must be in accordance with the purpose of the programme and the specific call for proposals. Furthermore, it should be the result of a joint process with the participation of key actors in the partnership.

2.3.2   Selection criteria

The selection criteria are specific for each programme level and are stated in detail in the specific calls for application. However, they are all structured according to the following main questions:

A.   The cluster's resources and position (baseline)

  1.   Cluster resources: Does the cluster have a composition of stakeholders and a collaborative foundation that provide a basis for collaboration-based innovation and development of the cluster and its participants?
  2.   The cluster's position and potential: Does the cluster have an established position and potential for further growth that can be utilised for increased innovation and value added?

B.   The quality and relevance of the cluster project

  3.   The cluster project's objectives, strategies and potential impact: Does the cluster project have a strategic idea that can help

achieve the objectives of innovation and value creation?

4. Ownership and leadership: Does the cluster project provide a necessary foundation among participants and a professional leadership that can help trigger strategic collaboration activities?

5. Plan for implementation: Does the cluster project have a well-developed plan for implementation and a resource base that can provide the basis for effective and targeted implementation?

2.3.3 Selection procedure

Project proposals are assessed in accordance with specified procedures explained in the individual calls. The selection of new cluster projects is normally conducted in two stages: (i) potential applicants submit outlines (mandatory) which provide the basis for initial feedback; and (ii) applicants submit complete applications for assessment and decision.

The outline must include details of the level at which it is applied, applicant information and information that makes it possible to assess the project according to the above questions (e.g. the project's objectives and the cluster's relational prerequisites). The complete application should be an elaboration of the outline submitted.

A group of independent external experts evaluates the applications, while complementary assessments, such as interviewing applicants, are conducted by the programme management. Furthermore, the board of owners decides, in principle, on new cluster projects.

Cluster projects included in and funded by the programme enter into agreements governing the relationship between the programme and the project.

2.4 Three different programme levels

Norwegian Innovation Clusters supports cluster projects at three levels. These levels differ from each other in two important areas: (i) *target group* and (ii) *duration of support*.

Arena targets immature clusters and the projects are supported for a period of three to five years. NCE targets mature clusters with a national position, while GCE targets mature clusters with a global position. NCE and GCE support projects for up to ten years.

Each cluster project establishes its specific objectives, based on the cluster's established position and prerequisites for further development (in accordance with the abovementioned selection criteria) and the specific objectives for the individual programme level (cf. Table 2.1). As is evident from the stated impact and output targets, the main difference between the three programme levels is that the requirements for achieving the objectives reflect higher aspirations.

In the following the different programme levels are presented in more detail.

2.4.1 Arena

The Arena programme was established in 2002 based on experience from a series of regional pilot projects in the period before 2002. The programme is intended to increase firms' and industries' ability for innovation, through increased and enhanced collaboration.

Arena targets clusters of newly established and/or immature collaboration initiatives, with an organisation, strategic platform and resource base that provide good potential for further growth based on collaboration. Arena clusters can be relatively small

and primarily have a regional position, or be larger with a national position.

Arena offers financial and professional support to cluster projects with a duration of three years (phase 1). In addition, there is an opportunity to apply for a two-year extension of the project (phase 2). A status assessment is conducted after three years to assess the grounds for extension. Projects that apply for extension are assessed according to the following criteria:

1. Effectiveness (performance) during the first three years.
2. Implementation, ownership and leadership during the first three years.
3. Potential for further results and effects if the project is extended.

Table 2.1

Objectives for cluster projects at the individual programme level

Impact targets			
	Arena	**NCE**	**GCE**
	Increased ability for innovation	Increased value creation within the cluster	Increased value creation and attractiveness and a position within global value chains
Output targets			
	Arena	**NCE**	**GCE**
Innovation skills	Increased innovation collaboration and innovation activity	Increased innovation activity through systematic collaboration between firms and R&D institutions	Increased innovation activity with a significant impact within radical innovation processes
International orientation	New or enhanced relationships with international partners	Increased collaboration with international partners	Increased strategic collaboration with leading international partners
Access to competence	Better access to relevant competence	Better access to relevant competence through strategic collaboration with educational institutions	Better access to relevant competence through strategic cooperation with leading national and international educational institutions
Attractiveness and visibility	Increased regional recognition as an innovative and sustainable environment	Increased recognition as a nationally important environment for innovation and growth	Increased recognition as a hub or node in a global innovation system
Interaction and collaboration	Increased dialogue and collaboration internally and externally	Increased targeted collaboration internally and externally	Increased strategic collaboration internally and externally

Source: Programme description 12 January 2015

4. Objectives, strategy plan for implementation for the next two-year period.

Arena projects are subject to external evaluation at the end of the project period.

Arena clusters may apply for participation at the next level (NCE) during the project period. Approval of the application implies that the current agreement is terminated and replaced by a new agreement in accordance with the requirements at the new level.

Arena has supported around 70 cluster projects since the establishment in 2002 and currently supports 18 cluster projects (see list of projects and their characteristics below).

2.4.2 Norwegian Centres of Expertise

Norwegian Centres of Expertise (NCE) was established in 2006 based on prior analyses and inspiration from other countries. NCE is intended to focus, improve and accelerate already ongoing development processes in clusters that have established systematic collaboration, with potential for growth in both national and international markets.

NCE targets clusters with an established organisation, with well-developed services, partners with experience and achieved results from collaboration projects, a well-established national position and further national and international growth potential.

NCE offers financial and professional support to cluster projects with a duration of five years. If the cluster project is recruited directly into NCE (not following an Arena project), it may apply for a second

contract period of five years. If the cluster started out as an Arena project, the years in Arena is deducted, so that the project period does not exceed ten years. A status assessment is conducted after two years, and after seven years if the project is extended. NCE projects are subject to external evaluation after five years, to assess the grounds for extension, and at the end of the project period.

NCE clusters may apply for participation at the next level (GCE) during the project period. Approval of the application entails that the current agreement is terminated and replaced by a new agreement in accordance with the requirements at the new level.

NCE has supported 15 cluster projects since 2006, of which 11 are currently active (see list of projects and their characteristics below).

2.4.3 Global Centres of Expertise

Global Centres of Expertise (GCE) was introduced in 2014 with the establishment of Norwegian Innovation Clusters (see discussion above). GCE is intended to increase value creation and attractiveness in clusters with considerable potential for growth in both national and international markets.

GCE targets clusters with a well-functioning organisation, a critical mass of partners with high interaction in a broad strategic area of activity, anchored in a well-functioning innovation system, and with a well-established position within global value chains.

Due to state aid rules, GCE does not offer financial support for cluster development (operational activities)[8], and there are thus no formal limitations to the

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[8] The EEA agreement limits the Norwegian authorities' opportunities to provide support for business activities. Financial support for operating activities to the legal entity that operates a cluster can be granted for five years with an aid intensity that is either linearly decreasing from 100 to 0

per cent throughout the project period, or fixed at 50 per cent over a five-year period. Support may be granted beyond five years and up to ten years if the need for this is sufficiently documented (Fornyings-, administrasjons- og kirkedepartementet 2010).

maximum time horizon for the projects. However, the current cluster programme limits GCE projects to maximum ten years. GCE offers financial support to increase and enhance knowledge, innovation and cluster-to-cluster collaboration (see below). GCE follows the same evaluation routines as NCE.

GCE supports three cluster projects, all of which have been NCE clusters.

2.5 Funding of cluster projects

Norwegian Innovation Clusters offers partial funding of cluster projects through annual grants for activities organised by the cluster management. Financial support given through the cluster programme is intended for activities considered to be strategically important to achieving the purpose of the given cluster project.

2.5.1 Strategic priorities and eligible activities[9]

Funded activities should be based on the cluster project's strategy, as well as collaboration between several partners or participants, and have openly available results. All costs funded by the cluster programme should be linked to activities in the following four strategic priorities:

A. General cluster development: The purpose is to carry out basic services within the cluster, i.e. managing and developing the cluster based on efforts from the contractor, project manager and participants in the cluster.

B. Knowledge collaboration: The purpose is to establish and strengthen collaboration between participants in the cluster and R&D&I

and educational institutions, both nationally and internationally.

C. Innovation collaboration: The purpose is to contribute to more and more quickly initiated R&D&I-based collaboration projects in the cluster, as well as technology dissemination linked to these projects.

D. Cluster-to-cluster collaboration: The purpose is to initiate and reinforce strategic alliances with other clusters to establish research and innovation collaboration between firms in the clusters and knowledge institutions.

Table 2.2

Examples of activities eligible for support from the cluster programme

Strategic priorities and activities
A General cluster development
Facilitation of collaboration and information sharing
Management of cluster facilities
Analytical processes to develop the cluster's activities
Promotion of the cluster
Organisation of training, networks and meeting places
B Knowledge collaboration
Explore, establish and reinforce links to R&D institutions
Strategic collaboration with educational institutions
Apply and disseminate new knowledge
C Innovation collaboration
Early stage innovation projects
Technology dissemination linked to R&D activities
Establish technical and intangible infrastructure
D D Cluster-to-cluster collaboration
General networking and dialogue
Establish strategic partnerships
Develop collaboration in SME groupings

Source: Programme instruction dated 12 January 2016

The objectives under the latter three priorities include activities that arise from general cluster development (A). The activities (see examples in Table

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[9] This section is based on the third programme instruction, dated 12 January 2016.

2.2) are organised as sub-projects conducted in collaboration between cluster participants, with the support of the project manager (of the cluster project) where it is needed.

The main principles for eligible cost are the contractor/project manager's personnel and administrative costs (A), personnel costs, etc. for project participants (B-D) and costs for advisory services, etc. (D).

Arena and NCE can support activities within all strategic priorities from A to D above, whereas GCE can only support activities from B to D.

2.5.2 Annual budget

The cluster programme had a budget of around NOK 143 million for cluster projects in 2016. Including administrative costs, the total budget was approximately NOK 166 million (Innovation Norway 2016). Compared to the years prior to the establishment of Norwegian Innovation Clusters, except for 2009[10] and 2012[11], there has been a significant increase in the cluster programme's annual budget (cf. figure 2.1). This is due to the introduction of GCE, which has larger budgets per project, and an increase in the number of cluster projects. With the increase in the number of cluster projects, and mainly Arena projects, the average project size has decreased (cf. figure 2.2).

The size of the annual grants is determined by the cluster project's format, level of activity and the programme's financial resources. Furthermore, the grant is differentiated for the three programme levels and will normally be within the following limits:

- Arena: NOK 1.5-3 million. per year

- NCE: NOK 4-6 million per year
- GCE: NOK 8-10 million per year

Total funding of cluster projects.[1] NOK million. Constant 2016 prices. 2002-2016
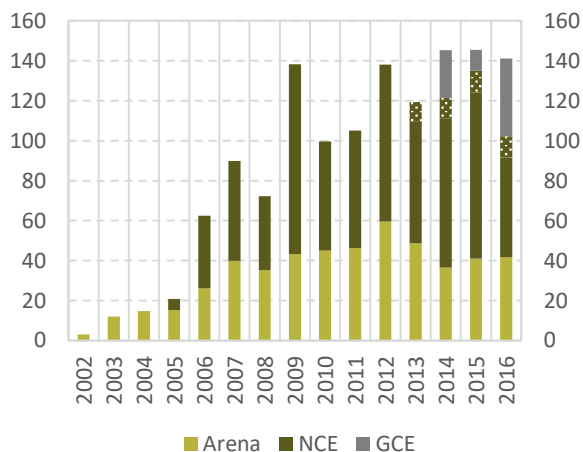
Source: Samfunnsøkonomisk analyse AS
1) The dotted area indicates grants to NCE clusters via Innovation Norway's scheme 1022 (see explanation below).

Figure 2.2

Average funding per cluster project.[1] NOK million. Constant 2016 prices. 2002-2016
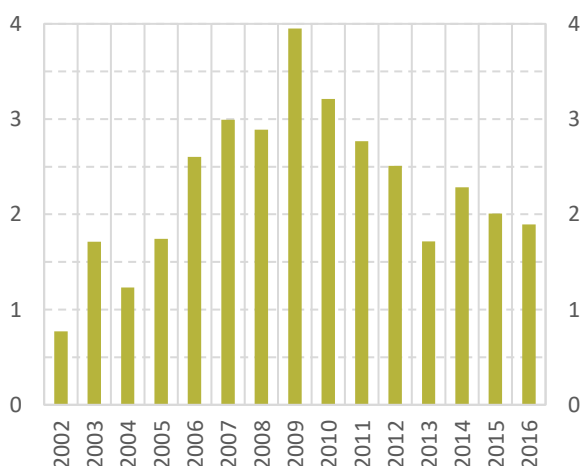
Source: Samfunnsøkonomisk analyse AS
1) Excl. scheme 1022 (development funding for NCE).

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[10] The increase in 2009 is mainly due to time displacements of NCE projects in previous years and the lag from 2008 is largely retrieved in 2009 (Innovation Norway 2009).

[11] The increase in funding of Arena projects in 2012 is mainly due to time displacements in previous years and transferred funds from 2011 (Innovation Norway 2012).

2.5.3 Self-financing and other funding

The cluster programme mainly finances up to 50 per cent of the total cost of eligible activities. The remainder should be funded by members of the cluster in the form of cash payments (membership fees), or hourly rates and direct expenses (connected to implemented projects).

In addition to the programme-specific funding from the Ministry of Trade, Industry and Fisheries and the Ministry of Local Government and Modernisation (managed by Innovation Norway), since 2013 the cluster programme has allocated funds from the Ministry of Trade, Industry and Fisheries to a line of credit for cluster projects, called "Innovasjonsrammen" (cf. scheme 1022 in figure 2.1).

The purpose of "Innovasjonsrammen" is to stimulate innovation through greater collaboration between firms. Both present and former cluster projects in the cluster programme can apply for these funds. If granted, the clusters can prioritise which projects, within the cluster, they will support themselves, and these funds are thus more flexible than the programme-specific funding (A-D).

A cluster project may also receive funding from other public sources than Innovation Norway, e.g. municipalities or county municipalities. If this funding is channelled to the same activities as the funding from the cluster programme (via Innovation Norway), this must be included in an overall budget for these activities and be in line with the requirements for maximum public funding. Additional funding of cluster projects must not be confused with the public funding that individual members may receive (see Chapter 4).

2.6 Professional services[12]

In addition to the abovementioned funding, the programme offers professional services to the clusters. This includes services aimed at developing a well-functioning cluster organisation with a qualified facilitator, and a network of relevant contacts and partners, with a visible profile. The professional services are based on the programme's own experience and relevant experience from related activities; theoretical perspectives, policy perspectives, etc. The programme's professional services include:

a. Competence services: Upgrading the cluster organisation's insight and skills to develop, manage and carry out cluster activities.
b. Advisory services: Develop the clusters' strategic organisation (offer counselling by external advisers).
c. Networking services: Develop and strengthen the clusters' contact and collaboration with external operators to develop the cluster.
d. Promotional services: Market and promote the clusters as important hubs for innovation and value creation.

These services are channelled to the clusters through gatherings, seminars, study tours, conferences, etc.

2.7 Termination of cluster projects (exits)

In the final phase of the project the project facilitator (manager) must plan how the cluster (collaboration) will continue without funding from the programme. This is referred to as the project's exit strategy. There must be a plan for termination or continuation

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[12] This section is based on the third programme instruction, dated 12 January 2016.

no later than six months before the contract with the cluster programme expires, e.g. both Arena and NCE clusters may apply for participation at the next level during the project period. An exit strategy is needed even when no continuation of the project is planned.

There are currently three GCE clusters. All three are former NCE clusters. Four other NCE clusters have reached the maximum ten years of funding, but are not continued as GCE. However, several of these have participated in pilots for other publicly funded programmes targeting clusters or business environments, such as Innovation Norway's *Klynger som omstillingsmotor* (Clusters for conversion) and Siva's *Norsk katapult* (Norwegian Catapult.

The abovementioned programmes are not designed to be continuations of the cluster projects as such, but they target leading clusters and mature business environments, and thus represent a possible path for cluster projects that are or have been part of the cluster programme. As both programmes have come up in our interviews with cluster managers, which we will pursue in our recommendations, we give a brief presentation of the two programmes in the following sections.

2.7.1 Clusters for conversion

Innovation Norway launched the pilot "Klynger som omstillingsmotor (KOM)" in the autumn of 2015. The pilot focused on (i) *increased productivity and innovation* and (ii) *digitisation.* The former was managed by Kongsberg Innovation (NCE Systems Engineering) and SINTEF Raufoss Manufacturing (NCE

Raufoss), and the latter by Smart Innovation Østfold (NCE Smart Energy Markets).

KOM aims to strengthen what already works in the leading clusters and make this available for firms outside the clusters across the country. The idea is that the clusters' expertise will boost the overall innovation and conversion rates. Applicants may be one or more established clusters, or a consortium with partners from different clusters and business environments.

Experience from the pilot shows that the clusters' expertise can contribute to faster conversion in SMEs outside the clusters in a cost-effective manner (Innovation Norway 2016).

Innovation Norway implemented "Klynger som omstillingsmotor" in 2017[13] and emphasises that the scheme must be seen in relation to "*Norsk katapult*".

2.7.2 Norwegian Catapult

Siva launched "Norwegian Catapult" in the spring of 2017.[14] The scheme is intended to strengthen the national infrastructure for innovation and thereby contribute to the faster, cheaper and better development of ideas, from the conceptual stage to market introduction. The establishment of catapult centres (pilot plants) will enable firms to test, simulate and visualise technologies, components, products, solutions and processes.

Norwegian Catapult targets applicants (a legal entity) with a strong connection to dynamic business environments, and has the capacity and ability to

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[13] On 1 November 2017, Innovation Norway appointed two groups to raise the level of knowledge and help small and medium-sized businesses across the country to exploit new business opportunities in the digital transformation. NCE Raufoss and GCE Subsea are part of one group and

Arena iKuben, Smart Innovation Norway (managing NCE Smart Energy Markets) and NCE Systems Engineering are part of the other group.
[14] Siva appointed two catapult centres on 20 October 2017. NCE Raufoss hosts one and NCE Eyde is part of the other.

develop a centre in line with the purpose of the scheme.

A dynamic business environment means an environment with established venues to meet, collaborate and share expertise for at least a dozen firms with a well-established position in global value chains. In general, the environment should have a well-functioning innovation system, a good international network, and established collaboration with R&D environments, both nationally and internationally.[15]

2.8 Cluster characteristics

A total of 47 cluster projects are included in the current evaluation (see the list of projects in table 2.4). These comprise 29 Arena projects, 15 NCE projects and three GCE projects. The first projects started in 2005, while the latest started in 2016. Without distinguishing between type of membership or degree of involvement, these clusters have included almost 2,600 members.

However, most clusters divide their members into four groups: core businesses, other active firms, R&D and educational institutions and public development operators. It appears that practice varies among the clusters in terms of how they categorise their members, especially when distinguishing between core members and other active firms. In the presentation of different cluster characteristics and in the econometric analysis (Chapter 4), it has been necessary to refine the selection of core members on a more consistent basis.

2.8.1 Core members

Our definition of core members is based on the list of participants categorised as "core businesses" and "other active firms". In accordance with previous evaluations of effects of participation in a cluster project, we have chosen to limit the selection of core members to limited liability companies (LLC).[16]

Table 2.3
Number of core members per cluster level by enrolment year. 2005-2016

Enrolment year	Arena	NCE	GCE[1]	Total
2005			23	23
2006		51	22	73
2007		8	8	16
2008		3	7	10
2009		23	21	44
2010	31	15	28	74
2011	61	46	12	119
2012	97	31	10	138
2013	42	55	13	110
2014	90	28	9	127
2015	71	75	11	157
2016	107	59	11	177
Total	499	394	175	1,068

Source: Samfunnsøkonomisk analyse AS
1) All GCEs were previously NCEs, but are categorised as GCE throughout the entire period. Though NCE was established in 2006 some firms are registered with enrolment in 2005

Further, we have limited the selection of core members in each cluster to LLCs located in the economic region[17] we consider to be the cluster's geographical localisation (see next section). As we wish to focus on the firms' performance, we have chosen to exclude research institutes organised as limited liability enterprises.

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[15] https://siva.no/norsk-katapult/beskrivelse-av-ordningen/
[16] The econometric analysis presented in Chapter 4 largely follows the method used in annual evaluations of effects on firms' performance of the support from Innovation Norway (Cappelen, et al. 2015). Furthermore, to study effects on and the development in the number of employees, value creation, productivity, etc. it is a prerequisite that the cluster members are

present in accounting data. All LLCs are liable for accounting and by refining the selection of core members to these firms we ensure that we have the necessary information on all firms in our sample.
[17] Economic region is a regional classification for the level between county and municipality. The main criteria used for defining the regions are labour market and trade. The classification corresponds to the NUTS 4 level in the EU's regional classification.

Table 2.4
Cluster projects included in the evaluation (highlighted clusters are subject to individual evaluation)

Cluster project[1]	Economic region[2]	Main industry[3]	Members[4]
Arena Arktisk Maritim Klynge (2013-)	Harstad	50 Water transport	10 (10)
Arena Arktisk Vedlikehold (2014-)	Hammerfest	52 Support activities for transportation	5 (8)
Arena Biotech North (2012-2016)	Tromsø	72 Scientific research and development	29 (21)
Arena Blue Legasea (2014-)	Ålesund	10 Food products	18 (13)
Arena DesignArena (2012-)	Bergen	74 Other prof., scientific, techn. act.	45 (31)
Arena Digin (2009-2015)	Kristiansand	62 Computer programming, consultancy	20 (39)
Arena Electric Mobility Norway (2011-2015)	Drammen	35 Electricity, gas and steam	13 (7)
Arena Heidner (2012-)	Hamar	72 Scientific research and development	7 (13)
Arena i4plastics (2014-)	Gjøvik	22 Rubber and plastic products	12 (7)
Arena iKuben (2011-)	Molde	71 Architecture, engineering activities	26 (25)
Arena Innovasjon Torskefisk (2015-)	Vesterålen	10 Food products	14 (14)
Arena Lønnsomme vinteropplevelser (2011-2016)	Tromsø	79 Travel agencies, tour operators	20 (22)
Arena Mineralklynge Norge (2012-)	Mo i Rana	07 Mining of metal ores	23 (5)
Arena Norwegian Fashion Hub (2014-)	Oslo	46 Wholesale trade	34 (15)
Arena Norwegian Rooms (2013-)	Ålesund	31 Furniture	15 (14)
Arena Norwegian Smart Care Cluster (2014-)	Stavanger	62 Computer programming, consultancy	31 (46)
Arena Nxt Media (2012-2015)	Trondheim	62 Computer programming, consultancy	9 (15)
Arena Ocean of Opportunities (2011-2014)	Stavanger	03 Fishing and aquaculture	9 (8)
Arena Olje- og gassklynge Helgeland (2015-)	Mo i Rana	25 Fabricated metal prod.	45 (13)
Arena Oslo Edtech Cluster (2016-)	Oslo	62 Computer programming, consultancy	30 (17)
Arena Skognæringa i Trøndelag (2016-)	Levanger	02 Forestry and logging	14 (5)
Arena Smart Grid Services (2011-2014)	Steinkjer	62 Computer programming, consultancy	15 (10)
Arena Smart Water Cluster (2010-2016)	Steinkjer	25 Fabricated metal prod.	25 (17)
Arena Solenergiklyngen (2016-)	Oslo	46 Wholesale trade	8 (14)
Arena Subsea Valley (2010-)	Oslo	46 Wholesale trade	170 (44)
Arena Tunnel Safety Cluster (2016-)	Stavanger	74 Other prof., scientific, techn. act.	7 (29)
Arena Usus (2010-2015)	Kristiansand	55 Accommodation	97 (21)
Arena Vannklyngen (2011-2014)	Tønsberg	46 Wholesale trade	16 (7)
Arena Vindenergi (2010-2014)	Trondheim	71 Architecture, engineering activities	19 (10)
GCE Blue Maritime (2005-)	Ålesund	46 Wholesale trade	36 (53)
GCE NODE (2005-)	Kristiansand	28 Machinery and equipment	91 (38)
GCE Subsea (2006-)	Bergen	71 Architecture, engineering activities	92 (84)
NCE Aquaculture (2007-)	Bodø	03 Fishing and aquaculture	23 (6)
NCE Aquatech Cluster (2016-)	Trondheim	71 Architecture, engineering activities	79 (24)
NCE Culinology (2009-)	Stavanger	10 Food products	11 (13)
NCE Eyde (2007-)	Kristiansand	71 Architecture, engineering activities	14 (9)
NCE Instrumentation (2006-2016)	Trondheim	71 Architecture, engineering activities	65 (35)
NCE Maritime CleanTech (2011-)	Sunnhordland	30 Other transport equipment	20 (18)
NCE Media (2013-)	Bergen	62 Computer programming, consultancy	12 (70)
NCE Micro- and Nanotechnology (2006-2016)	Tønsberg	26 Electronic and optical products	33 (33)
NCE Oslo Cancer Cluster (2006-)	Oslo	72 Scientific research and development	28 (27)
NCE Oslo Medtech (2011-)	Oslo	62 Computer programming, consultancy	114 (88)
NCE Raufoss (2006-2016)	Gjøvik	25 Fabricated metal prod.	21 (31)
NCE Seafood Innovation Cluster (2015-)	Bergen	10 Food products	11 (5)
NCE Smart Energy Markets (2009-)	Halden	62 Computer programming, consultancy	31 (13)
NCE Systems Engineering (2006-2016)	Kongsberg	28 Machinery and equipment	8 (11)
NCE Tourism Fjord Norway (2009-)	Bergen	79 Travel agencies, tour operators	50 (11)

Source: Samfunnsøkonomisk analyse AS

1) The first year of each cluster project is mainly set as the year that we first observe members in data.
2) Economic region with the highest share of members (excl. R&D and educational institutions and public development actors).
3) The industry with the highest share of core members.
4) Core members as categorised in the member lists versus core members defined as in section 2.8.1 (in parentheses).

Our sample consists of a total of 1,068 core members. Around 47 per cent. are (or have been) members of an Arena cluster, 37 per cent a NCE cluster and 16 per cent a GCE cluster (cf. table 2.3).[18] For most clusters included in the evaluation, our definition of core members reduces the number of participants compared to the categorisation in the member lists (cf. table 2.4).

The core members are relatively mature firms when they become members of a cluster project; approximately 12 years on average for NCE and GCE, and 13 years for Arena. Measured by number of employees[19], the core members are on average significantly larger than a typical limited liability company (cf. table 2.5).

Table 2.5
Average number of employees per core member by cluster level. 2003-2016

|	Core members				Others[1]
Year	Arena	NCE	GCE	All	Others
2003	71.2	87.4	43.9	74.6	12.0
2004	79.0	104.1	54.4	86.1	11.5
2005	78.8	101.2	57.4	85.1	11.6
2006	84.3	103.1	74.8	92.9	11.6
2007	91.0	114.1	87.3	102.1	12.0
2008	96.3	120.2	103.5	109.3	12.2
2009	93.4	120.0	100.1	106.2	12.0
2010	90.8	111.6	96.9	101.1	11.7
2011	91.5	110.6	96.9	100.8	11.9
2012	99.0	109.7	102.2	105.0	11.7
2013	92.3	102.4	108.2	99.7	11.5
2014	101.2	101.8	120.2	105.5	11.3
2015	99.1	100.8	119.9	103.8	11.0
2016	86.0	105.6	84.7	93.4	11.0
N	499	394	175	1 068	155 426

Source: Samfunnsøkonomisk analyse AS
1) LLCs never registered as members of a cluster project.

2.8.2 Geographical distribution

Most clusters have members from several different regions. Nevertheless, one region usually stands out when counting members per region and can be considered as the cluster's "headquarters". When defining core members, we have chosen to define the cluster's geographical location as the economic region where the largest proportion of members is located (excluding R&D, educational institutions and public development actors).

Figure 2.3
Number of cluster projects per economic region. 2005-2016[1]
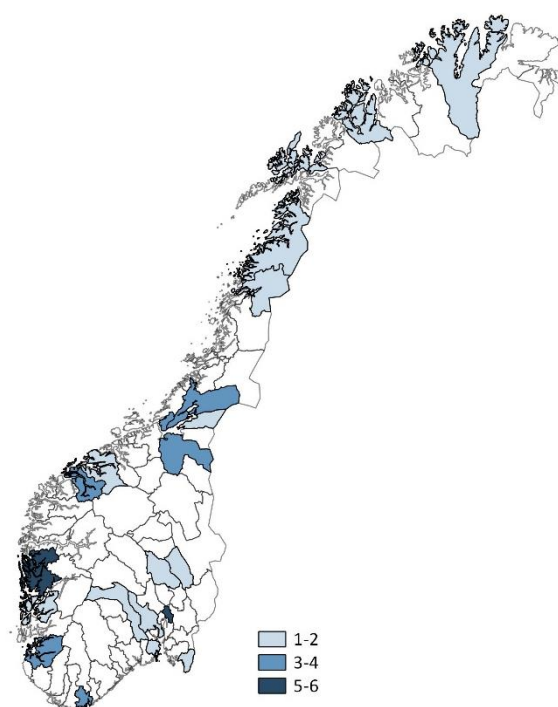
Source: Samfunnsøkonomisk analyse AS
Map: ©Kartverket
1) The 47 cluster projects included in the evaluation.

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[18] Firms defined as a core member of more than one cluster project are counted once per project. However, with our definition, the cluster projects must be in the same economic region for this to happen. In the econometric analysis we retain only the first membership.
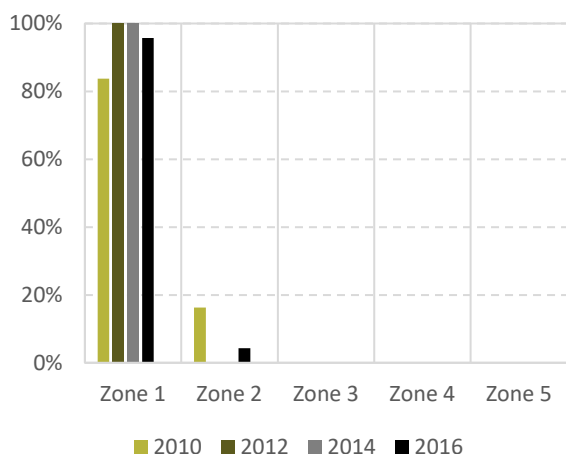[19] Employment is measured by number of full-time equivalents (FTEs).

The cluster projects are located all over Norway, but with variation in the number of projects per region (cf. figure 2.3). Arena targets cluster projects with a regional position and a significantly larger proportion of clusters at this level are in more rural regions, compared to NCE and GCE clusters, which are all located in central regions. However, there is a tendency for a larger proportion of new Arena clusters to be in central regions (cf. figure 2.4).

Figure 2.4

Core members by labour tax zone and enrolment year.[1] Share of total. Arena
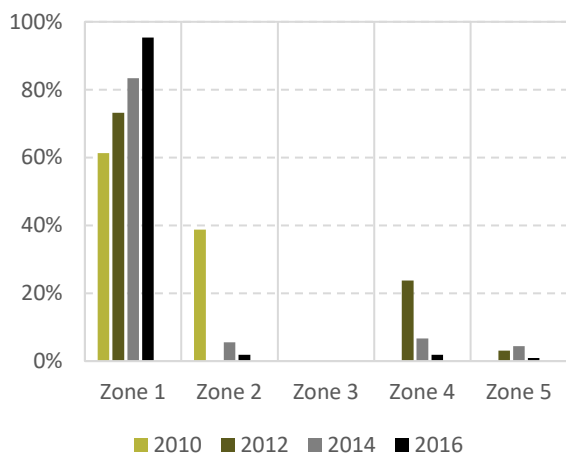
Core members by labour tax zone and enrolment year.[1] Share of total. NCE and GCE.

2.8.3 Industrial distribution

Each cluster project's objective(s) will naturally affect the cluster's industrial composition. Some clusters gather firms within the same value chain and/or market, while others gather firms with common technology or competence needs.

Looking at which industries make up the largest proportion of members in the different clusters, it is apparent that professional, scientific and technical activities and ICT is the largest industry in several clusters, regardless of objectives (cf. table 2.4).

Manufacturing represents, in relative terms, a significant share of employment across the three cluster levels, compared to the rest of the economy (cf. figure 2.6).

Figure 2.5

Number of employees among industries within manufacturing (two-digit NACE).[1] Share of total employment in manufacturing per cluster level. Total for 2003-2016

Source: Samfunnsøkonomisk analyse AS
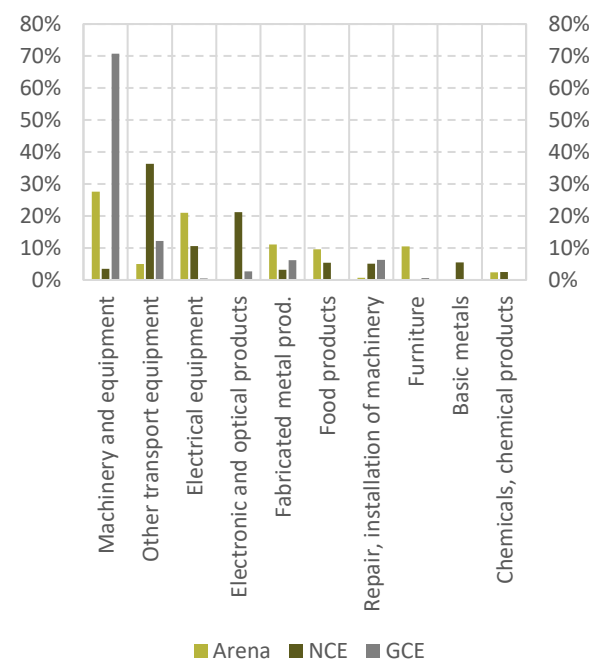1) Zone 1 comprise the most central regions, whereas Zone 5 is the most rural.
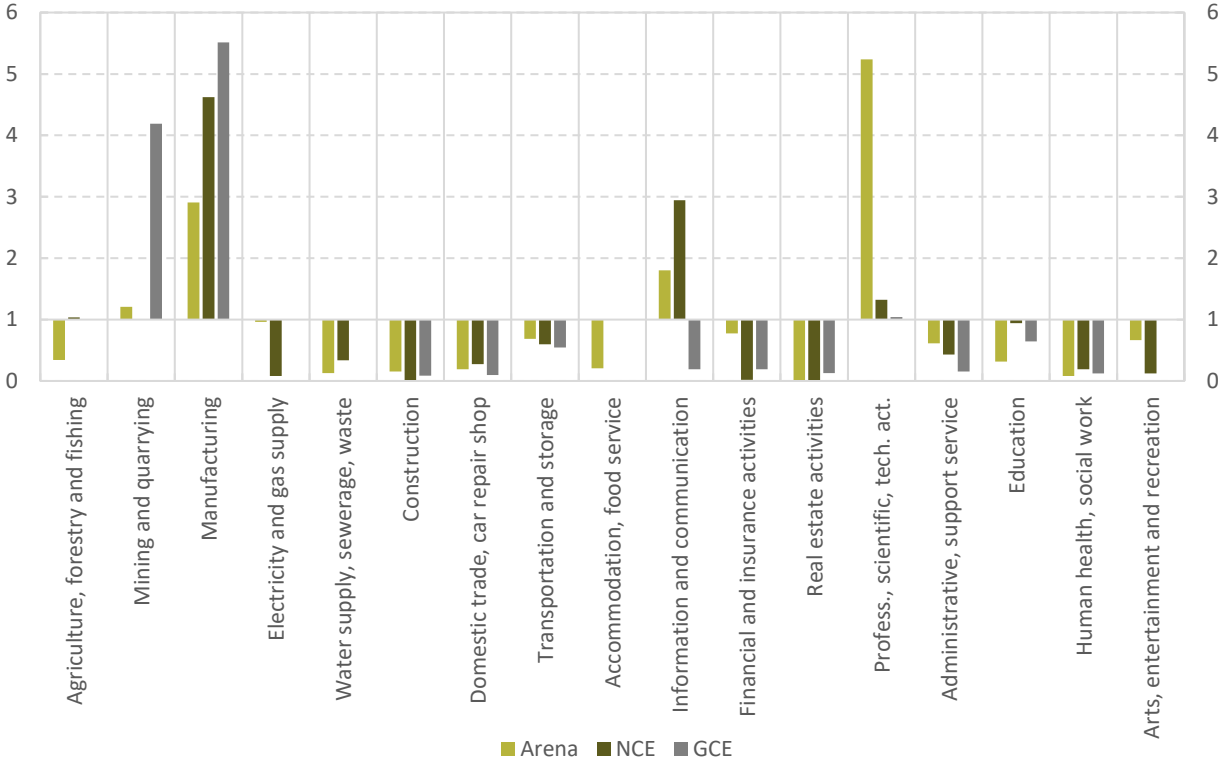
Source: Samfunnsøkonomisk analyse AS
1) Only top 10 industries within manufacturing included.

Employment shares within selected manufacturing industries, such as manufacturing of machinery and equipment (NACE 28) and manufacturing of other transport equipment (NACE 30), show a clear orientation towards the petroleum industry among the clusters (cf. figure 2.5). Furthermore, support activities for petroleum and natural gas extraction (under mining and quarrying) represent more than three times the share of employees among core members of the three GCE clusters than in the rest of the economy.

It also appears that Arena and NCE clusters have a relative advantage within ICT and professional, scientific and technical activities. The relative industrial advantage within ICT can be attributed to media-, energy- and health-oriented cluster projects.

The relative advantage within ICT has become clearer in recent years. Solely including cluster projects established during the last four years, ICT is by far the dominant industry (measured in terms of relative employment shares). Furthermore, there

Figure 2.6

Relative industrial advantages by cluster level.[1] Number of employees. Balassa index.[2] Total for 2003-2016

are almost no firms within mining and quarrying among these cluster projects.

2.8.4 Overall economic development

The clusters' industry composition will affect the overall economic development of the cluster. A first glance at growth in value added among core members shows a positive trend throughout the period 2003-2014 at all cluster levels. For NCE members in total, this positive trend continued, while falling oil prices seem to have affected the overall growth among Arena and GCE members since 2014 (cf. figure 2.7).

Furthermore, compared with other firms in the same industries, growth in value added has been higher among firms participating in a cluster project. We find the same pattern for the development in employment. However, this does not tell us whether the higher growth is due to cluster participation or other characteristics of these firms. This will be explored in further detail in Chapter 6.

There is little difference in productivity between cluster participants and other firms.

Figure 2.7

Total value added. Core members and other firms.[1] Constant 2016 prices. Index (2003=100). 2003-2016
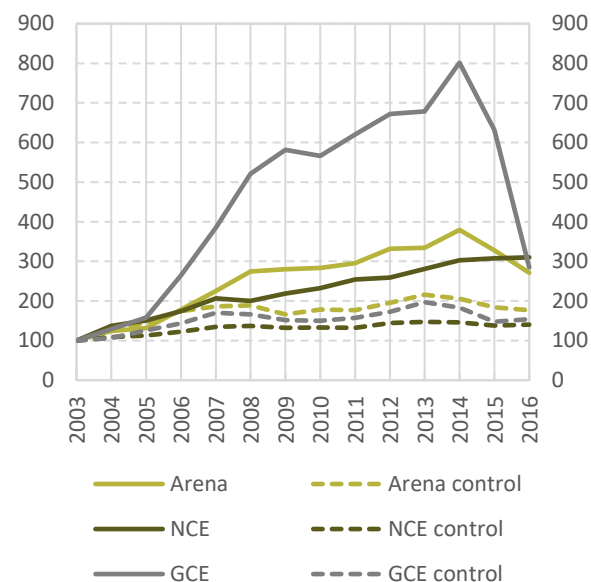
Source: Samfunnsøkonomisk analyse AS
1) Weighted sum for LLCs never registered as a member of a cluster project (weighted by industry share per cluster level).

3 Economic relevance of clusters and cluster policy

Norway has a relatively broad portfolio of industrial policy schemes. Some schemes can be traced back to the 1960s, while others are relatively new. The importance of clusters in national and regional economic development has been acknowledged in several European countries since the 1990s, and for more than two decades governments have designed cluster policies aimed at promoting clusters. Norwegian Innovation Clusters is a relatively new scheme. However, Norway has had a strategy to strengthen industry clusters through national cluster programmes since the beginning of the 2000s (see Chapter 2).

Industrial policies should facilitate the greatest possible value creation, within sustainable budgets. Thus, resources must be allocated to where they crate the most value. Economic theory suggests that economic returns and growth are maximised when markets are free and well-functioning. In well-functioning markets, resources are allocated to where they create the most value (Smith 1776). However, economic theory also suggests that not all markets are well-functioning. Information asymmetries, natural monopolies, public goods or principal agent problems are examples of market failures. When markets fail to work properly it may be right or necessary to interfere. The industrial policies therefore seek to actively facilitate well-functioning markets by correcting market failures where appropriate (Meld. St. 27 (2016-2017)).[20]

3.1 Cluster theory

Most economic activity takes place in geographical clusters: in towns and cities, and in geographically confined business communities, as has been acknowledged since Alfred Marshall's seminal work "*Principles of Economics*" (Marshall 1920). In his work, Marshall identifies several benefits of clusters for firms' performance. However, the breakthrough which resulted in how most view clusters today came with Porter's "*The Competitive Advantage of Nations*" in 1990 (Porter 1990).

The cluster literature can be divided into three main fields: Michael Porter's theory on the competitivity of countries and regions (e.g. Porter (1990) and (1996)); Paul Krugman and his co-theorists' work in the field between international trade, businesses' choices of location and geographical economic agglomeration (e.g. Krugman (1991a) and (1991b), Krugman and Venables (1995), Venables (1996)); and the field of national and regional innovation systems (e.g. Martin, Mayer and Mayneris (2011), and Asheim, Smith and Oughton (2011)), which may constitute a helpful supplement to our understanding of clusters and innovation. To better understand the rationale for Norwegian Innovation Clusters and how the scheme is intended to lead to industry growth, a brief description of each of these main theories is given below.

3.1.1 Porter's Diamond Model

Porter's origins are in business strategy, and his work on competitiveness at the macro level builds on his knowledge of factors affecting companies at the micro level. In essence, his understanding of clusters is that companies that are co-located benefit from a joint specialised labour market, lower transport costs, and a form of tacit industry knowledge. He defines a cluster as "*a group of industries connected by specialised buyer-supplier relationships or related by technologies or skills*".

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[20] Industrial policies can also be used to reach other objectives, i.e. protect national markets or players of strategic importance from international competition. Such interventions are, however, limited by international agreements.

Results and insights from Porter's empirical studies laid the foundation for "Porter's Diamond". The framework in the diamond model can be summarised with four relations and their attributes:

- *Factor conditions.* The cluster's position in factors of production, such as the skilled labour or infrastructure necessary to compete in each industry.
- *Related and supporting industries.* The presence or absence of supplier industries and other related industries that are competitive is of critical importance for growth.
- *Demand conditions.* The nature of the demand for a cluster's products or services is the primary source of growth, innovation and quality improvement.
- *Firm strategy, structure and rivalry.* The conditions in the cluster governing how companies are created, organised and managed, as well as the nature of rivalry.

The nature of these four relations can be influenced by the values of the society, the government and public opinion, as well as coincidences, which determine how well a business, an industry, or even a country, will develop.

Porter's theory emphasises how different characteristics of these four relations leads to the best possible outcome. Following Porter, business activity is more valuable when and where businesses reciprocally influence each other, i.e. when and where cluster mechanisms exist. However, it is of equal importance that the businesses operate in a competitive environment which encourages innovation and efficiency. Succeeding in such environments entails

that the businesses give value to demanding customers and to competition in relevant markets, such as the markets for products, input factors and input goods.

Figure 3.1
Porter's Diamond
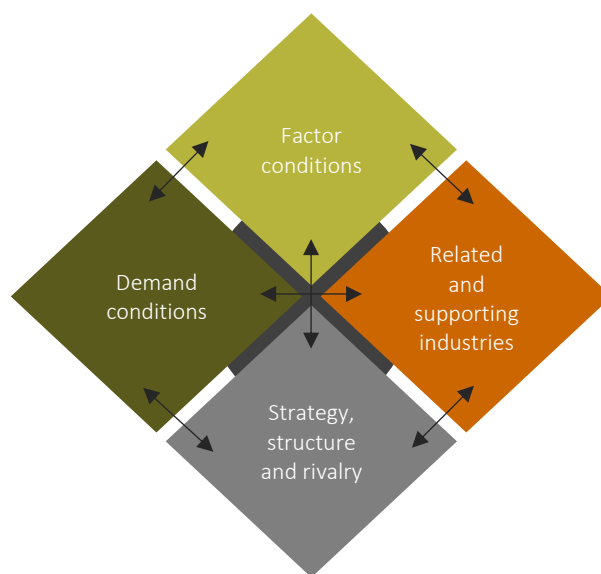
Source: Porter (1990)

Porter emphasises that *"the process of clustering, and the interchange among industries in the cluster, also works best when the industries involved are 'geographically concentrated'"* (Porter 1990, 157)*.*

Porter's main argument is that the business behaviour in clusters is a product of localised learning processes[21], and that the importance of clusters is that they represent the basis for an innovation-based economy (Asheim and Isaksen 1996).

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[21] Localised learning processes are frequently held up as the foundations for the continued geographical 'stickiness' of innovation activities.

Based on his empirical work, Porter states that (all) strong clusters are characterised by three central upgrade mechanisms:

- Innovation spill-over
- Complementarity
- Knowledge spill-over

Porter's theory of clusters, and related theories, suggest that clusters may not simply reduce the cost of production, but also the cost of exchange, by enhancing trading relationships; related local discoveries may simultaneously enhance the knowledge base of multiple local firms; and specialised local institutions can play a crucial role in facilitating complementarities (Porter and Emmons (2003); Sölvell, Lindqvist and Ketels (2006)).

Furthermore, Delgado, Porter and Stern (2012) emphasise the following important results of their research, which also has implications for cluster theory and cluster policies:

"We find that the cluster and related clusters surrounding a region-industry matters not only for the growth of existing industries but also for the creation of new industries in a region. In other words, new regional industries are born out of strong regional clusters. These findings suggest that clusters play a crucial role in the path of regional economic development (Porter 1990, 1998, 2003; Swann, 1992).

(…) First, the traditional distinction between industry specialization and regional diversity is misplaced. This dichotomy overlooks the powerful role played by complementary economic activity in shaping economic growth, and the central role of clusters as the manifestation of complementarity. Narrow regional specialization in an industry is likely to result in diminishing returns, and the presence of unre- *lated economic activity is unlikely to significantly enhance opportunities for growth but may increase congestion. However, the presence of complementary activity via clusters is a strong driver of growth through allowing firms ready access to key inputs, better interactions with customers, and facilitating experimentation and innovation."* (Delgado, Porter and Stern 2012, 34)*.*

Porter does not explicitly discuss the government's role in fostering clusters, but points out the importance of clusters facilitating both collaboration and rivalry between firms, as well as collaboration between firms and academia.

3.1.2 Krugman's economic geography

While Porter's theories stem from the field of business strategy, Krugman's contribution, *"Increasing Returns and Economic Geography"* from 1991, signifies the start of the new economic geography and the economical-theoretical breakthrough in the understanding of business clusters (see Krugman (1991a)).

Krugman's theories regarding clusters are deeply rooted in general economic theory. He addresses problems from the field of geographical economics with microeconomic theory and theories of international trade. Compared with Porter, Krugman is somewhat narrower, in the sense that his formalised analyses demand stylised assumptions and a more constrained set of mechanisms. However, his approach yield results that are easier to interpret, are more in line with general economic insight, and easier to relate to policy making.

Krugman's theory draws on the positive knowledge-based externalities[22] that exist within industry clusters, which means that co-localised firms learn from each other through knowledge spill-over effects, both by way of the labour market and of the knowledge market. Lack of competition in specialised supplier markets may also imply a market failure. More competing suppliers increase competition and reduce production costs. The greater geographical concentration of customers and suppliers can contribute to this.

Firms close to each other may also develop a common infrastructure to reduce costs. Significant gains thus can be achieved through co-location. Concentration of firms also entails greater competition, ensuring an effective social resource allocation and, where possible, lower costs.

Krugman's main idea is that firms must be located close to each other, so as to benefit from the externalities and overcome other market failures. By pointing out market failures, Krugman's perspective has a clear industry policy implication: it is an advantage for a country to facilitate dynamic industrial clusters. However, exactly how this should be done must be developed by policy makers.

3.1.3 Regional innovation systems

The theory of Regional Innovation Systems (RIS) was developed in parallel with the literature described above. While Porter is more focused on the role of clusters in explaining competitive advantage at the regional or national level, and Krugman on the effect of static efficiencies on value creation in clusters, RIS emphasises the effect of networking, so-cial and institutional interactions, and learning processes on innovation in "learning economies" (Asheim, Smith and Oughton 2011).

It is important to note the distinction between networks and clusters, since each promotes different types of external economies. In clusters, firms benefit from external economies such as knowledge spill-overs or the attraction of labour and consumers to the cluster through market processes. In the case of networks, firms engage in cooperative activities, i.e. the external economies are achieved through cooperation – not competition – and are internal to the network, if not to the firms themselves (Asheim, Smith and Oughton 2011).

A key argument for the RIS approach is that the occurrence of technological change and innovation is determined by the interaction between private- and public-sector organisations, authorities, knowledge institutions and financial providers, combining the creation, development and diffusion of technologies and innovations. It is important to be aware that the system cannot be understood by focusing on the activities of any of its components in isolation (Asheim, Smith and Oughton 2011).

In modern innovation theory, learning is emphasised as a localised, and not a placeless process, and geographical proximity and territorial agglomeration are expected to greatly facilitate the required learning processes (Storper and Scott 1995). Thus, the RIS theory acknowledges that clusters, as understood by Porter's and Krugman's theories, are important, but it also emphasises a range of other factors to promote and diffuse innovation within a region.

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[22] Examples of direct externalities can be the benefit or cost of an activity that affects a party which do not take part in the activity, e.g. education will normally benefit the individual who receives the education, but also anyone who gains access to better educated labour. The latter is an external effect.

Theories concerning *innovation and business eco-systems* also emphasise that local innovation collaboration is important in understanding how innovation occurs. These theories focus on dynamic, purposive communities with strong relationships based on collaboration, trust and co-creation of value, and sharing complementary technologies or competences (Durst og Poutanen 2013). Innovation ecosystems are usually created around a central node – technology platform, social or economic conditions – that puts key agents together to interact. The Innovation ecosystem idea has also been evolved towards several levels of organisation (Gooble 2004).

3.1.4 Links between the main theories

All abovementioned theoretical approaches suggest that clusters bring economic growth. However, the views on how clusters contribute to growth differ. In Porter's view, clusters are important to society because they contribute to competition and innovation, and thereby increased exports, whereas Krugman sees export and innovation levels as almost irrelevant. What matters in Krugman's theory is whether the total value added to society is greater than it would have been without clusters. In the theory of regional innovation systems, geographical clustering is important because it facilitates the collaboration and learning processes necessary for innovation creation and diffusion.

While Porter emphasises the effect of competition on innovation, Krugman only emphasises competition to the degree that higher competition reduces production costs in the cluster, thereby facilitating growth and value creation. The RIS theory, as mentioned above, emphasise active collaboration and not competition.

All three theories, however, stress the importance of geographical concentration, although to different degrees. Porter argues that competitive advantage is both created and sustained through highly-localised processes (Porter 1990), and that the clustering process works best when the industries are geographically concentrated (Porter 1998). For Krugman, geographical concentration is necessary for the exploitation of external economies, and thus highly emphasised. The RIS theory, on the other hand, emphasises geographical proximity to the degree that it is understood as an important facilitator for the innovation processes, also through how it enables the exploitation of external economies, as in Krugman's world. Porter's view leans on dynamic efficiencies, revolving around the rate of learning and the capacity for innovation, which is very much in line with modern innovation theory, as represented by RIS. Krugman relies more heavily upon static efficiencies such as economies of scale.

To a greater extent than the other two methodologies, RIS emphasises collaboration not only between firms in a cluster, but also between different operators in a larger network of private and public R&D operators, knowledge centres, etc.

3.2 Rationale for publicly supported clusters

Even though theory suggest that clusters bring economic gain, this cannot be the sole justification for public support of clusters. A prerequisite for public support is that these economic gains could not have been achieved without the public support. This presupposes the existence of a market failure that prevents economic growth to some degree. One such market failure could be the existence of external economies (positive externalities), which without internalisation (through public intervention), would not be exploited. Thus, the clusters would not be able to reach their full potential.

The following argument for public support of clusters, with focus on economies of scale, is mainly based on arguments creditable to Krugman and his co-theorists.

Most economic activity takes place in geographically confined clusters. Firms' choice of location normally reflects costs and market access. With equal access to relevant markets, they will prefer the location with the lowest production costs. Given equal costs, they will prefer the location with best access to relevant markets. The cost assessment implies locating close to natural resources, in areas where infrastructure is well developed, and/or there is a good availability of essential inputs or intermediate goods. Market access implies locating close to customers, which in most cases means close to large population concentrations.

The existence of clusters is, however, not fully explained by conditions such as access to natural resources, or a given distribution of the population in cities and towns. The accumulation of business activity in clusters should rather be explained by the fact that there are synergy gains in some form between firms located close to each other, and where one firm's profitability is positively affected by its proximity to other firms.

Two factors can give rise to synergy gains of this type:

Real externalities, i.e. direct, positive links between firms. Positive external effects mean that one firm, through its activity, imposes gains that do not fall as income to that firm. The classic example is when knowledge acquired in one firm directly benefits the neighbouring firm.

Market links (pecuniary externalities), i.e. positive effects that one firm imposes on others because its presence helps to create a larger market for end-products, inputs, or key resources such as labour and capital. However, for market links to create synergies, there must be economies of scale somewhere in the value chain, so that the market size restricts competition and/or product range.

In the presence of positive externalities, due to the abovementioned, a firm's private economic transactions will, without intervention, deviate from the best from a socio-economic point of view, i.e. the firm will underestimate the value of its production and location. The existence of such external effects therefore gives the authorities good reason to intervene in a market economy, to improve resource utilisation (Strøm and Vislie 2007).

How cooperative gains affect the marginal return of an input, and thereby the size of the cluster, can be elaborated on with an example: We assume an economy with two industries, one with a high degree of cluster characteristics (increasing returns to scale), and one without such characteristics (decreasing returns to scale). Furthermore, firms in the two industries use only two inputs in their production: capital and labour.

Given a set of assumptions, three possible equilibria exist in this example: A, B, and C (cf. figure 3.2). In A and B, the capital is divided between the two industries so that the marginal return on capital is equal in both industries. Point C represents an outcome where all capital is invested in the non-cluster industry. If the initial division of capital is somewhere to the left of point B, point C is a stable equilibrium, because the marginal return on investment in the non-cluster industry is always higher than the marginal return on investment in the cluster industry. Once point C is reached, no market agent will have any incentive to move capital to the cluster industry.

Starting out with point B, the marginal return on investment is the same in both industries, but an infinitesimal investment in either group would shift the marginal returns in favour of that group, so that point B is an unstable equilibrium.

Point A is a stable equilibrium. To see this, consider a situation where we start out with capital divided as in point A. If one were to move a small part of the capital from the non-cluster industry to the cluster industry, the marginal return on capital would subsequently be higher in the non-cluster industry, and the market agents would move the capital back to point A, and vice versa.

Points A and C represents the only stable outcomes of the model. In point C, as we have seen, no cluster firms will exist, and the total value creation will be less than in point A. Thus, point A is the desired outcome.

Figure 3.2

Allocation of capital between the cluster industry and an industry without cluster characteristics
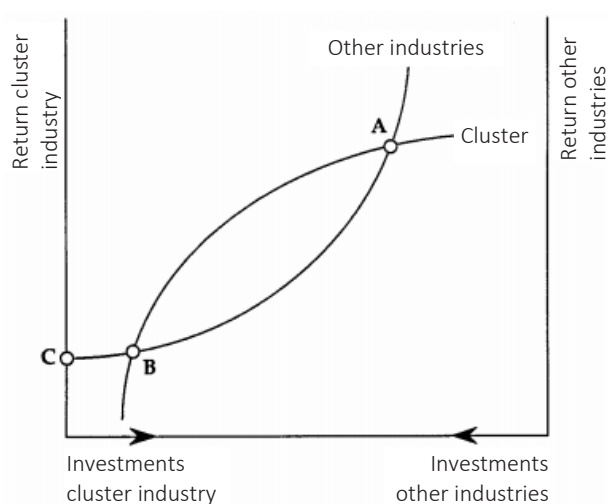
Source: NOU 1996: 17, 38

However, whether the outcome will be point A or point C depends on exogenous factors. One such factor is what the market agents *believe* will be the outcome.

If no investors believe any other investors will invest in the cluster industry, or are even aware of the increasing returns to scale, there will be no investment, and the outcome will be point C. This matters a great deal, because it also implies that the government can affect the outcome, e.g. by applying funding schemes that incentivise the formation of clusters, thus leading the economy to the efficient outcome, point A.

The theoretical example presented here is an argument to facilitate the establishment of clusters (kickstart), e.g. by subsidising collaborative processes. Arguments for more long-term support for clusters, e.g. in the form of public cluster programmes, require more detailed argumentation, which we will present in the following.

3.3 Clusters as a tool for enhancing innovation

The OECD (2007) assessed 26 different national programmes intended to promote the growth of clusters in 14 countries and found a variety of approaches to strengthening existing and initiating new clusters. While most programmes seemed to be based on shared assumptions about the value of clusters to society, including the importance of connecting people, skills and knowledge at a regional or national level, the objectives of the programmes ranged from national competitiveness and strategic high-technology sectors to small-scale groupings of co-located firms.

The European Cluster Observatory has very similar findings in its reviews, but also concludes that in more recent years there has been a shift towards programmes focusing on mature clusters, internationalisation and international competitiveness, to a

greater degree than before (European Cluster Observatory 2015).

A noteworthy trend among cluster programmes in the OECD countries is an increased emphasis on innovation as an objective, also in programmes not necessarily rooted in science and technology policies. Another common trait is that they have transitioned from targeting SMEs to supporting national competitiveness clusters, through innovation and technology.

The greater acknowledgement of clusters as a tool for enhancing innovation raises questions about why innovation should be supported indirectly by supporting clusters, instead of supporting innovation directly.

One answer could be found in the intersection between innovation theory and the theory of cluster development. The relation between geographical proximity and innovation has been studied in the field of economic geography (see Storper (2013) for a comprehensive discussion) in particular. The theory points out how important collaboration between firms and between firms and research institutions is developing new ideas and commercialisation. This view is also an important part of the theories concerning regional innovation systems mentioned earlier. At the same time, economic geographical theory emphasises the importance of proximity for lowering the costs of transmission of complex tacit knowledge between enterprises (Storper 2013). Such complex communication requires the understanding and trust that historically have come from face-to-face contact.

Even though cluster programmes do not draw exclusively on the theories of Krugman (and his co-theorists), it is our interpretation that insight from

theories of this type and theories on regional innovation systems provide the justification for the cluster programme. The argument is that supporting clusters will lead to greater collaboration and that greater collaboration is necessary to trigger more innovation.

This argument can be further elaborated on to understand how public support can increase the extent of collaboration. It takes time for new collaboration patterns to expand and public- funded (partly or fully) facilitators can help make this happen. The OECD assessment documents that this is how governmental programmes support clusters.

3.4 Cluster mechanisms

In the wake of the evaluations of Arena and NCE, Jakobsen and Røtnes (2011) discuss how public support for clusters could be understood within a formalised framework. This means understanding how public cluster programmes may result in significantly greater benefits than the collaboration which would have taken place without the help of such programmes.

It is important to bear in mind that collaboration will take place even without public support, but public support should enhance the magnitude and direct the objectives of the collaboration activities.

Jakobsen and Røtnes have developed a conceptual model for cluster-based development, to illustrate typical cluster characteristics and how they lead to improved performance (see figure 3.3). The solid lines in the Figure illustrate direct effects, while the dashed lines illustrate long-term effects generated by system dynamics.

Capability and willingness to initiate and carry out collaboration processes to realise potential synergies depend on the groups' relational basis for collaboration. If potential synergies are significant and the relational basis is in place, actual collaboration processes will result in gains such as innovation, improved productivity and/or internationalisation, and consequently growth and profitability (illustrated by the solid lines in the model).

The model can be interpreted as a situation where the yield curve for cluster industries is lifted upwards (cf. figure 3.4). Such a situation generates a new equilibrium (D), where the cluster industry expands at the expense of other industries. In such a situation, productivity (the return on resources) will in principle be higher in all industries, compared to the initial situation.

Potential synergies between the operators in the group – or potential external economies of scale – will exist if there are:

- *Economies of scale* in activities that are *collective for the operators and non-excludable.*
- *Complementarity* in markets and/or competences, activities and resources.

Potential synergies between operators in a cluster can be achieved through *collaboration processes*, i.e. through internal and external linkages within the cluster:

- *Collaboration and sharing of resources within the cluster*. Formal and informal collaboration whereby the operators *develop* (innovation), *share* (economies of scale) and *transfer* (complementarity) resources between them.

Figure 3.3

Conceptual model for cluster-based development
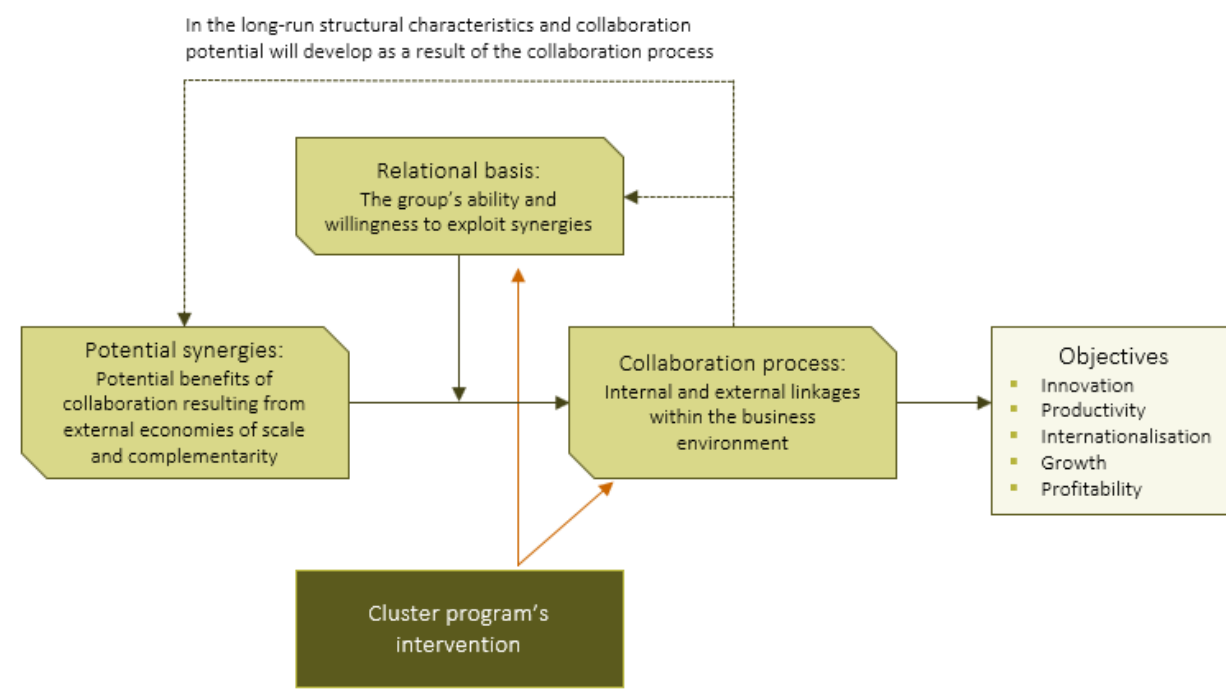
Source: Jakobsen and Røtnes (2011)

- *External linkages to business environments*:
  The operators within the cluster's connections
  to related national and international industrial
  environments, including their own subsidiaries/offices within these environments.
- *Linkages to knowledge institutions*: The *number*
  and *competence level* of relevant operators
  within education and research and specialised
  suppliers of knowledge in the region, as well as
  the *extent and strength of the links.*
- *Links to professional capital providers*: The extent of owners/investor groups in geographical
  proximity and/or are specialised towards a certain cluster's market, technology and competence.

Figure 3.4

Allocation of capital between the cluster industry and an industry without cluster characteristics ᵂ/new equilibrium

Sources: NOU 1996: 17 and Samfunnsøkonomisk analyse AS

Even though potential synergies between the operators within a cluster clearly exist, they might still not be realised. Operators might lack sufficient information about other operators' activities to know when collaboration might result in mutual benefits.

The incentives to invest in collaborative relationships might also be unevenly distributed. In many cases, trust is the decisive factor to make collaboration work in practice, and if there is a lack of trust, collaboration may seem like too much of a risk. In other words, the operators' ability to realise potential synergies through collaboration processes depends on their relational basis for collaboration, i.e. whether they trust each other enough to be willing to share their knowledge and invest in the community.

3.5   Cluster programmes' role

It is important to distinguish between cluster effects, i.e. effects resulting from collaboration in clusters, and effects of the cluster programme. The cluster programmes' role is to stimulate cluster development or, more specifically, to *trigger collaboration-based development* which would not have happened otherwise, *and to reinforce and accelerate existing collaboration*. This both concerns stimulating collaborative potential (relational basis) and financing and enabling specific collaboration processes.

In the conceptual model above, the cluster programmes' role is illustrated by orange lines. This means that the cluster programmes' activities aim to:

- Strengthen clusters' relational basis for collaboration.
- Finance, organise and carry out specific collaboration projects.

Norwegian Innovation Clusters aims to promote and enhance collaboration activities in clusters, which is an important reference for policy implication from theories based on economic geography, and of regional innovation systems.

"The services offered to the clusters comprise financial and professional support to help them initiate, strengthen and accelerate various collaboration processes. The support acts as a catalyst for developing new collaboration relations and concrete collaboration measures to strengthen joint knowledge development, innovation processes, internationalisation measures etc. Public involvement also serves as a neutral and 'safe' framework for the collaboration in that it reduces the risk of any party reaping unreasonable benefits." (Innovation Norway 2015)*.*

Based on review of programme descriptions and instructions, it is our assessment that policy makers have good reasons to expect cluster support to affect clusters in two ways. Firstly, cluster policies could increase the size of existing clusters (by allocating resources to these firms), and thereby improve the performance of firms by reaching a critical mass, which allows the firms to exploit the theoretical external economies. Secondly, for a given size, cluster policies could enhance and improve the collaboration activities within the cluster.

Norwegian Innovation Clusters appears to be a relevant programme to enhance innovation, and subsequently increased value added, that would not have happened otherwise. Although there are reasons to expect positive effects on collaboration, innovation and value added, these possible effects must be identified in accounting data before any conclusions can be reached as to whether the programme achieved its objectives. This will be discussed in the following chapters.

4   Significant interaction with other schemes

The cluster programme offers services and tools that act as catalysts for enhanced collaboration on strategic needs within each cluster project. It will not solve all challenges, but is intended to be utilised in close interaction with R&D, innovation and infrastructure schemes, so that they can overall contribute to powerful efforts towards environments with potential for value creation (Innovation Norway 2015).

To distinguish between the effect of the cluster programme and other schemes intended to have an impact on individual firms' performance, we need to know the extent of support from other (relevant) public funding schemes.

In addition, the extent of other schemes channelled towards the cluster participants can be seen as a result of the cluster programme itself. There may be two reasons for this; Firstly, several cluster facilitators assist firms in providing information about the possibilities of using public schemes to support various innovation projects. Secondly, given that participating firms have to some extent revealed their innovation potential by being included in the cluster programme, participation can increase the likelihood of being approved for support from other schemes.

In the following we document the cluster participants' support from other public schemes.[23] Our data does not allow us to determine the causal link between changes in the use of other schemes and cluster participation. The analysis below should therefore be read as a clarification that cluster participants make themselves better qualified for other

schemes and increase their visibility among relevant funding agencies.

4.1   Relative importance of other schemes

Of the 1,068 core members in our sample, 793 (74.3 per cent) of the firms have received support from one or more public schemes (apart from participation in a cluster project).[24] The proportion of firms with support from other schemes is somewhat higher among members of an NCE or GCE cluster, than of Arena. In addition, there are differences in the types of schemes that constitute the largest share of the various members' total support.

Norwegian Innovation Clusters gather several of Norway's most export-oriented firms. Most firms, regardless of cluster affiliation, export goods and services without the need for public export financing. It is still worth noting that the clusters' core members have received about 60 per cent of all loans and guarantees granted by Export Credit Norway and the Norwegian Export Credit Guarantee Agency (Giek). By comparison, the same firms account for 16 per cent of all limited liability companies that have received loans and guarantees from these agencies. Furthermore, almost all loans and guarantees have accrued to a few participants in the three GCE clusters.

Comparing different funding agencies' share of the total number of core members utilising different schemes with their share of other supported firms[25], it is apparent that Export Credit and Giek constitute a significantly higher share among the cluster participants than other firms (cf. figure 4.1).

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[23] Samfunnsøkonomisk analyse AS has, commissioned by the Ministry of Trade, Industry and Fisheries, established a database for public support schemes. The database is a compilation of project data from 16 public funding agencies and allows us to identify public schemes' industrial and geographical distribution, as well as how they are distributed among firms and over time. Furthermore, this makes it possible to map the aggregated

public funding of individual firms. In total, the database contains 649,749 recipient-year observations.
[24] Schemes funding agricultural activities and energy efficiency measures are excluded. If such funding is included, 850 of the core members have received support from one or more public schemes.
[25] Limited liability companies

In addition to being "overrepresented" among export-oriented schemes, funding agencies providing equity investments, such as Argentum and Investinor, constitute a relatively high share among the core members. The same applies most R&D-oriented schemes (the EU's Seventh Framework Programme (EU FP7) and Horizon 2020, the Norwegian Seafood Research Fund (FHF) and Regional Research Funds).

It is apparent that different funding agencies' relative importance for the cluster participants differs among cluster levels. Which kind of schemes the participants make use of must also be seen in the light of the cluster projects' composition of firms. Furthermore, it may also be explained by the schemes' design or formal requirements, e.g. requiring collaboration between firms and R&D institutions. In such cases, cluster participants may have an advantage by exploiting the network already established within the cluster.

The three owners of the cluster programme (Innovation Norway, the Research Council and Siva) are all important sources of funding for the cluster participants, but, except for the Research Council, no more than they are for limited liability companies in general.

Figure 4.1

Relative importance of funding agencies by cluster level. Funding agencies' relative share.[1] Total[2] for 2000-2016
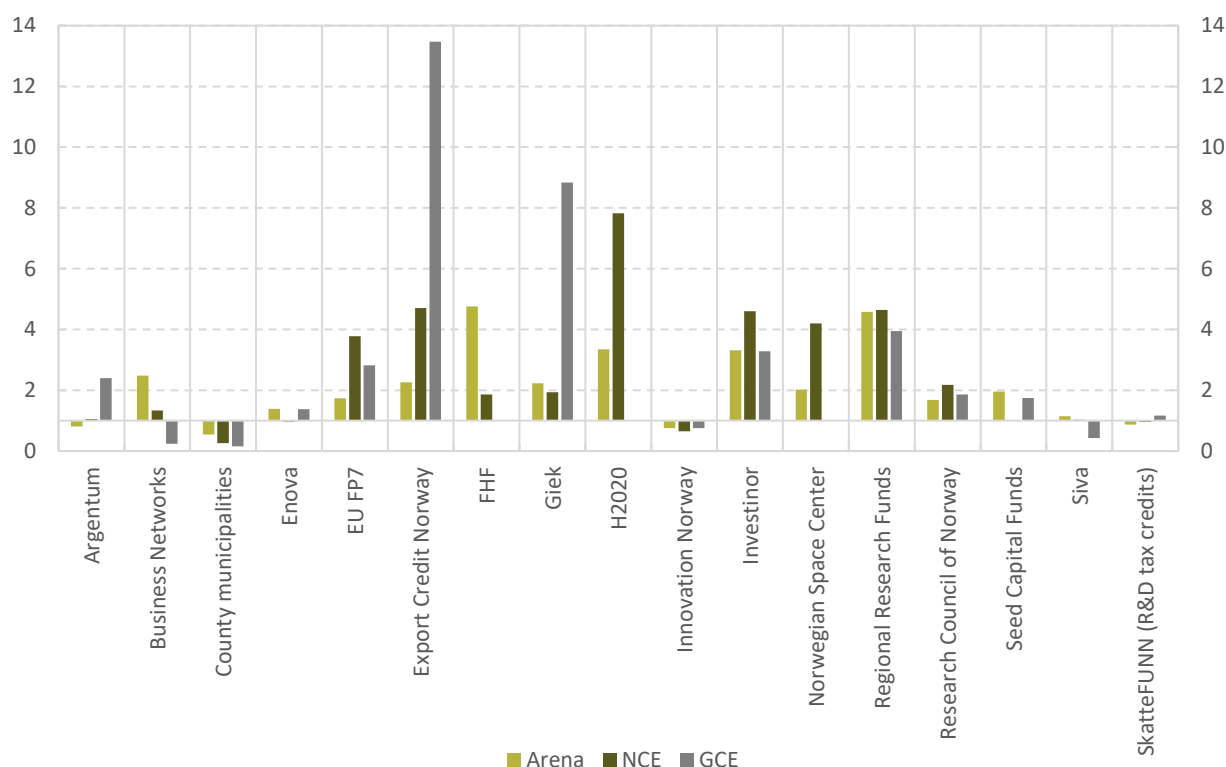
Source: Samfunnsøkonomisk analyse AS

1) Relative share per agency indicates the relationship between the agency's share of firms in the sample (core members at each cluster level) and the agency's share of all other LLCs with support from the respective agency. A factor greater than 1 indicates that the agency is "overrepresented" among cluster members, and vice versa.

2) The sample only includes core members and other LLCs (excl. research institutes organised as LLCs). Schemes funding agricultural activities and energy efficiency measures are excluded.

Innovation Norway has supported a little more than half of all the core members, at all cluster levels, but does not represent a greater proportion among these firms than among other recipients of support from Innovation Norway.[26] Neither does Siva.
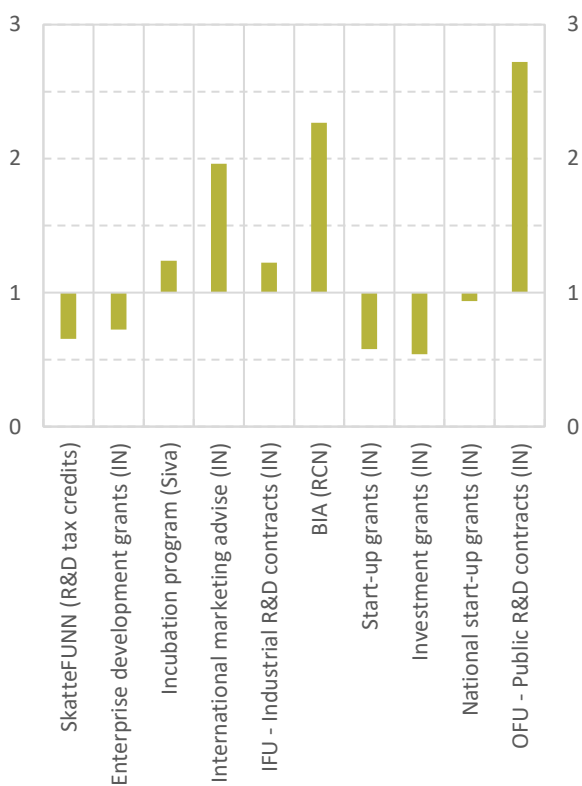
The share of core members receiving funding for R&D projects from the Research Council varies between the three cluster levels, from almost one third

of the members of an Arena or GCE cluster, to just under half of the members of an NCE cluster. Overall, the Research Council is overrepresented among cluster participants at all levels.
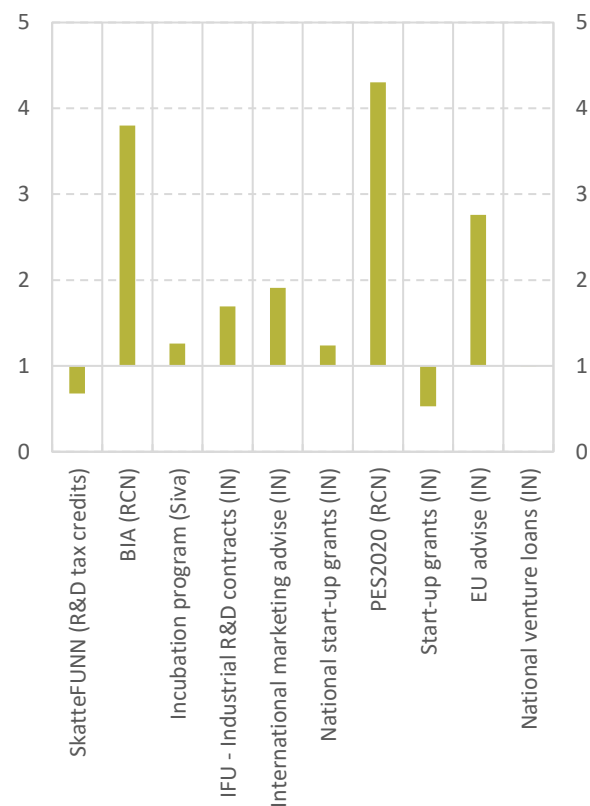
Measured by number of core members receiving support from different schemes, SkatteFUNN is the most used, independent of cluster level (cf. figure 4.2-figure 4.4). However, this seems to be relatively

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[26] Support from the cluster programme (see section 2.5.2) is not included.

less important for participants in an Arena or NCE cluster than for others (relative factor less than one).

SkatteFUNN is a rights-based R&D tax incentive scheme, intended to stimulate R&D in Norwegian trade and industry. Firms within all industries can apply, regardless of firm size.[27] Eligible applicants are firms with R&D projects intended to develop a new or improved product, service or production process. The project must generate new knowledge, skill and capabilities within the firm.[28] Given the nature of the scheme, as expected this constitutes the largest share of the firm's use of public schemes.

The main difference between the cluster levels appears to be the increasing importance of the Research Council's different programmes (measured by number of core members being supported) with increasing cluster level. The shift in the extent to which programmes and schemes are used is probably also associated with the composition of the clusters, and not only the cluster level, i.e. there may be differences between clusters at the same level which are as big as across levels.

4.2 Changes in interaction with other schemes

There is reason to believe that cluster participation contributes to changes in the participants' use of public support schemes, in terms of both scope and type of schemes. At least, the facilitator will make participants aware of schemes they did not know, and certain schemes require formalised collaboration. In addition, cluster participation signals the firm's potential for innovation or value creation.

Interviews conducted as part of this evaluation indicate that the facilitators devote resources to assisting members with applying for funds. Furthermore, if we compare the core members' use of public schemes before and after enrolment in a cluster

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[27] There is a distinction, however, between SMEs and large firms when determining the tax credit (SMEs may be granted a tax deduction of a percentage of the R&D costs associated with a given R&D project. Large enterprises may be granted a deduction of 18 per cent. of such project costs).

[28] Read more about SkatteFUNN here: https://www.skatte-funn.no/prognett-skattefunn/Home_page/1222340152176

project, our data indicate that there has been an increase in the number of firms receiving some form of support after enrolment.

However, it is challenging to quantify changes in the use of public schemes adequately. Firstly, our data on support from public schemes starts in 2000. For firms that enrolled in a cluster project around 2006 (most participants in an NCE or GCE cluster), the period covered by the data is longer after enrolment than before. The increase in volume can therefore solely be a consequence of the number of years with the possibility of receiving support. Secondly, there has been an increase in the number of schemes offered by the funding agencies that have existed throughout the data period (Innovation Norway and the Research Council), and an increase in the number of funding agencies.

Notwithstanding the above challenges, it is our impression that cluster projects appear to be particularly relevant for firms with R&D potential, although they are in no way restricted to this. Cluster projects may also (and should) encourage R&D through joint projects. This is discussed in more detail in the next chapter.

5   Significant effects on collaborative relationships

Norwegian Innovation Clusters, as well as similar cluster programmes internationally, has a clear objective to enhance collaboration activities. Our interviews with members of the seven cluster projects subject to evaluation (see the list in Chapter 1) confirm that this is a prioritised task.[29] In this chapter, we analyse whether it is possible to confirm such results in data on cluster members' formalised research collaboration.

Immediate effects resulting from enhanced visibility and identity will necessarily diminish with time. Maintenance of collaboration depends on the initiated activities and processes being perceived as relevant for the participant, also in the long run. It is therefore of interest to assess whether the cluster programme affects the number of collaborative relationships.

The success of collaboration projects, measured in terms of innovation and patents, is often assumed to be dependent on knowledge transfers among the different participants. Such knowledge spill overs can either be direct between two contributors working on the same project, or indirect, i.e. when knowledge circulates among contributors to different projects if there is a mechanism for the flow of information, such as a mutual third contributor to both projects.

There have been several collaboration projects between and within different cluster projects in recent years. To answer how these types of relationships and projects arise, how they work and which results and effects they create, we used Innovation Norway's own survey to cluster participants, conducted interviews and our own database on public support.[30] The latter allows us to map formalised R&D collaborations in projects with public funding.

5.1   Reported collaborative relationships

As part of their system for Management by Objectives and Results (MBR) Innovation Norway has developed a small-scale survey targeting the members of the different cluster projects. The purpose of the survey is to map the number of firms that have established new or enhanced existing collaborative relationships. It has been conducted annually for the last three years.

Respondents in the 2016 survey reported an average of 11 new collaborative relationships with other firms or knowledge institutions as a consequence of cluster participation.

Figure 5.1

Average number of new collaborative relationships by cluster level. 2014-2016
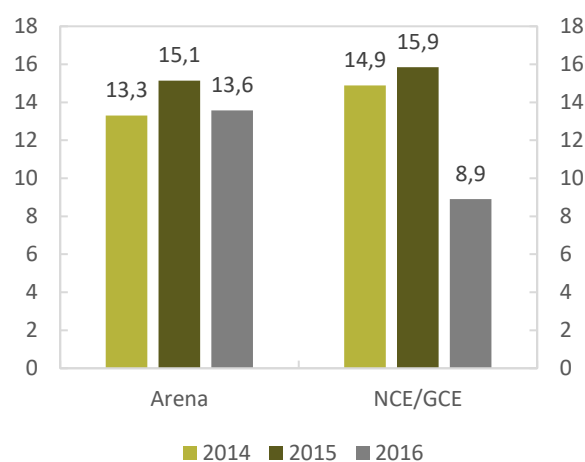
Source: Innovation Norway

On average, it appears that the number of new collaborative relationships is relatively stable for members of an Arena project, while the last survey indicates a drop in the number of new relationships among participants in an NCE or GCE project in 2016 (cf. figure 5.1). The latter may be a consequence of the downturn in the petroleum industry, which affected members of the GCE projects relatively severe (Innovation Norway 2016).[31]

5.2   Growth in formalised R&D collaboration

One of the objectives of the cluster programme is to promote and enhance collaboration activities between firms and R&D and other knowledge institutions. With reference to the literature on network analysis and knowledge transfer in networks,[32] we have checked whether participation in a cluster project has had an impact on the firms' R&D collaboration networks. To the best of our knowledge, no one has used a network approach for R&D collaboration, perhaps because detailed information regarding the identity of project participants is typically hard to obtain.

Our data comprises detailed information on firms and research institutions that are engaged in different R&D projects (supported by the Norwegian R&D tax credit scheme SkatteFUNN, the EU programmes FP7 and H2020 and/or the Research Council of Norway). This information allows us to construct an R&D collaboration network for each cluster member, counting direct links between them and other participants (collaborators) in the R&D project (primary network), and indirect links between cluster members and collaborators of collaborators (secondary network). We have also constructed cluster networks, i.e. links between all firms and research institutions participating in the given cluster.[33]

As a result, we can form an overall picture of R&D relationships for cluster members, as well as changes in their collaboration network over time.

The main idea of our analysis is to check whether the size of the primary R&D collaboration network has changed after a firm has enrolled in a cluster project (illustrated in figure 5.2). As for the secondary network, we have constructed a set of potential R&D collaborators in the future by counting partners of partners in the present.

Figure 5.2

The main idea behind the R&D collaboration analysis

Enrolment in
cluster project

-3   -2   -1   0   1   2   3

CNW_1
Links between all members
of the same cluster

RNW_0
R&D projects where at least
one future cluster firm is involved

RNW_1
R&D projects where at least
one cluster firm is involved
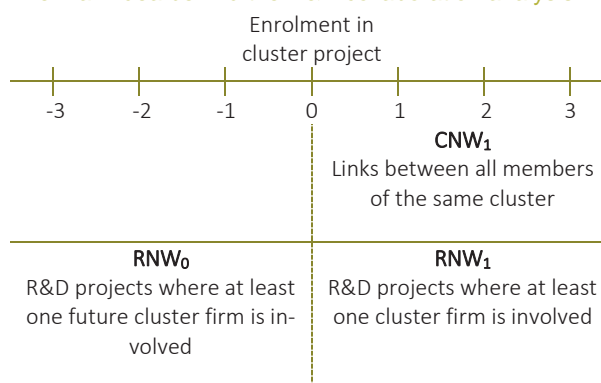
It is noteworthy that this approach does not *fully* tell us the extent to which the cluster programme has

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changed the degree of collaboration (we cannot observe informal collaboration and collaboration in projects without public support), but it does give an indication of the direction of changes resulting from the programme. Furthermore, if we do observe changes in formal R&D collaboration, there is reason to believe that there have been some changes in informal collaboration too.[34]

Firstly, we set the time for each firm's enrolment year as zero. Then we construct a cluster network (CNW), i.e. the links between all firms and research institutions participating in the given cluster project during the three years after a given firm has enrolled in the cluster project. All Arena cluster projects are included in the analysis, while only NCE cluster projects that primarily started out as NCE (and not as a successor to an Arena cluster project) are included.[35] That gives us 57,514 unique links for Arena and 31,159 unique links for NCE in the period 2005-2015.

Secondly, we identify all R&D projects (in our database) that have at least one cluster member involved either as a project leader or as a collaborator. Based on this information, we construct the firm's primary R&D network in the three-year period prior to cluster participation (RNW_0) and in the three-year period after enrolment (RNW_1) by mapping all collaborators of the ongoing projects in these two periods.[36]

Thirdly, we study how the R&D collaboration network has changed, i.e. changes in the total number

Table 5.1
Cluster members'[1] R&D collaborative projects[2] three years before and after enrolment in a cluster project

	Arena		NCE[3]	
	3 years before t=0	3 years after t=0	3 years before t=0	3 years after t=0
No. of R&D projects				
Total firms in cluster network	1 543	2 436	702	1 332
No. with collaboration	963	1 512	240	633
Share with collaboration	62 %	62 %	34 %	48 %
No. of collaborators				
Average	15	17	18	19
Min	2	2	2	2
Median	13	15	17	16
Max	34	45	34	45
No. of patent applications				
Total by all collaborators	1 119	1 085	555	762
No. among cluster members	102	156	86	130
Share among cluster members	9 %	14 %	15 %	17 %
Patent application per project	0.73	0.45	0.79	0.57

Source: Samfunnsøkonomisk analyse AS
1) Excluded research institutes.
2) Based on R&D projects with funding from the Research Council of Norway, EU FP7, H2020 and/or SkatteFUNN.
3) Includes two GCE projects that started as NCE.

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[34] Receiving funding from one of the R&D schemes requires some amount of effort, and in many cases probably more than in informal collaboration between two firms.
[35] These clusters are NCE Aquaculture, NCE Instrumentation, NCE Micro- and Nanotechnology, NCE Oslo Cancer Cluster, NCE Raufoss, NCE Seafood Innovation Cluster and NCE Systems Engineering. This group of NCE firms also includes members of two GCE clusters that started out as

NCE clusters (i.e. GCE Blue Maritime and GCE Subsea). Some of the excluded clusters are to some extent a successor of an Arena project. However, due to changes in the composition of members, etc. these projects can essentially be considered as new projects.
[36] Our data is available until 2016. Thus, to have at least one full year of cluster participation, we restrict this analysis to the firms that enrolled in a cluster project no later than 2015.

of links three years prior to enrolment (period 0) and three years after enrolment (period 1).

We observe more R&D projects with higher collaboration intensity (i.e. number of collaborators per ongoing project) in the three-year period after enrolment in both Arena and NCE projects (cf. table 5.1). Furthermore, we observe an increase in the number of patent applications in total and among members of a cluster project.

However, we cannot claim that the observed increase is a result of cluster participation. Moreover, the number of patent applications per ongoing project is falling from period 0 to period 1, implying that the number of projects has increased more rapidly than the number of patent applications. One reasonable explanation is that it takes time for project ideas to be realised in the form of a patent application. This makes it even harder to claim that observed patent applications are connected to the ongoing projects in the given R&D network and not to other projects that took place earlier and/or outside the network. Given these observations, we will restrict the further analysis to collaboration dynamics and intensity.

Figure 5.3

An example with two clusters and three connected collaborative R&D projects (in ovals)
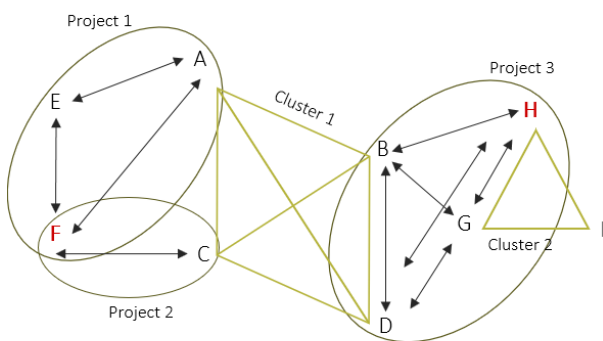
In the analysis, we distinguish between the following types of links between the participants in the identified R&D networks:

- Two firms in the same cluster (e.g. B and D in figure 5.3).
- A firm and an R&D institution in the same cluster (e.g. G and H in figure 5.3).
- Two R&D institutions in the same cluster (not represented by figure 5.3).
- Two firms in different clusters (e.g. D and G in figure 5.3).
- A cluster firm and an operator outside the cluster (e.g. A and E, or C and F, in figure 5.3).
- Two operators outside the cluster (e.g. E and F in figure 5.3).

Figure 5.4

Potential R&D collaboration through secondary R&D network prior to enrolment
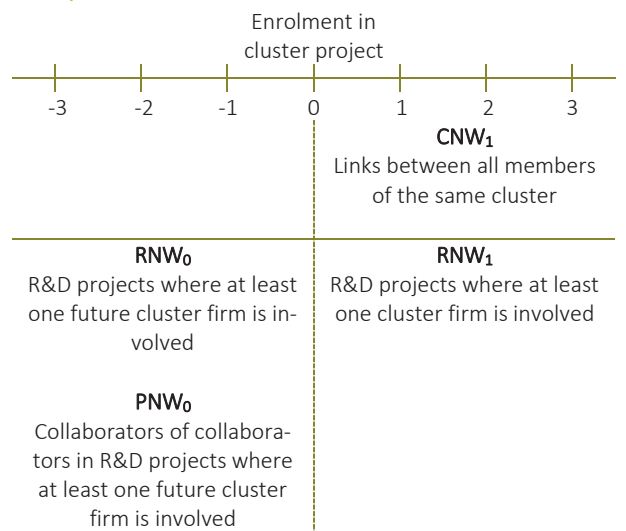
It is worth noting that new partnerships (collaborations) in period 1 could be a result of the realisation of potential R&D collaboration from period 0 (someone gets in contact with a new collaborator through their earlier common collaborator). For example, if firm A and firm C start a new project, we cannot tell whether this project is a result of their participation

in the same cluster, or of their earlier collaboration with R&D institution F.

To check which of the new collaborations in period 1 are most likely to have been established through a cluster network, and not through contacts with collaborators of collaborators, we also report the adjusted results by excluding the links observed earlier in the secondary network (cf. network PNW_0 in figure 5.4).

We observe an almost doubling of links in the three-year period after enrolment, compared to the three-year period prior to enrolment, i.e. comparing RNW_0 and RNW_1 (cf. figure 5.5). Our results thus imply a significant increase in R&D collaboration after enrolment in a cluster project, for both Arena and NCE

projects. This conclusion holds true even when possible collaboration through a secondary R&D network in period 0 is accounted for.

In period 0, we distinguish between links that were only active in period 0 (the corresponding R&D projects were completed prior to enrolment), and links that were observed in both periods (the corresponding R&D projects were active in period 0 and continued in period 1). In period 1, we distinguish between new links by the types of collaborators defined in the above list. It is apparent that collaboration between a cluster member and a firm/research institution that is not a part of any cluster project is the most common form of collaboration when looking at the new relationships.

Figure 5.5

R&D collaboration before and after enrolment in a cluster project. Number of links
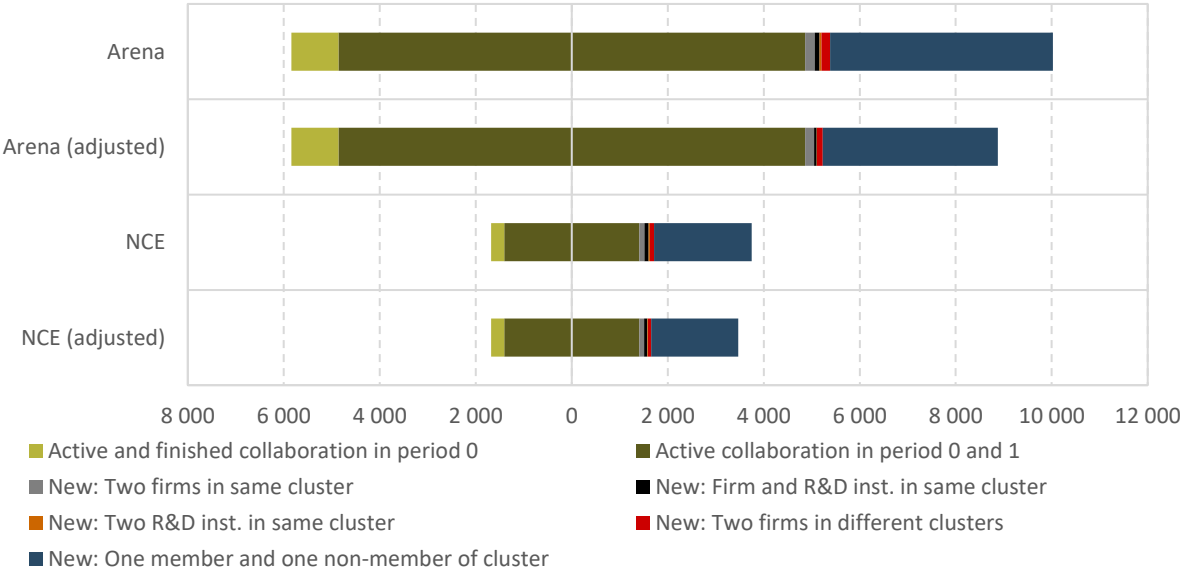
Source: Samfunnsøkonomisk analyse AS

Note: The year of enrolment is set to zero. The adjusted numbers are corrected for possible collaboration through the secondary network in the three-year period prior to enrolment in the cluster project (i.e. excl. links established with partners of partners).

Table 5.2

R&D collaboration before and after enrolment in a cluster project. Growth in number of links by type of collaboration. Arena projects

Collaboration	Types of links in R&D collaborative network[1]					
	Two firms in same cluster	Firm and R&D inst. in same cluster	Two R&D inst. in same cluster	Two firms in different clusters	One member and one non-member	Two non-members
Active and finished in period 0 (RNW$_0$ only)	12	6	4	19	940	3 297
Active in both period 0 and 1 (RNW$_0$ and RNW$_1$)	161	133	66	205	4 295	12 339
New in period 1 (RNW$_1$ only)	204	99	37	185	4 640	13 697
Increase	192	93	33	166	3 700	10 400
Growth rate	111%	67%	47%	74%	71%	67%
Collaborators in RNW$_1$ observed in PNW$_0$[2]	16	46	27	69	991	2 167
Net increase[3]	176	47	6	97	2 709	8 233
Net growth rate[3]	102%	34%	9%	43%	52%	53%

Source: Samfunnsøkonomisk analyse AS
1) Based on R&D projects with at least one cluster member involved.
2) PNW$_0$ is a network of firms which have a common collaborator in period 0 and are thus potential collaborators in period 1.
3) Adjusted for potential collaborators from period 0 (PNW$_0$).

Table 5.3

R&D collaboration before and after enrolment in a cluster project. Growth in number of links by type of collaboration. NCE and GCE projects

Collaboration	Types of links in R&D collaborative network[1]					
	Two firms in same cluster	Firm and R&D inst. in same cluster	Two R&D inst. in same cluster	Two firms in different clusters	One member and one non-member	Two non-members
Active and finished in period 0 (RNW$_0$ only)	1	6	5	4	255	895
Active in both period 0 and 1 (RNW$_0$ and RNW$_1$)	64	67	42	44	1 191	5 185
New in period 1 (RNW$_1$ only)	107	85	25	90	2 032	8 307
Increase	106	79	20	86	1 777	7 412
Growth rate	163 %	108 %	43 %	179 %	123 %	122 %
Collaborators in RNW$_1$ observed in PNW$_0$[2]	8	16	13	22	220	489
Net increase[3]	98	63	7	64	1 557	6 923
Net growth rate[3]	151 %	86 %	15 %	133 %	108 %	114 %

Source: Samfunnsøkonomisk analyse AS
1) Based on R&D projects with at least one cluster member involved.
2) PNW$_0$ is a network of firms which have a common collaborator in period 0 and are thus potential collaborators in period 1.
3) Adjusted for potential collaborators from period 0 (PNW$_0$).

However, after dividing links in period 0 by the types of collaborators defined in the above list, we observe the highest growth in the number of collaborations between two members of the same cluster (cf. table 5.2 and table 5.3). The number of links for this type of collaboration was more than doubled after enrolment in a cluster project, even after adjustment for possible collaboration through the secondary R&D collaboration network, PNW_0.

This result clearly indicates that Norwegian Innovation Clusters has achieved one of its objectives, i.e. to *"(…) trigger and strengthen collaboration-based development activities within the cluster"*.

Regarding collaboration between a firm and a research institution in the same cluster, this has increased by 67 per cent for members of an Arena project and by 108 per cent for members of an NCE project (the corresponding rates after adjustment are 34 per cent for Arena and 86 per cent for NCE, which are lower, but still imply an increase in collaboration).

Furthermore, we find a high growth rate for collaboration between two firms in different clusters, especially for members of NCE projects. A possible explanation may be that these firms have more informal collaboration and contact than solely through membership of the corresponding cluster. In addition, there is an expectation of cluster-to-cluster collaboration for NCE and GCE projects (cf. the list of strategic priorities in section 2.5.1).

The lowest growth rate is observed for collaboration between two research institutions in the same cluster. This is positive, but almost negligible, when adjusting for potential collaborators from period 0. The

Table 5.4
R&D collaboration intensity[1] (number of R&D projects per collaboration) before and after enrolment in a cluster project

Collaboration	Types of links in R&D collaborative network[2]					In total		
	Two firms in same cluster	Firm and R&D inst. in same cluster	Two R&D inst. in same cluster	Two firms in different clusters	One member and one non-member	Mean	Max	With > 1 project
Arena								
Finished in period 0	1.08	1.17	1.00	1.11	1.06	1.06	4	5.4 %
Active in both, period 0	1.48	2.59	2.86	1.66	1.37	1.44	55	18.2 %
Active in both, period 1	1.96	3.77	4.20	1.82	1.55	1.67	59	26.4 %
New in period 1	1.23	1.33	1.24	1.13	1.15	1.16	18	9.7 %
NCE and GCE								
Finished in period 0	1.00	1.50	1.20	1.00	1.04	1.05	3	4.4 %
Active in both, period 0	1.59	1.69	2.60	1.14	1.19	1.28	18	11.9 %
Active in both, period 1	1.78	2.55	3.79	1.39	1.39	1.53	30	22.0 %
New in period 1	1.32	1.25	1.48	1.02	1.21	1.21	16	10.7 %

Source: Samfunnsøkonomisk analyse AS

1) If we observe the same link in more than one project (e.g. the same two firms collaborate in five different projects), the intensity of collaboration is greater than 1.
2) Based on R&D projects with at least one cluster member involved.
3) Share of links observed in more than one project.

growth rate for this type of collaboration in Arena projects is reduced from 47 per cent to 9 per cent after adjustment, and for NCE projects from 43 per cent to 17 per cent. One possible explanation may be that research institutions have a long tradition for R&D collaboration so that participation in a cluster project does not play a significant role in developing their network. This is not an objective for the cluster programme either.

Comparing Arena with NCE, we can conclude that members of projects at both programme levels were active in R&D collaboration prior to participation in a cluster project, but participation in an NCE (including GCE) project seems to result in higher growth in collaboration than in the case of Arena projects.

5.3   Changes in collaboration intensity

Looking at the average number of R&D projects connected to each unique link between collaborators (collaboration intensity), it is apparent that the intensity of collaboration varies considerably, depending on the type of collaboration.

We observe the highest collaboration intensity when a research institution is involved, i.e. either between a firm and a research institution or between two research institutions in the same cluster (cf. table 5.4). Links that are active in both periods have the highest intensity, indicating that some of these links can be the result of long-term, stable collaboration leading many collaborative projects.[37] Interestingly, even for this group of well-established links, the intensity has increased from period 0 to period 1, implying that these operators have been involved in both more and larger R&D projects after enrolment in a cluster project.

Comparing the intensity of new links with existing links, we observe that the collaboration intensity is lower for the former group of links. The main explanation is that new collaboration is often only linked to one project. It is, however, naturally expected that it takes time to expand a new collaboration to include more projects. The summarised results for all types of links confirm that new links (collaboration) on average collaborate on fewer projects. Furthermore, the proportion of links observed in more than one project is much lower for new than for well-established links (but higher than for the links that disappeared after period 0).

Comparing Arena with NCE is more challenging regarding collaboration intensity. While some forms of collaboration become more intensive among members of an Arena project, other types become more intensive for NCE members. However, both seem to impact the collaborative intensity positively.

An assessment of changes in collaboration based on data concerning formalised R&D collaboration is a relatively strict delimitation. As mentioned above, however, since we observe changes in formal R&D collaboration, it is reasonable to believe that there have also been some changes in informal collaboration. This is confirmed in our interviews with members of the seven cluster projects we have evaluated.

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[37] Not surprisingly, a few large research institutions are the main collaborators within these types of collaboration.

6   Significant impact on economic performance

The main objective of Norwegian Innovation Clusters is to contribute to value creation through sustainable innovation, by making clusters more dynamic and attractive, and by increasing the individual firm's innovativeness. The above network analyses document that cluster participants increased their formal collaboration in research and innovation projects significantly after enrolment in a cluster project. However, to assess the cluster programme's effectiveness, we should trace the effects of the programme on the participants' innovation activity and economic performance.

6.1   Increased innovation activity

There has been a marked increase in the number of SkatteFUNN[38] projects in recent years. If we compare growth in the number of projects managed by core members[39] of the cluster projects included in the evaluation with projects managed by others, it appears that the growth has been higher among the core members, especially the members of an NCE project (cf. figure 6.1).[40]

We are aware that the increase in the total number of SkatteFUNN projects (or at least applications) is partly because the Research Council has taken it upon themselves to mobilise firms to apply for SkatteFUNN. Unless the Research Council sees cluster participation as an indication of whom to encourage to apply for SkatteFUNN, this applies to all firms and should not undermine the observed difference between the core members and other firms.

Given that all firms engaged in innovation-oriented R&D are eligible applicants (see section 4.1), we consider SkatteFUNN to be a good indicator of

firm's innovation activity. Our interpretation of the data is that the core members have somewhat higher growth in innovation projects within the SkatteFUNN scheme, regardless of when they enrolled in a cluster project.

Figure 6.1
Number of active SkatteFUNN projects. Core members and others[1]. Index (2002=100). 2002-2016
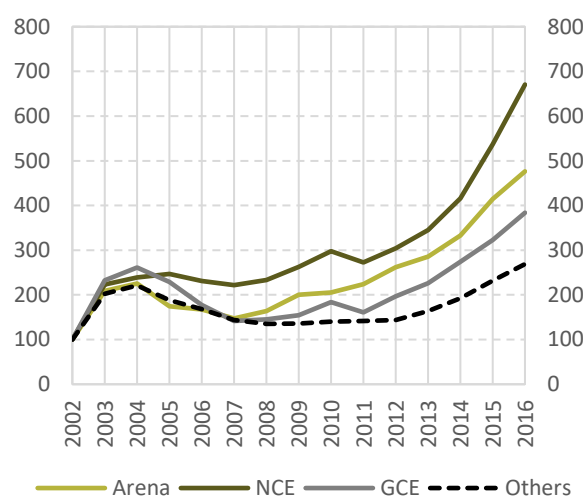
Source: Samfunnsøkonomisk analyse AS
1) Other recipients of SkatteFUNN (90 per cent of SkatteFUNN recipients are limited liability companies (LLC)).

It is not clear whether the growth in the use of SkatteFUNN can be attributed to participation in a cluster project. The significant growth in collaborative relationships (documented in Chapter 5) indicates that this could be the case. Our interviews also show that the cluster projects have led to increased knowledge of and trust in each other among the members, and often, to a stronger cluster identity. This has increased the members' willingness to collaborate. Several respondents also state that the cluster project has increased their knowledge of funding agencies and the possibilities

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[38] See discussion of the scheme in section 4.1.
[39] See definition in section 2.8.1.

[40] Core members are defined as such in all years. Hence, the increase in the number of projects among these firms is not merely the result of an increase in the number of cluster participants.

that exist for cluster-based innovation. This has relatively consistently resulted in an increased willingness to initiate, and capacity to conduct, innovation activities.

Regardless of whether the increased innovation activity is a result of cluster participation or not, we should expect this increase in innovation activity to affect the firms' economic performance. Given that most core members have received additional public support, both through SkatteFUNN and other supporting schemes (cf. Chapter 4), it is crucial to control for this additional support when estimating the effects of cluster participation on firms' performance.

6.2   Significant impact on economic performance

Comparing core members in our sample with a matched control group, we find significant positive effects on employment, sales revenues and value added during the first three years after enrolment in a cluster project. This is in line with previous and similar studies of effects of cluster participation (see Cappelen et al. (2015)).

In addition to confirming the results in previous studies, we have taken the established methods one step further in this evaluation to assess whether there are differences in the effects between the programme levels, and whether we can document heterogeneous effects.

6.2.1 All cluster projects
As part of their system for Management by Objectives and Results (MBR) and reporting to the minis-

tries, Innovation Norway measures the economic effects of participation in a cluster project.[41] The measurements are carried out by Statistics Norway and documented in Cappelen et al. (2015).

Cappelen et al.'s estimations indicate higher growth in selected performance indicators among the firms in their sample during the first three years after enrolment in a cluster project. After the first three years, there is no significant difference compared to firms in the control group.

The MBR method implemented by Cappelen et al. (2015) comprises the following performance indicators:

- Employment
- Sales revenues
- Value added
- Labour productivity
- Return on total assets

In this evaluation, we have chosen to estimate effects on the same (aforementioned) indicators. We also apply the same method as in Cappelen et al. (2015), i.e. the matching method with difference-in-differences (diff-in-diff), to compare the development in these indicators for firms participating in a cluster project (before and after participation) with the development in the corresponding indicators for firms in the control group.

Though the method and the performance indicators are the same, we make several adjustments to the choice of control group and the presentation of results.

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[41] See e.g. Innovation Norway (2016) *Annual report to ministries 2016*, p. 263.

While Cappelen et al. use firms without support from Innovation Norway as controls, we allow both cluster firms and controls to be recipients of other types of public support. Using our database of all public schemes available tor Norwegian firms (described in Chapter 4), we identify core members and potential controls with support from other public schemes. Not all public schemes are relevant for our analysis, so that we only include innovation- and industrial development-oriented schemes, since these schemes are also expected to affect our performance indicators. All core members, as well as potential controls, are limited liability companies.

As in Cappelen et al. (2015), we use matching with stratification. This means that, when searching for controls, we look within groups (cells) with certain predefined characteristics equivalent to those of the core members. In addition to the specification of cells based on the firms' industry, region and cohort, we include an indicator of whether the firm has received additional public support or not.[42]

We thus match the core members to firms from the same industry and region which were established in the same year and with corresponding types of public support, but that have not participated in a cluster project.

Given that most core members have received additional public support (cf. Chapter 4), we believe that matching these with other firms with the same kind of public support gives us a more precise control group for interpreting the effects of cluster participation. Not accounting for other types of support makes it difficult to claim that the effects achieved are solely the result of cluster participation and not the result of other types of support.

With this approach, the only observable difference between firms in the treatment group (core members) and the control group is participation in a cluster project. However, this approach does not account for unobservable differences (e.g. qualities of the firm's general manager that could affect the firm's performance). Further, both previous evaluations and our interviews emphasise the importance of the cluster facilitator's qualities for the project's success. We do not possess sufficient data con-

Table 6.1
Estimated average annual difference in ΔX between core members and control group. Matched difference-in-differences. All clusters. Percentage points

Dependent variable (X)	First three-year interval				Second three-year interval			
	Effect	z	[95 % conf. interval]		Effect	z	[95 % conf. interval]	
Number of employees	7.41***	6.64	5.22	9.60	-1.99	-1.11	-5.50	1.52
Sales revenues	12.74***	6.41	8.84	16.64	2.29	0.65	-4.62	9.20
Value added	8.06***	4.62	4.65	11.48	-4.07	-1.32	-10.13	1.99
Value added per employee	0.80	0.58	-1.89	3.49	-2.21	-0.88	-7.14	2.71
Return on total assets	-34.22	-0.42	-195.68	127.24	-34.00	-0.21	-344.68	276.69
Number of core members	460				229			

Note: 1:5 nearest neighbour matching with stratification by cohort-industry-region-other public support
*** p < 0.01; ** p < 0.05; * p < 0.1

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[42] This indicator comprises support from the Norwegian R&D tax credit scheme SkatteFUNN, innovation and development schemes in Innovation Norway, development support from the county municipalities and R&D support from the Research council of Norway and EU FP7 and Horizon 2020.

cerning the latter to control for this. Hence, the results obtained do not necessarily represent causal effects and should be interpreted with caution.

The firm's characteristics on start-up, or in 2003 (or the first year of observation in our accounting data) for firms established before 2003, are used as matching variables, and include firm size measured as total assets and number of employees.[43] We use the same matching procedure as Cappelen et al.,

i.e. the Stata routine *psmatch2* with 1:5 nearest neighbour matching with trimming.[44]

As emphasised by Blundell and Costa Dias (2009) and pointed by Cappelen et al. (2015), the matching variables must be determined before a unit *can* potentially be assigned to treatment (and not just before it *is*). This is challenging when the time of treatment is not a fixed date, as in the case of cluster participation. A firm may be assigned to treatment

Table 6.2

Estimated average annual difference in ΔX between core members and control group. Matched difference-in-differences. Arena clusters. Percentage points

Dependent variable (X)	First three-year interval				Second three-year interval			
	Effect	z	[95% conf. interval]		Effect	z	[95% conf. interval]	
Number of employees	6.52***	3.6	2.98	10.07	-5.97	-1.6	-13.28	1.35
Sales revenues	14.72***	4.8	8.70	20.73	-9.06	-1.25	-23.22	5.10
Value added	8.89***	3.34	3.67	14.10	-11.75*	-1.84	-24.26	0.76
Value added per employee	1.67	0.79	-2.46	5.80	-5.97	-1.11	-16.56	4.62
Return on total assets	0.60	0.12	-9.19	10.40	-0.60	-0.05	-25.12	23.93
Number of core members	202				87			

Note: 1:5 nearest neighbour matching with stratification by cohort-industry-region-other public support
*** p < 0.01; ** p < 0.05; * p < 0.1.

Table 6.3

Estimated average annual difference in ΔX between core members and control group. Matched difference-in-differences. NCE clusters.[1] Percentage points

Dependent variable (X)	First three-year interval				Second three-year interval			
	Effect	z	[95 % conf. interval]		Effect	z	[95 % conf. interval]	
Number of employees	7.30***	4.22	3.85	10.75	-0.98	-0.4	-5.74	3.78
Sales revenues	9.67***	2.66	2.56	16.78	5.97	1.21	-3.70	15.63
Value added	7.11**	2.40	1.31	12.92	-2.85	-0.68	-11.10	5.40
Value added per employee	1.01	0.44	-3.55	5.57	-2.42	-0.71	-9.10	4.26
Return on total assets	-32.03	0.18	-377.68	313.62	-66.36	-0.26	-563.01	430.29
Number of core members	139				94			

Note: 1:5 nearest neighbour matching with stratification by cohort-industry-region-other public support
*** p < 0.01; ** p < 0.05; * p < 0.1.

1) Only NCE cluster projects that primary started out as NCE (and not as the successor of an Arena cluster project).

[43] Our accounting data starts in 2003. We do not possess information on firms' ownership structures, so unlike Cappelen et al. we are not able to construct the Herfindahl index for the owner concentration. However, in addition to total assets we use firm size measured by number of employees. The correlation between number of employees and total assets is low and does not imply any multicollinearity problem.

[44] The option specification used is the same as in Cappelen et al. (2015): *neighbour(5) common trim(10),* but as described above, the cell definition differs, as well as the matching variables. Thus, our results may differ.

early, or late, in its lifetime. We control for this by including an indicator for the firm's age at the year of treatment (here enrolment in cluster project) when estimating difference-in-differences. In addition, we control for the firm's location and the post-2008 crisis and post-oil-price crisis periods.[45]

Pooling all cluster projects, we find significant positive effects on employment, sales revenues and value added during the first three years after enrolment in a cluster project. After the first three years, however, there is no significant difference between the core members and the firms in the control group. For productivity and return on total assets, we do not find any significant effects (cf. table 6.1). These results are in line with the results in Capellen et al. (2015).

6.2.2 Differences between programme levels

While Cappelen et al. (2015) only control for participation in any cluster project (by binary indicator, i.e. participation or not) and report average results for all participants, we test whether the results differ for different levels of the cluster programme by grouping firms by Arena and NCE.[46]

The results for all cluster projects presented above hold true on distributing the projects by their programme level, i.e. significant positive effects on the same performance indicators during the first three years after enrolment for both Arena and NCE projects.

Comparing Arena projects with NCE projects, we observe higher growth in sales revenues and value added for core members in an Arena project than for core members of an NCE project, compared to

their respective control groups (cf. table 6.2 and table 6.3). The result is the opposite for growth in employment. However, these effects are not statistically different from each other.

In addition to distributing the members by cluster level, we could also estimate effects per cluster project. However, our preferred method requires a certain amount of data to provide consistent results. For projects with few or no years of observable data in the period after the project was included in the cluster programme, or projects with few core members, it is not possible to perform the abovementioned estimates. To assess the individual project's effectiveness, we therefore supplement the econometric analysis provided with several interviews with participating firms. These results are presented in the individual project reports.

6.2.3 Heterogeneous effects

To elaborate on the abovementioned results, we consider the heterogeneity of the effects for different indicators that are significant in the main analysis (i.e. number of employees, sales revenues and value added). This means that we check whether most of the firms experience positive effects, or whether only a few of the firms experience extremely high growth and others none at all.

We check the heterogeneity of effects by ranging core members at the year of enrolment by the value of the variable of interest and defining their "initial position". This procedure allows us to check whether core members in the highest quartile (top 25 per cent), with respect to their initial position, perform systematically differently from the firms in the lowest quartile.

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[45] All diff-in-diff models are estimated using the mixed command in Stata (see http://www.stata.com/bookstore/stata12/pdf/xt_xtmixed.pdf).

[46] Includes members of two GCE cluster projects that started as NCE clusters (i.e. GCE Blue Maritime and GCE Subsea).

Our results indicate a heterogeneous effect. That is, we find that small and medium-sized firms (at the time of enrolment) perform better than micro and large firms (cf. 2nd and 3rd quartiles for the number of employees in table 6.4).

Apart from core members in the lowest quartile with respect to sales revenues at the time of enrolment, most firms seem to have increased their sales revenues after enrolment in a cluster project. This is in line with several of our interviews, in which respondents argue that cluster participation has initiated innovation or R&D projects in which they would not otherwise be involved, which in turn has led to increased sales revenues.

Only core members starting out in the lower quartiles of the value-added distribution experience significant effects on value added after enrolment. A possible explanation for this result could be the "catching-up" effect. The cluster projects may help firms that are far removed from "best practice" to catch up with those which are close to "best practice".

The proven heterogeneous effects do not change our main conclusions. The participation by the "best" firms, in terms of initial value added, in a cluster project is still important to teaching others how to perform better. In a recently published NIBR report which studies structure and performance in five clusters (not all cluster projects within the cluster programme) the authors document how crucial the participation of well-established and successful firms is for a cluster. These firms promote ideas, bring in network contacts and push start-ups and immature firms to a new level. While they only observe growth in employment for start-ups, they conclude that *"(…) both the older and newer firms report a high level of innovation"* (Onsager, et al. 2017).

Table 6.4

Heterogeneity of participation effects by distribution of dependent variable (X) at the time of enrolment in the cluster project. All clusters. Percentage points

Dependent variable (X)	Quartile	Mean of X	Effect	z	[95% conf. interval]	
Number of employees						
	1	1	-9.06*	-1.87	-18.54	0.43
	2	5	17.28***	4.29	9.39	25.17
	3	13	14.76***	3.69	6.92	22.60
	4	88	6.81*	1.82	-0.52	14.14
Sales revenues (NOK 1,000)						
	1	347	-6.36	-0.59	-27.59	14.87
	2	4,098	32.02***	4.12	16.78	47.25
	3	19,617	17.03**	2.28	2.39	31.67
	4	224,659	20.63***	2.80	6.21	35.05
Value added (NOK 1,000)						
	1	79	31.85**	2.11	2.30	61.40
	2	2,106	22.30***	3.07	8.06	36.53
	3	9,119	10.11	1.50	-3.13	23.35
	4	76,515	11.53*	1.75	-1.38	24.44

Note: 1:5 nearest neighbour matching with stratification by cohort-industry-region-other public support

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

7 Links to the rest of the economy

The impact of the cluster programme and the individual cluster projects on local, regional and national economic activity might be greater than solely the direct effect estimated in the previous chapter. As sales revenues and value added among the core members of the clusters increase, these firms require higher production input, i.e. firms purchase goods and services from others. In addition, most firms have employees who spend their pay on goods and services from local, regional, and national suppliers.

In this chapter, we will analyse how the core members[47] are connected to other industries in the economy, and the extent to which increased value added within the cluster projects results in increased value added in other industries within the economy.

To do this, we conduct an economic ripple-effects analysis for the core members of all 47 cluster projects at national level. We have also studied how the seven cluster projects subject to individual evaluation[48] differ from the national analysis and how they differ from each other.

7.1 Economic ripple-effects analysis

An economic ripple-effects analysis seeks to measure or estimate changes in economic activity in a specific region, caused by a specific economic event. In this analysis, the specific economic event is the public support for cluster projects in the cluster programme.

The sources of the impact can be broken down into different components, as direct, indirect and induced effects:

The *direct effect* is the effect which can be identified as a result of the activities funded by the cluster programme. The direct effects thus consist of value added among the core members in the cluster projects supported, as estimated above.

Core members of the cluster projects which benefit from the participation will subsequently increase their spending on goods and services from other firms, which will create additional activity in the local or regional economy. *Indirect effects* are thus the result of business-to-business transactions indirectly caused by the direct effects.

The *induced effects* are the results of increased personal income or increased capital returns due to the direct and indirect effects. Firms experiencing increased revenue from the direct and indirect effects will increase their payroll expenditures (by either hiring more employees, raising salaries or increasing payroll hours, etc.). Households will, in turn, increase their spending on goods and services from local suppliers. The induced effect is thus a measure of the increase in household-to-business activity.

However, it is not clear how to measure relevant induced effects. In principle, relevant induced effects will result from productivity growth in the economy as a whole (cluster members grow at the expense of other firms, as discussed in Chapter 3). Whether this is a measurable effect is uncertain, however.

The purpose of this analysis is more modest in scope and will solely examine how the core mem-

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[47] See definition in section 2.8.1.

[48] Arena Biotech North, Arena Lønnsomme vinteropplevelser, Arena Smart Water Cluster, NCE Instrumentation, NCE Micro- and Nanotechnology, NCE Raufoss and NCE Systems Engineering.

bers of the cluster projects are related to other industries in the economy. We therefore ignore the induced effects in the following.

7.1.1 How to interpret the results

The results from this analysis should be interpreted as a study of how the cluster projects are interconnected with other industries in the economy. It is difficult to determine the extent to which increased value added among the core members is a result of higher productivity and/or higher export intensity, hence leading to an effect for the Norwegian economy, or whether the increase is a distribution effect that solely reallocates resources from other industries.

Moreover, there is a difference between net and gross ripple effects. Gross ripple effects do not consider that labour and capital can be used elsewhere in the economy, i.e. they do not measure the alternative use of labour, which may potentially be greater elsewhere. This applies to both the direct and indirect effects.

As an illustration, the value of a new employee depends on the alternative use of the labour force. A new position is most valuable if it is filled by an unemployed person and is less valuable if the new position displaces another position, in the sense that it contributes to reduced employment in another company.

When estimating net ripple effects, on the other hand, the employment and value creation that labour and capital can create elsewhere are deducted. Net impacts are particularly relevant in economies where unemployment is low, or it is difficult to import labour from other regions or countries. In socioeconomic net-benefit analyses it is common to assume full employment in Norway, whereby everyone who wants to be employed is already employed. At a national level, this means that measures to create new jobs are essentially distributional effects from other industries, and that the socio-economic gain is potentially marginal.

On the other hand, at a regional level it is not unusual to assume that there is a local mismatch between labour supply and labour demand in the labour market. Measures that affect the regional labour market could lead to more people being employed, and the potential for net ripple effects is greater at a local level than at national level.

In our calculations, we study the gross ripple effects. Consequently, the results do not provide a basis for concluding that we have a significant effect on value added at national level.

7.1.2 Modelling economic impacts

The ripple-effects analysis is conducted by using Samfunnsøkonomisk analyse AS' own model SARMOD[49]. SARMOD is an input-output model that analyses indirect effects, based on how the industries (i.e. the industries that the core members are part of) within the clusters are linked to other industries in the economy. The model relies on inter-industry data to determine how effects in one industry will impact other sectors.[50] In addition, the model estimates the share of each industry's purchases that are supplied by national firms and the share that is imported.

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[49] Samfunnsøkonomisk analyses RingvirkningsMODell.

[50] The model uses the ESA Questionnaire 1500 – Supply table at basic prices, including a transformation into purchasers' prices and ESA Questionnaire 1600 – Use table at purchasers' prices.

As described in Chapter 2, clusters are both geographically and industrially diversified. The core members of all projects included in the evaluation represent firms from several regions of Norway, while each of the seven cluster projects represents a smaller region. Moreover, the group of all cluster projects and the seven regional cluster projects will differ by which industries the core members represent.

For this analysis, we have composed a "synthetic industry" based on the composition of the core members of the specific cluster projects. Since the clusters are made up of different industries, the ripple effects of an equal value-added effect will differ in magnitude. There are two main reasons for this difference.

Firstly, industries differ in terms of production input ratios. For example, for a given production level, "Manufacture of basic pharmaceutical products" has an input level[51] of 85 per cent, while "Architectural and engineering activities" has an input level of 49 per cent. The first round of ripple effects to other industries is thus presumably smaller in the case of "Architectural and engineering activities".

Secondly, the products required for the production process may differ in import intensity. For example, if an industry demands products that are produced in Norway, the ripple effects will be greater than if the products are imported.

The next aspect to consider in a study of ripple effects is which regional dimension to examine. We have applied a national perspective to the analysis of all core members, thereby quantifying the ripple effects in Norway.

We have chosen a stylised example to illustrate the ripple effects of an increase in value added among core members in the 47 cluster projects. In addition, we study how the magnitude of national ripple effects differs between the different cluster projects.

Our stylised example examines the ripple effects of an increase of NOK 10 million in value added from cluster participation. We applied the same stylised shock when analysing the core members in all cluster projects and the seven different cluster projects. The results presented here thus cannot be applied to quantify the value creation in the rest of the economy from increased spending on cluster programmes in general. However, it is useful to qualitatively discuss how identified effects on core members' value added might lead to higher economic activity in the region. For comparison, we perform the same exercise for the industries in the private sector[52] of the Norwegian economy.

Finally, we have not taken into account that some of the increased demand for goods and services may be subcontractors who are also members of the cluster projects themselves. If this is the case, we overestimate the ripple effects.

7.2   High interconnection with other industries

Our results show that the core members in our sample have a strong interconnection with other industries. An increase in the core members' value added by NOK 10 million gives additional indirect ripple effects of around NOK 9.9 million in other industries

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[51] By input level we mean the share of intermediate input at a given production level, i.e. production (gross output) = value added + intermediate input.

[52] Industries in the private sector with NACE ranging from 1 to 82. The value-added effect is evenly distributed on the industries.

in the Norwegian economy (cf. figure 7.1). The calculation is an upper estimate of the ripple effect (as discussed above).

An increase in the core members' value added has a significant impact on value added in other industries within the economy. In terms of numbers, a presumed increase in value added of NOK 10 million will give an increase in demand for intermediate inputs worth NOK 19.4 million.[53] This demand for inputs will be directed at firms in all industries within the economy (members of the cluster projects, but mainly from other parts of the economy). Using our SARMOD ripple effects model, we have calculated that NOK 9.8 million of the input will be imported, while NOK 9.9 million is gross products in industries located in Norway. The latter is the indirect effect.

Figure 7.1

Ripple effects of a NOK 10 million increase in value added among core members
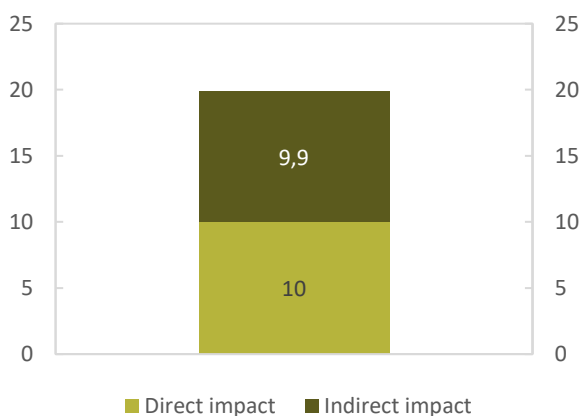
Source: Samfunnsøkonomisk analyse AS

7.2.1 Comparing with the average in the economy

By performing the same exercise for all industries in the private sector[54] of the Norwegian economy, we find that the overall ripple effects are slightly lower. An increase in value added of NOK 10 million [55] gives additional ripple effects of around NOK 9.2 million. This shows that an increase in value added for the core members in all cluster projects generates slightly higher indirect ripple effects than if the same increase in value added is distributed evenly on all industries in the private sector.

Our analysis leads to two main conclusions concerning the core members' interaction with the rest of the Norwegian economy:

- The core members are in general more intensive in their use of intermediate inputs.
- The core members have a higher share of imports.

These two results move in opposite directions: the greater intensity of intermediate inputs increases the indirect ripple effects, while a higher share of imports reduces the indirect ripple effects. Overall, the core members' ripple effects are slightly higher than the average in the private sector.

7.2.2 Differences between the cluster projects

We have applied the same shock as above to the seven cluster projects subject to individual evaluation. The results show that the cluster projects differ in terms of the magnitude of the ripple effects compared to the core members in all 47 cluster projects (cf. figure 7.2[56] and table 7.1). The reason for the

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[53] To simplify, gross output = value added + intermediate inputs.
[54] Industries in the private sector with NACE ranging from 1 to 82.
[55] This is evenly divided with a value-added effect of NOK 137,000 for each of the 73 industries with NACE ranging from 1 to 82.

[56] The figure illustrates the ripple effects in seven cluster projects compared to the average of all cluster projects (all core members in all 47 cluster projects). A positive number means that the specific cluster project has relatively higher national gross ripple effects than the average of all core members, and vice versa.

variation is the differences in the industry composition between the cluster projects.

Arena Biotech North has a high degree of national ripple effects. This is due to the cluster project's relatively high share of members within food product manufacturing, which has a high intensity of intermediate inputs in their production. An increase in the core members' value added will thus lead to high demand for intermediate inputs from other industries. In addition, the share of imports is relatively low, leading to high indirect ripple effects for this specific cluster project.

Two other cluster projects with relatively high national ripple effects are NCE System Engineering and NCE Raufoss. NCE System Engineering mainly consists of core members within manufacturing of machinery and transport equipment, both of which have a relatively high intensity of intermediate inputs in their production. NCE Raufoss consists of core members within several different industries, mainly manufacturing of metals and motor vehicles, which all have a relatively high intensity of intermediate inputs in their production. However, the share of imports is relatively high for both clusters, thus dampening the indirect ripple effects.

On the other hand, the core members of NCE Instrumentation and NCE Micro- and Nanotechnology have relatively low ripple effects to the Norwegian economy. These cluster projects consist mainly of core members within the manufacturing of computer, electronic and optical products, which have a low intensity of intermediate inputs in their production. In addition, the share of imports is relatively high, leading to lower national ripple effects for these clusters.

Figure 7.2

Relative ripple effects in seven cluster projects compared to the average of all cluster projects
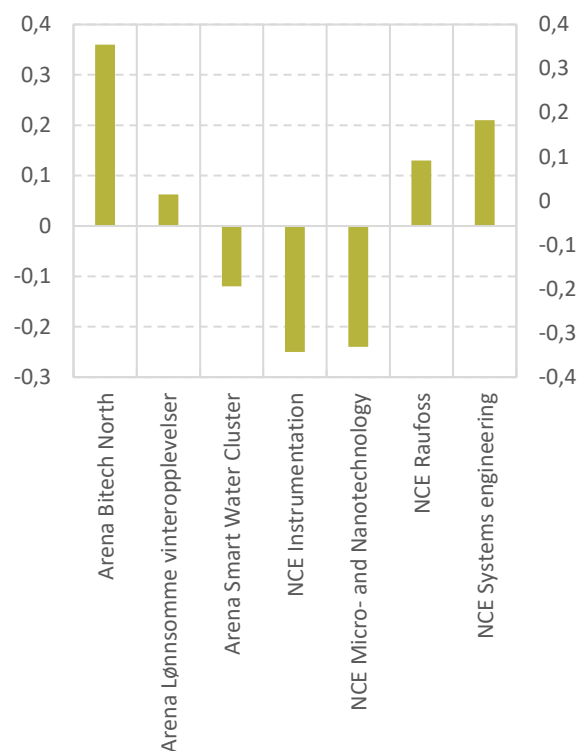
Source: Samfunnsøkonomisk analyse AS

Arena Lønnsomme vinteropplevelser is another project with relatively high ripple effects to the Norwegian economy. This cluster project mainly consists of core members within accommodation and tourism, and is characterised by a medium share of intermediate inputs. On the other hand, the share of imports is relatively low, resulting in above-average ripple effects to the Norwegian economy.

On the other hand, the core members of NCE Instrumentation and NCE Micro- and Nanotechnology have relatively low ripple effects to the Norwegian economy. These cluster projects consist mainly of core members within manufacturing of computer, electronic and optical products, which have a low intensity of intermediate inputs in their production. In

addition, the share of import is relatively high, leading to lower national ripple effects for these clusters.

Arena Smart Water Cluster has relatively low ripple effects to the Norwegian economy. This cluster project mainly consists of core members within manufacturing industries, and is characterised by a medium share of intermediate inputs. In addition, the share of imports is relatively high, resulting in below-average ripple effects to the Norwegian economy.

In this evaluation, we have studied how the seven cluster projects would interact with the rest of the Norwegian economy if the cluster projects had the same characteristics as the average of the industries they represent.

The degree of regional ripple effects will, however, depend on the characteristics of the specific cluster project. Firstly, the regional ripple effects depend on the share of intermediate inputs that is required by regional industries. This will dampen the regional ripple effects. As an extreme, if all intermediate inputs are imported from outside the region, the regional ripple effects are zero. Secondly, the core members within the cluster projects could have different characteristics from the average of the industry they belong to, both regarding the level of intermediate inputs (for a given production level) and the share of imports from abroad. Unfortunately, we do not have sufficient data to draw any conclusions concerning these perspectives.

Table 7.1

Gross ripple effects of an increase in value added of NOK 10 million. Numbers in NOK million

	Direct effect (value added)	Intermediate input from direct effect	Share of imports	Indirect effect (value added in)
Arena Biotech North	10	29.4	42%	17.1
Arena Lønnsomme vinteropplevelser	10	18.9	41%	11.2
Arena Smart Water Cluster	10	16.6	55%	7.4
NCE Instrumentation	10	12.7	62%	4.9
NCE Micro- and Nanotechnology	10	13.4	62%	5.1
NCE Raufoss	10	25.0	50%	12.4
NCE Systems Engineering	10	27.6	49%	14.2
All core members	10	19.8	50%	9.9

Source: Samfunnsøkonomisk analyse AS

8 Assessment of organisation and operation

One of the main objectives of this evaluation is to assess whether changes in the organisation and operation of the cluster programme have contributed to the programme's relevance, effectiveness and efficiency. In this chapter, we therefore assess the efficiency of the cluster programme. We discuss the selected organisational and operational choices that have been made within the programme, and whether these choices promote or inhibit the results the cluster projects might potentially achieve.

An assessment of the extent to which our documented effects of the cluster programme justify the total public funding of the programme is made in Chapter 9.

8.1 Organisational changes

With the implementation of Norwegian Innovation Clusters (NIC), several organisational changes have been made, compared to the two previous cluster programmes. Today's organisation and operation of the programme are presented in Chapter 2. Below we give a brief assessment of the most important changes, as well as the programme ownership.

8.1.1 Re-introduction of the advisory board

The current arrangement with an advisory board was introduced in the autumn of 2013, i.e. prior to the introduction of the new cluster programme. A similar arrangement had been in place up until 2009, for Arena and NCE.

The board *advises* the owners on the programme's strategic development and arrangements. For example, the board participates in assessing applica-

tions for new cluster projects, as well as assessments of existing cluster projects. The board does not have decision-making authority concerning the individual projects. However, their assessments have a disciplinary effect.

It is our impression, from interviews with operators of the cluster programme, that the arrangement with an advisory board has worked very well, especially during the first phase after the implementation of Norwegian Innovation Clusters.

8.1.2 Introduction of regional account managers

Our review of different cluster programmes in Europe reveals that there has been increased focus on the professionalisation of cluster organisations.[57] This also seems to apply to the Norwegian cluster programme.

The evaluation of the Arena programme (Jakobsen, Iversen, et al. 2011) pointed out that there were significant regional differences in Innovation Norway's efforts concerning the cluster projects. In mid-2015, Innovation Norway went from having 20 people (at their district offices) working part-time on follow-up of the cluster projects (in addition to other tasks), to nine regional account managers in full-time positions. The regional account managers participate in an advisory forum (network), with monthly meetings.

It is our assessment that the introduction of regional account managers in full-time positions must be seen as an efficiency improvement and professionalisation of the programme operation. The regional account managers follow the clusters more closely, and are more active than before.

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[57] See Chapter 10.

However, some tasks that were previously managed centrally are now transferred to the regional account managers, e.g. the "learning arenas", which were gatherings on different topics in which all clusters could participate, regardless of cluster level. The regional account managers have taken some responsibility to organise regional learning arenas, but it is our impression that not everyone see this as the best solution.

8.1.3 A single comprehensive programme

The merger of Arena and NCE as one joint programme and the introduction of the third programme level, Global Centres of Expertise (GCE), was perhaps the greatest change when the new cluster programme was introduced. The merger of the two previous cluster programmes into one comprehensive programme is in line with the recommendations following the evaluation of NCE (Econ Pöyry and Damvad 2011), suggesting that a more formal link between Arena and NCE would contribute to significant simplification and improvement in selecting new NCE projects (see Chapter 2).

We do not have any grounds to state that the selection of new NCE clusters is simplified or improved by the merger of the two programmes. Yet it is our impression that the overall selection of new cluster projects has improved. Instead of individual calls for proposals for each cluster level, there is now a common call for proposals. It is not determined in advance how many cluster projects per level will be included in the programme. This means that the quality of the cluster project (substantiated in the application) determines which type of cluster projects is chosen, within the budgetary constraints. This has increased the flexibility of the selection of new

cluster projects. A more exhaustive assessment of the actual selection criteria is presented below.

With the introduction of Norwegian Innovation Clusters, some changes have been made to the professional services offered through the programme.[58] Prior to the new cluster programme, some of the services (e.g. professional and project management gatherings) were separate for the two cluster programmes. Due to significant differences in maturity between individual clusters, especially Arena clusters, this was unfortunate in many contexts. Most professional services are therefore now offered across cluster levels.

Our interviews indicate that the last-mentioned change has had positive effects. For mature facilitators (project managers) of mature Arena projects, gatherings with NCE clusters are likely to be more relevant than participating in gatherings with less mature Arena projects. Moreover, for the facilitators of NCE clusters, gatherings with facilitators of Arena clusters, who they may not have previously met, may also be inspiring and motivating.

It is our assessment that the merger of Arena and NCE in one comprehensive programme has mainly had positive effects. However, it may be the case that a joint programme increases the cluster projects' expectations of continuation at the next cluster level (mainly for Arena clusters). We discuss this as part of the assessment of exit strategies below.

8.2 Tripartite ownership

Norwegian Innovation Clusters is jointly owned by Innovation Norway, the Research Council of Norway and Siva. Based on this evaluation, we have no

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[58] See section 2.6 for a presentation of the different professional services.

reason to suggest that changes should be made to the programme ownership.

Norwegian Innovation Clusters is part of an interaction with schemes that have complementary functions, by supporting research and innovation collaboration within regions and/or sectors (Innvation Norway, Siva and the Research Council of Norway 2012).

This evaluation shows that there is significant interaction with other schemes. Members of cluster projects supported by the cluster programme are frequent users of other schemes, including schemes offered by all three owners.[59]

In the outline of the new cluster programme, the owners stated an ambition to reinforce links with surrounding schemes, in order to stimulate research and innovation activity in the clusters. We believe that this requires a concerted effort by the three owners and it is our assessment that this alone serves as an argument for a continuation of the current tripartite ownership.

8.3   Sufficient selection criteria

Norwegian industrial policy is based on the belief that public schemes should be industry neutral. This means that the government should not define which industries are "tomorrow's winners". In practice, however, to a great extent the various industries differ in their use of public schemes. The Research Council, Innovation Norway and other parties support some industries more than others, based on the objectives of the different schemes, the applications and the assessments of the potential of each project.

The industrial distribution of the cluster projects' core members (see Chapter 2) shows that Norwegian Innovation Clusters is not industry-neutral in practice. As part of an industry policy assessment, it must be discussed whether the allocation of cluster projects has contributed to preserving an industry structure, rather than promoting conversion. This discussion is relevant because several of the cluster projects supported gather firms within the petroleum sector as their main market. To meet the challenges we face, Norway needs the country's industrial expertise to contribute to increased growth in other export industries besides petroleum. This issue has become even more important after the drop in oil prices in 2014.

In line with the need for growth in industries outside the petroleum sector, it can be argued that Norwegian Innovation Clusters should prioritise non-petroleum-related cluster projects to a greater extent. Changes in the distribution of core members by industry in recent years (see Chapter 2) indicate changes in this direction.

The identification of clusters can be top-down, bottom-up, or a combination of the two (OECD 2007). Countries identify potential programme recipients mainly through two contrasting approaches: either (1) a statistical method, such as a mapping study; or (2) a process of self-selection, such as a call for proposals. The former is used in particular when the objective is to support national economic drivers. Norwegian Innovation Clusters represents the latter.

Our assessment is that this sets excessively high requirements for the programme in deciding which projects are to be selected. An important feature of

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[59] See Chapter 4.

Norwegian Innovation Clusters is that the programme makes strict requirements of the applicants (cf. Chapter 2). The criteria are designed to be a combination of objective data concerning the firms and an assessment of the cluster project's market position and potential for innovation.

When the selection criteria emphasise objective data, there will always be a bias towards firms and industries that have so far demonstrated a strong position or growth. The assessment of potential will naturally be based on this, but will add knowledge concerning market development and assessments of how a reinforced cluster organisation can help to improve the collaboration within the cluster. External experts are brought in to assess the situation and potential.

It is difficult to see how to impose "rules" in the selection criteria stating that applicants with few links to the petroleum sector, but with weaker innovation potential, should get "extra points" in the selection of new projects. After a financial shock, such as the drop in oil prices in 2014, it may seem wrong to have chosen so many petroleum-related cluster projects. However, at the time when they were selected this probably seemed right and nobody can foresee everything. In addition, our assessment of seven cluster projects does not substantiate that cluster projects without links to the petroleum sector have benefited more from being part of the cluster programme than those which do have such links.

We recommend that the cluster programme maintains the strict selection criteria, in order to identify projects where a cluster facilitator is most likely to stimulate innovation collaboration, regardless of which sector the cluster belongs to.

8.4 Unclear exit strategies

Both theory and empirical results indicate that the effects of public funding of cluster projects are greatest in the first years after the initiation of the projects. More precisely, our empirical analysis indicates positive significant economic effects from cluster participation during the first three years after a firm enrols in a cluster project.

Part of the market failure that publicly supported cluster projects are intended to correct is that the members initially do not have sufficient knowledge of, or are unable to take account of, the gains resulting from closer collaboration on innovation and the production of common goods.

However, the benefits of a common cluster organisation will become more visible to the members after a while. The benefits will also mainly be materialised in the form of higher economic growth. It is thus reasonable to assume that the members will continue to support a cluster facilitator, even if public support ceases after a few years, provided that the services which the facilitator provides are perceived as relevant and create results.

In the final phase of the project, the project facilitator must plan how the collaboration will continue without funding from the programme. This is referred to as the project's exit strategy, which must be prepared no later than six months before the contract with the cluster programme expires. However, the cluster programme's multi-level system gives incentives for both the cluster facilitators (for their own sake) and the cluster members to position themselves for the next level at the end of the project period.

From the cluster facilitator's point of view, positioning for continuation makes sense, in order to increase the likelihood of continuing to further develop the activities. Nevertheless, the positioning for further public funding may affect the development of innovation-related collaboration which the members are willing to finance, even when the project does not receive public support. If too many cluster projects rely on continued public funding, the impact of the programme will decrease over time.

Based on interviews and previous evaluations, our opinion is that most cluster projects spend quite a lot of energy and effort on positioning themselves for continued public funding. The problem seems to be greatest when the cluster project is an NCE project. In these cases, the project facilitator has been funded for several years. It is thus difficult to see that the members have, over time, not become aware of the benefits of continued funding through membership fees.

Problems may arise if the cluster constitutes a substantial part of a region's business community. The cluster facilitator may then be tempted to appeal to regional political actors to work politically for continued support, with the risk that some are willing to ignore the criteria for continued funding. Such situations cannot be excluded in practice, and if so, they will weaken both the ability to fund new cluster projects and the selection criteria.

Arena projects do not usually constitute a large share of local economies, which has varying implications for their exit strategies. It can be assumed that new, immature clusters need more time to achieve a large enough mass of members, as well as sufficient collaboration among them to no longer

need external assistance to organise the cluster. However, it is not obvious that there is a need for public support beyond 3+2 years. In this case, any extension given to NCE projects must be justified by the need to promote common goods that are difficult to achieve without public support. Such measures may include the establishment of research or educational institutions, laboratories or other types of knowledge infrastructure that will benefit everyone.

Our assessment is that it would be better if it was clear from the outset of the project that further funding after the end of the project period is not an option for NCE projects, and only in exceptional cases for Arena. In such case, the difference between NCE and Arena projects will depend on which type of cluster they are initially, e.g. how established the clusters are. Clusters with an already established common identity and knowledge of each other (relational basis) may need more assistance than newly established clusters to organise the development of common goods. Newly established clusters will need more assistance, simply to establish arenas for collaboration. The selection criteria should clarify that the development of the different types of common goods that are important for the members requires more long-term efforts than the development of arenas for collaboration.

8.5   The facilitator is important for the results[60]

Earlier evaluations of cluster programmes have pointed out the importance of the personal qualities of the staff of the cluster organisation for the success of cluster projects. There is also general agreement that the management of clusters – i.e.

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[60] This chapter is based on a similar chapter in Jakobsen and Røtnes (2011), but is updated with results from this evaluation.

the execution of the role of cluster facilitator – requires more and other kinds of competences than a traditional development project.

One main reason is that the cluster facilitator must be able to communicate effectively with operators in several different arenas: a business arena with owners and managers of enterprises operating under conditions of market competition; a research arena with researchers and other parties operating in a world of universities and university colleges; and a political arena with bureaucrats and politicians. Mastering all of these arenas requires a certain 'multilingualism'.

Another element that makes cluster projects demanding is that they are organised from the bottom up, in the sense that enterprises and knowledge parties that are part of the project participate on a voluntary basis and can withdraw if they lose interest and belief in the project. A cluster organisation therefore depends on continued legitimacy and the commitment of its members.

Both earlier evaluations, as confirmed in this evaluation, document that there is a close relationship between active participation and the results of cluster projects: The more involved enterprises are in activities, the more they will benefit from the project. This underlines how important it is that the project manager has the ability to create excitement and enthusiasm, while also ensuring credibility and a long-term perspective.

Ingstrup (2011) discusses different types of cluster organisation and claims that different characteristics are needed in connection with clusters in the start-up phase compared to more mature clusters. He lists three cluster facilitation roles:

1. Facilitators that mainly focus on the development of *favourable framework conditions* for collaboration in the cluster. Often, these clusters will be new. When this is the cluster facilitator's primary task, it is of decisive importance that the facilitator is able to act in line with the cluster's own values. In addition, the facilitator must have personal integrity and be entrusted to handle different types of relations in a professional way.

2. Facilitators that mainly focus on supporting the development of *specific collaboration projects* in the cluster. This type of task will often be important in more mature clusters. Here, characteristics like a certain humbleness (an attitude that takes care not to force one's own opinions into a facilitation process), flexibility (openness to changes in thinking and processes) and an awareness of one's own influence will be important. The facilitator needs to understand the power and control that the role entails and act in such a way that the required activities actually take place.

3. Facilitators that take on both of the roles described above.

In this evaluation, we interviewed members of seven cluster organisations. The facilitators could best be described as being of type 2 and 3 above. Overall, the project managers received good evaluations. However, it is worth noting that one of the clusters had changed project manager several times. This is also the cluster with least positive achievement of its own objectives.

Based on the rationale for how cluster organisation can influence the cluster members' achievements, our evaluation confirms that the cluster project results come *via the active participation of enterprises*. In other words, the most important thing the project manager can do in order to create results is to encourage the enterprises to allocate enough time and resources to active project participation.

In addition, earlier evaluation shows that the more sophisticated and established the business environments are, the more demanding the cluster facilitator's role will become. Established environments engage in collaboration on a number of levels; from well-developed customer-supplier contacts, to formal and informal meeting places outside the auspices of the cluster project. In established environments, it is a very demanding task for a publicly financed cluster facilitator to develop arenas that are both relevant and offer collaboration which does not already exist under its own auspices.

This evaluation confirms the demanding role of facilitators in established clusters. However, time helps. The OECD (2007) points out that it takes time for new collaboration patterns to expand and publicly- funded (partly or fully) facilitators can help make this happen. Over time, well-functioning clusters start to discuss more demanding common projects, such as enhancing the level of knowledge infrastructure.

Over time the NIC programme has also developed arenas for sharing experience between cluster facilitators and conveying knowledge of best cluster practice. Improvement in the use of Innovation Norway's regional offices has contributed positively to this. During the last three years, Innovation Norway has allocated an *account manager* to each cluster project. The account managers offer advice and guidance during the application process and are responsible for funding and payments throughout the project period, as well as monitoring the projects' progress. It is our assessment that this work has contributed positively to the cluster results.

Each cluster project independently chooses its own project management. Innovation Norway and the NIC programme administration have little opportunity to influence the choice of facilitator, other than through the selection of applicants to the programme. Our assessment is that the programme owners pay a lot of attention to the importance of choosing good facilitators for the individual projects and that this insight is taken into account in the selection process.

8.6   GCE lacks theoretical justification

Global Centres of Expertise (GCE) was introduced in 2014 on the establishment of Norwegian Innovation Clusters. GCE targets clusters with a well-functioning organisation, and with a well-established position within global value chains.

GCE has some similarities with the German go-cluster programme, which aims to combine the most powerful innovation clusters in Germany. However, this programme only provides limited financial support for the participating clusters; and the only direct support to the clusters is distributed through a competition on measures to enhance the quality of the cluster management. Clusters can annually apply for cluster-specific projects and in total around NOK 4.8 million is allocated to the awarded projects, which is about half the annual budget for each GCE cluster.[61]

Due to the criteria for GCE funding, the applicants were cluster projects that had already received several years of funding from NCE. In practice, these cluster projects applied for funding for up to 20 years (ten years as an NCE and another ten years as a

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[61] See Appendix 2 for a detailed description of this cluster programme.

GCE). We have not been able to find theoretical arguments for such a long period with public funding of cluster activities. Rather the opposite in fact: clusters arise as a consequence of the geographical agglomeration of potentially collaborative firms in order to internalise ways to overcome market imperfections related to knowledge spill-overs and economies of scale. Both of these require geographical proximity.

According to the theory presented in Chapter 3, cluster organisations (facilitators) can strengthen the dynamics of clusters by helping to:

- Increase members' knowledge and confidence in each other;
- Organise innovation-enhancing collaboration; and
- Strengthen the cluster's knowledge infrastructure.

However, no theory shows reasons for cluster facilitators (as facilitators) to receive public funding over many years. Our empirical data add to this by clearly indicating that the cluster project's ability to increase the dynamics within the cluster is limited to "some years".

The establishment of three GCE projects in 2014 challenges this understanding. We have therefore considered which lessons we can draw from the existing GCE projects' activities so far. We have not evaluated the existing GCEs as such[62], but interviewed each project's facilitator and examined which results they report. Our understanding of the characteristics of the established GCE projects can be summarised as follows:

a) They all have accelerated, ongoing collaborative activities, due to increased resources from the cluster programme.
b) They all have a facilitator who enjoys a high degree of trust from the members and who quickly follows up on members' and other local firms' needs.
c) The members' main market is within different parts of the petroleum sector and they are consequently affected by the recent "oil crisis".

Item a) solely proves that public support generates activity. The reason is, in principle, the same as for funding Arena and NCE activities. Had this been the only activity in the GCE projects, it is difficult to see any other reasons for GCE as a separate programme level than that the objective regarding "a global position" is more clearly formulated.

In a situation with falling oil prices, the cluster facilitators in the three GCE projects have proved to be very useful in contributing to new market openings and collaborative projects to convert the members' competence and knowledge to make it applicable to new fields. Items b) and c) thus indicate that funding through GCE has been very useful during a difficult transition period for important industries in the Norwegian economy. Due to facilitators' proximity to the firms (members), and knowledge of their needs and ability to quickly establish real restructuring projects, they may have reduced the conversion costs for both the members and the economy.

Crises like the one mentioned above are sudden in their nature. The fact that the GCE projects have proved to be useful in the transition to new markets must be seen as a non-intentional (probable) gain. It illustrates that such business organisations can

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[62] An evaluation of the three GCE projects is beyond the scope of this evaluation.

play an important role in specific situations. How-ever, the effect is not replicable, in the sense that it is not possible to support organisations with public funding solely in order to be prepared for a possible future crisis.

Due to increased and extended funding, the GCE projects have been able to commit to both new and further development of the existing knowledge infra-structure (e.g. laboratories, educational pro-grammes, etc.). Better knowledge infrastructure can be characterised as a common good, which seldom (if ever) would be realised if left to the operators themselves. Even with public support, such invest-ments usually require a long-term perspective for them to be realised. The latter advocates supporting cluster projects over several years.

Our assessment of the GCE project's work so far is that the rationale for a third programme level is weak. Furthermore, if the purpose was to promote the most powerful clusters, the objectives could have been formed in line with the objectives of the go-cluster programme. The three GCE projects sup-ported have proved to be useful, but mostly due to unforeseen market changes, which in itself is not a valid argument for a third level of the cluster pro-gramme. We therefore cannot see any reason to support more GCE projects within Norwegian Inno-vation Clusters.

9   Benefits exceeds the costs

Norwegian Innovation Clusters aims to promote and enhance collaboration activities in clusters. The Norwegian government supports the cluster activities by financing cluster facilitators and common activities within each cluster project. The programme's cost can therefore largely be described as public support of (desired) organising activities.

In addition to financing cluster facilitators, there are costs associated with the administration of the programme itself. The administrative costs at the programme level are primarily related to application processes and the approval of new cluster projects, as well as follow-up, dialogue with and guidance of project organisations at the project level. Both cluster facilitators and Innovation Norway naturally also have some costs associated with reporting and disseminating the results to the ministries and the general public.

Participants in cluster projects have direct costs associated with membership fees[63] and the costs of participating in the activities that are organised. These are costs that each individual participant presumably considers to be lower than their own benefit from participating. In total, these costs can be estimated to be of approximately the same magnitude as the public funding (cf. Chapter 2).

Whether the benefit of the publicly supported activities is greater than the social costs related to those activities depends on whether the additional value creation that the programme entails exceeds the total public funding of the programme and the members' costs.

A significant part of the economic gain that is attributable to the cluster programme's activities accrues to participants in terms of salaries and capital returns. For the overall economy, the main economic effect is the increase in productivity for all industries as a consequence of the cluster participants being more competitive than firms with lower returns on the available resources. This follows from the theoretical arguments presented in Chapter 3.

It is a challenge to determine the extent to which higher growth among cluster participants contributes to higher value added in the overall economy. However, based on the empirical analysis in Chapter 6, it is possible to estimate whether the additional value added resulting from participation in clusters supported by Norwegian Innovation Clusters exceeds the costs of the cluster programme. If it does, this is a clear indication that the social benefit of the cluster programme exceeds the social costs.

Figure 9.1

Development in value added for core members and comparable firms. Stylised example
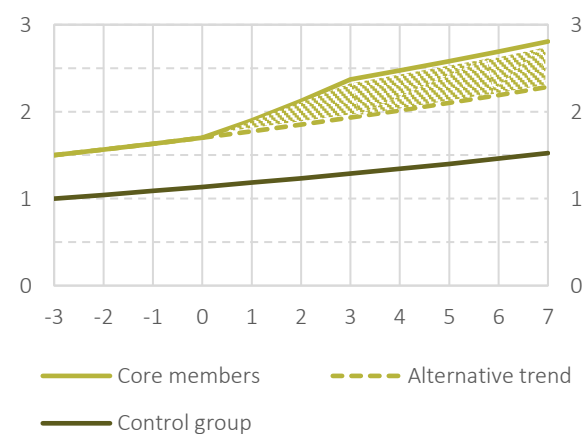
Source: Samfunnsøkonomisk analyse AS

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[63] The size of the membership fee varies between the cluster projects, and some pay nothing, at least not as monetary contributions.

Our estimates indicate that core members of all cluster projects have on average 8 percentage points higher growth in value added during the first three years after enrolment, compared to similar firms not participating in a cluster project. In the second three-year period after enrolment, the growth achieve by these two groups does not differ significantly. Our interpretation of these results is that the cluster projects enhance the core members' value added to a higher level, at which they remain (as illustrated in figure 9.1).

Though there are no additional effects on growth in value added later than three years after enrolment, the total value added continues to be higher than it would otherwise have been. This is illustrated as the shaded area in the graph, which is the accumulated difference between the core members' actual value added from what it would be if they did not participate in a cluster project (the alternative trend).

To assess how long it takes for the benefits of the cluster programme (measured as additional value added) to exceed the total (social) cost of financing the cluster programme, we can calculate the development in marginal value added for a median core member of a cluster project and compare thus with the social costs of the cluster programme per core member.

Norwegian Innovation Clusters' annual budget for the funding of cluster projects was an average of NOK 103 million in the years 2006-2013.[64] In addition, the costs associated with managing the programme amount to almost NOK 20 million per year.[65] The total cost of the cluster programme per 100 core members was thus NOK 45 million (we register about 2,200 active core members during that period).

Norwegian Innovation Clusters is a tax-financed programme, which means that the social cost associated with the public funding exceeds the government's direct costs. To adjust for the efficiency loss in the economy from tax financing of activities, it is customary to assume that the social cost is 20 per

Table 9.1
Marginal value added per 100 core members. NOK million

Years after enrolment	Development after enrolment[1]	Alternative development	Difference	Accumulated marginal value added
0	445	445	0	
1	497	464	33	33
2	555	484	71	104
3	620	505	115	219
4	647	527	120	340
5	675	549	125	465
6	704	573	131	596
7	734	598	136	732
8	765	623	142	874
9	798	650	148	1023

Source: Samfunnsøkonomisk analyse AS

1) 11.7 per cent increase in the first three years after enrolment, then 4.3 per cent as in the control group (based on the average of predicted rates). The value in year 0 is based on the median value added for core members one year prior to enrolment.

[64] See section 2.5.2 for details of the annual budgets. A substantial increase in the number of core members in the years after 2013 (caused by the introduction of GCE projects) creates some disturbances in the calculation of marginal value creation. Thus, we have chosen to exclude these years from this calculation.
[65] From Innovation Norway's annual reports.

cent higher than the public spending. With these adjustments, the social cost of public funding of Norwegian Innovation Clusters is estimated to be NOK 45 million * 1.2 = NOK 54 million per 100 core members.

With our estimate of growth in value added for the core members after enrolment in a cluster project, the accumulated marginal value added per 100 core members will be NOK 104 million after two years (cf. table 9.1). The additional value added thus exceeds the programme's social costs after only two years. This also holds true when we account for the members' own costs associated with participating in a cluster project. The additional value added in subsequent years must, in our opinion, be interpreted as a pure benefit to society.

However, there may still be the question of whether the programme has reached a size that may lead to a situation where the growth in costs exceeds the growth in social benefits. It is particularly uncertain whether the increased long-term support of individual cluster projects enhances participants' value added sufficiently in the last part of the support period. We do not have data that can clarify whether the benefits of public funding for individual cluster projects decline over time. However, our data do point in that direction. Below, we refer to certain factors which suggest that the support period for individual cluster projects should be limited, compared to today.

We are aware that some cluster projects also receive public funding from the county municipality, but it is difficult to get an overview of how much this accounts for annually. However, given limitations in the state aid rules and available funds, we do not believe these amounts will change our assessments of the costs significantly.

10 Lessons from international cluster programmes

Norway is one of many countries in Europe that focus on clusters as part of their industry and/or regional policy. Cluster policies across Europe are wide-ranging, but they also have certain common traits. In this chapter, we give a brief presentation of different cluster programmes and approaches in Europe. A more detailed overview of these cluster programmes is given in Appendix 1.

In addition to a brief review of various countries' cluster programmes, we have taken a closer look at the cluster programmes in three selected countries (Germany, Denmark and France). These case studies are presented in Appendix 2. Lessons from the three case studies are mainly used in our assessments and recommendations for further development of the Norwegian cluster programme (see Chapter 10).

10.1 Cluster programmes in Europe

Several countries and regions have cluster policies, programmes and cluster initiatives. However, each location has its unique set of economic opportunities and challenges, so that policies need to be aligned with these local conditions and be delivered in ways that are consistent with the realities of the location.

The general focus among European cluster programmes is to improve competitiveness by focusing on a specific cluster or group of clusters as the regional agglomeration of economic activities in related fields, and not on an individual firm, a specific industry, a broad sector, or the entire regional economy. Cluster programmes establish a framework that enables the implementation of cluster initiatives, the allocation of funding, the creation of organisational responsibilities and the definition of the specific conditions to increase the competitiveness of the national or regional economy.

The prevailing ideas behind supporting clusters have been, on the one hand, to foster links among key national/regional actors, especially by connecting the research and business spheres that have been promoted as research and innovation clusters and, on the other hand, stimulating the economic growth of regional enterprises and SMEs labelled as business clusters and networks.

Most national and regional cluster programmes launched in the 1990s and 2000s were inspired by the theories of Porter (see Chapter 3). Following Porter, the concept of clusters appealed to public policy makers, and the identification, development and upgrading of clusters became an important agenda for governments. One reason for the success of Porter's theories was that his ideas focused on competitiveness, which responded to the concerns of policy makers (Martin and Sunley 2003). Scotland, the Basque country and Catalonia were among the first regions to embrace the concept of cluster development based on Porter's conceptual framework.

In some countries Porter's concepts have been applied together with other analytical frameworks. In Sweden, the concept of "development blocks" was introduced first, by Dahmén (1989), who advocated that interdependence between firms and industries facilitates the diffusion of knowledge, encourages networks that strengthen businesses and is a source of development. Porter-based cluster analyses were carried out in Sweden at the end of the 1980s (Brandt, 2001).

Cluster policies in France (grappes d'entreprises) and in Italy have been significantly influenced by the work of Giacomo Becattini, who popularised the notion of the "Marshallian industrial district" in economic development. This was in the 1980s, when a

group of Italian economists rediscovered the importance of industrial clustering as an opposition to the Fordist model (Becattini 1975, Brusco 1982).

In the Netherlands and Finland, open innovation and innovation network theories resulted in a particular form of cluster support. In the Netherlands, from the very beginning the role of the government in cluster policy was seen more as an indirect facilitator and catalyst for dynamic comparative advantages in the national innovation system (Roelandt and den Hertog 1999). In Finland, a shift has taken place from a traditional cluster-based policy towards platform-based innovation, whereby open innovation and cross-sectoral collaboration are emphasised. In this open innovation platform approach, there is greater focus on fostering new combinations of knowledge and on co-creation with users than in the previous cluster-based policy that focused on building linkages between research and industry (Izsak and Romanainen 2016).

Following and complementing the report of the European Cluster Observatory (Meier zu Köker and Müller 2015), the following groups of countries can be differentiated with regard to national cluster policies and their respective programmes[66]:

- The first group includes countries such as Finland, Italy and the United Kingdom that do not have cluster programmes at national level in place, but do have cluster-based policies at regional level to varying extents.
- The second group includes countries such as Austria, the Netherlands and Spain that implement cluster policies at a regional level, but also have put in place a national cluster, industrial platform or programme.

- The third group includes countries such as the Czech Republic, Denmark, France, Germany, Greece, Latvia, Norway, Portugal, Romania and Sweden, which run very important cluster competitions at national level, but also support cluster development at regional level. Cluster policies at national level often target the top clusters or clusters of key strategic importance, while the regional level funds emerging cluster activities.

A survey conducted by the European Secretariat for Cluster Analysis in 2012 revealed that grant funding was the prevailing support instrument of nearly all cluster programmes. In terms of financing schemes, a programme usually supports both cluster management structures and activities within clusters. Furthermore, in several cluster programmes significant elements of the budget for specific activities are dedicated to the cluster management for the development of new business support services.

In some countries, such as Germany, there is no funding for cluster organisations at national level (but for cluster activities), while in others the funding of cluster organisations is highly relevant (such as Portugal). While cluster programmes still use grant funding to support cluster organisations, more and more programmes also provide technical assistance for the training and coaching of cluster organisations.

The common flagship terms in cluster policies have been growth, jobs and innovation; yet they have varied in terms of their implementation mechanisms. Some focus on setting up cluster management structures, while others implement cluster frame-

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[66] See Appendix 1 for a more detailed description of the different cluster programmes.

work policies (by focusing on the creation of favourable framework business conditions). Some focus on the further development of mature clusters (raising them to world-class levels), while others focus on emerging industries. Some provide direct funding to cluster organisations, while others provide labelling and support collaboration projects.

Depending on the developmental stage, it has been a common understanding that clusters have to receive corresponding tailor-made support through appropriate cluster policy measures. There is no "one-size-fits-all" policy or programme, but a need to develop and implement different policies or programmes addressing the different groups of clusters.

10.2   Recent trends in cluster policies

A wave of intensified interest in creative industries and clusters in the 2000s was based to a great extent on the work of Richard Florida. In his works, "Creative Cities" and the "Creative Class", he highlights that creative industries serve as providers of cultural services that make certain cities attractive for a "creative class" of knowledge workers and their innovative employers.

More recently, cluster programmes have been influenced by smart specialisation, regional proliferation and related variety theories. Jacobs (1969) wrote that variety within a region might matter for knowledge spill-overs conductive to useful re-combinations, but only if all the different industries in a region are technologically related to each other.

Theoretical advancements and the most recent economic and societal challenges have had an impact on the nature of cluster policies and still prevail today. Some of the concepts and analytical frameworks are also being further developed, such as

cluster mapping. Nevertheless, cluster policy makers devote more attention to certain aspects that can be summarised in the following:

- Combining "strengthening strengths" with "encouraging structural change and the emergence of new industries": instead of only supporting existing mature clusters, or focusing solely on new emerging industrial activities, a need for a combined approach has been recognised.
- Focusing on an appropriate portfolio: instead of narrow specialisation, cluster portfolio programmes whereby policy makers consider a well-selected group of clusters, encourage industrial diversification and stimulate cross-sectoral clustering, are a future direction of cluster support.
- Encouraging "collaboration within clusters" and "improving the business environment for cluster development": creating a better business environment in clusters and focusing on specific dimensions of the business ecosystem, in addition to enhancing collaboration structures among national or regional actors.
- Integrating cluster policies into smart specialisation strategies (using clusters as a tool to implement RIS3): with the new EU-incentivised smart specialisation strategies, some governments have built strongly on their existing clusters and cluster policies.

In recent years, a shift towards supporting mature clusters (instead of creating new clusters) and the development of emerging industries can be observed, in particular for national cluster programmes, but also increasingly for regional cluster programmes (European Commission 2016).

One consequence of this is the focus on existing cluster organisations and better exploitation of them

for national and regional development (and using them to implement other policies such as research or trade policies). Only a limited number of programmes, mainly at regional level, support the establishment of new cluster organisations. This also means that, in some countries and regions, well-developed and strong cluster management structures are long-term, and they are not meant to be dismantled as such, since they depend on the bottom-up industrial rationale rather than on top-down funding.

Besides this, in several regions a great interest in capturing promising emerging niche activities within clusters can be observed. There is a general recognition that certain sectors within the economy are internationally traded and strategically important for exports and investments, whereas others are generators of "local" employment or underpin other sectors; and a third broad group of emerging niches has the potential to drive increased value added in the economy (Izsak, Markianidou og Reid 2016).

Furthermore, the internationalisation and professionalisation of cluster organisations have been a new focus for several cluster programmes. Cluster organisations are considered to be instrumental in helping local SMEs to step out into international markets. Cluster excellence programmes have spread in many countries, with focus on maximising the quality of the support services offered by cluster management organisations.

10.3 International impact studies

The expected impact of cluster policies usually concerns better business competitiveness, enhanced innovation capacity, SME development, more research and innovation collaboration projects, and the uptake of innovations by the market.

Evaluations of cluster programmes conducted across different European countries and regions are overall positive about the outcomes of the cluster initiatives supported. The most recent analyses from countries such as France, Germany, Sweden and Denmark all conclude in general that firms within clusters outperform firms not operating in clusters. More specifically, the Scottish impact evaluations found that the presence and strength of industry clusters have a direct effect on regional economic performance. In 1998, the Basque Country already made its first efforts to evaluate the efficiency of its policies, and found that the cluster policy helped to prioritise public resources and, most importantly, increased inter-firm relations. Further Basque cluster studies revealed that the cluster management organisations analysed had facilitated collaboration, generated trust and helped to share knowledge and experience (Orkestra 2009).

The impact of clusters is related to regional development, firms' performance, entrepreneurship and innovation. The following results and positive effects of participation in clusters have been cited in the abovementioned national cluster evaluation studies:

- Increased probability to innovate
- Increased R&D collaboration
- Catalysing the R&D&I system
- Increased competitiveness of firms
- Creation of more jobs and higher wages

Evidence from the US and Sweden shows that firms within clusters are more competitive. Wennberg and Lindqvist (2010) analysed firm-level data for all 4,397 Swedish firms established in telecom and consumer electronics, financial services, information technology, medical equipment and pharmaceuticals, from 1993 to 2002. They found that firms

located in strong clusters create more jobs, higher tax payments, and higher wages to employees.

Similarly, the evaluation of the Walloon policy for competitiveness clusters, commissioned by the Walloon Institute for Evaluation, Prospective and Statistics (IWEPS), found increased R&D collaboration activity. However, it also revealed that the impact of cluster policy on mobilising investment projects had been weaker.

An impact assessment of the Innovation Networks programme in Denmark found that firms participating in the programme tend to grow faster than non-participants. Furthermore, the study showed that the effects of participation vary according to prior experience of the innovation system. This means that firms with prior involvement in the innovation system experience more profound results in the short run.[67]

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[67] See more detailed description in the presentation of the Danish cluster programme in Appendix 2.

11   Recommendations

The main objective of this evaluation has been to assess the extent to which Norwegian Innovation Clusters meets the needs of the target group, whether the operation and organisation of the cluster programme is appropriate, and whether the effects are in accordance with the objectives. The task of this evaluation has thus been to assess the following:

- The extent to which the market or system failure constituting the rationale for the programme is still present and whether and which alternative measures exist to compensate for these failures (relevance).
- Whether the cluster projects have achieved their stated objectives and whether they collectively contribute to achieving their programme level's objective and the cluster programme's shared objectives (effectiveness).
- The organisation and operation of the cluster programme, including an assessment of whether changes in organisation and operation have contributed to the programme's relevance, effectiveness and efficiency.

In this chapter, we summarise our findings and provide our recommendations for further programme development.

11.1   Rationale for the programme is still present

Our review of different theories of how clusters occur and how cluster dynamics can be stimulated shows that Norwegian Innovation Clusters has developed an instrument that is adapted to strengthening dynamic effects in Norwegian clusters.

It is important to distinguish between cluster effects, i.e. effects resulting from collaboration in clusters, and effects of the cluster programme. The cluster programme's role is to stimulate cluster development, or more specifically to *trigger collaboration-based development* which otherwise would not have happened, *and to reinforce and accelerate existing collaboration*. This is about stimulating collaborative potential (relational basis) as well as specific collaboration processes.

It is our assessment that Norwegian Innovation Clusters is based on a solid academic basis and that there is reason to assume that the programme activities should result in more collaborative activities, enhanced innovation, and subsequently increased value added, than would otherwise have been achieved.

However, we do not find any theoretical justification for a cluster programme with three levels, potentially supporting cluster projects for 20 years.

11.2   The programme has a significant impact

Norwegian Innovation Clusters "(…) *aims to trigger and enhance collaborative development activities in clusters. The goal is to increase the cluster dynamics and attractiveness, the individual company's innovativeness and competitiveness.*"[68]

Through extensive analysis, we believe that objective data substantiates that the Norwegian Innovation Clusters programme achieves its objectives. We find that the cluster programme enhances:

- Pride and the relational basis among members of the cluster projects.

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[68] http://www.innovationclusters.no/english/

- Collaborative research activities among members and between members and other parties.
- Growth in value added, employment and turnover.

Our data also indicates that the cluster programmes promote members' innovation activity, although this result is less clear.

We summarise these indicators in more detail in the following.

11.2.1 Cluster status enhances visibility and pride

Programmes such as Norwegian Innovation Clusters can lead to changes in firms' behaviour, just by announcing a call for proposals. When applying for admission to the programme, firms develop better knowledge of each other and search for new opportunities for collaboration. As a result, firms identify more with each other than before, wishing to develop new meeting places, while the number of collaboration projects increases, and pride in belonging to an acknowledged industry environment is clear among the firms themselves and in the local community of which they are part. These results are clear from our interviews, but are also confirmed by previous evaluations (Econ Pöyry and Damvad 2011, Jakobsen, Iversen, et al. 2011).

Acceptance into one of the cluster levels in the cluster programme is not an automatic process. The application must be better than other applications. When a cluster project is supported by the cluster programme, it thus becomes visible as a business environment which the public authorities believe to have particularly strong potential for growth. The cluster is assessed to be a successful business environment and can, as a function of this, further develop its common identity as a cluster.

Interviews reveal that this positive attention contributes to an internal sense of pride, which in turn creates interest in contributing to the further development of the cluster project.

In addition, most cluster projects have chosen to use project funds for different types of marketing of the project and its members. The combination of positive attention from the status achieved, and the profiling of the cluster in the aftermath of this, has made several clusters more visible than they were before they were accepted into the cluster programme.

Looking at data on allocations from various industry-based support schemes, members of the supported cluster projects are over-represented among funding agencies offering export-, innovation- and research-oriented schemes. Further, data shows that the cluster companies have more eligible projects, but this may also be a consequence of increased visibility. Our interpretation is that this is a result of increased visibility, as well as an increased understanding of the benefits of various support schemes. The impact has probably also been enhanced by the fact that many cluster facilitators help the members in applying for relevant support.

The effect of the new status and attention has naturally been strongest for those clusters which were little known to start with, and where the firms in the cluster have shown continued positive development during the initial years of the project.

The positive attention generated by enrolment also helps to reinforce the work of the cluster facilitators in developing common collaboration arenas and infrastructure. Interviews conducted in this evaluation and in earlier evaluations show that the cluster members have a very positive attitude towards participating in and utilising organised meeting places,

cluster-relevant education and training, and the in-cubators that are being developed.

The cluster programme's impact on clusters' visibility, pride and identity is, in our opinion, primarily an argument that supports the continued uptake of new clusters in the programme. However, the argument is conditional on the existence of positive effects on firms' performance. If not, this recognition and visibility could have been achieved in other and simpler ways (e.g. award ceremonies).

11.2.2 Significant growth in collaboration

Norwegian Innovation Clusters has a clear objective to enhance collaboration among firms in the cluster, and between firms and knowledge institutions. It is emphasised that market failures (referred to as system failures) "*limit firms' ability and willingness to invest in collaboration*". Hence, stimulating firms to collaborate in innovation activities is a highly prioritised task.

In this evaluation we have analysed whether participation in a cluster project has an impact on the firms' R&D collaboration networks. As our available data comprises detailed information about firms and research institutions that are engaged in various different R&D projects, we have been able to construct an R&D collaboration network for each cluster firm, counting direct links between them and other R&D project collaborators. We have also constructed cluster networks, i.e. links between all firms and research institutions participating in the given cluster.

The results are striking. When we compare collaboration links before and after enrolment in a cluster, the collaboration between cluster firms in the same cluster has been doubled in the Arena projects. Similar collaboration has more than doubled in the NCE projects. We also find a significant increase in

collaboration between cluster firms and R&D institutions in the same cluster.

Based on the above, it is our clear conclusion that Norwegian Innovation Clusters contributes to greater innovation-oriented collaboration among members of the cluster projects and between members and R&D institutions. There is further reason to assume that this collaboration contributes to more innovation than would otherwise have been the case, although such a conclusion requires a separate analysis.

Given that the objective is to strengthen innovation collaboration among firms and between firms and knowledge institutions, the data supports that Norwegian Innovation Clusters should continue to fund cluster projects, regardless of cluster level.

11.2.3 Increased innovation activity

An important objective for the Norwegian cluster programme, as well as for cluster programmes internationally, is to strengthen innovation among the participating firms. The increase in innovation-oriented collaboration gives reason to expect this to happen.

We have no data that directly measures the extent of firms' innovation activity before and after enrolment in a cluster project with support from the cluster programme. However, the development in the number of R&D projects with support from the Norwegian R&D tax credit scheme, SkatteFUNN, is closely linked to changes in firms' innovation projects. SkatteFUNN intends to stimulate R&D within all industries. All firms with an approved innovation project are eligible for tax credit. Thus, a firm with an actual innovation project has no reason not to apply for tax credit.

We find that the cluster members in our sample have higher growth in the number of innovation projects within the SkatteFUNN scheme than other firms. However, it is not clear whether this can be attributed to their cluster participation.

11.2.4 Significant economic growth

Comparing cluster members in our sample with a matched control group, we find significant positive effects on employment, sales revenues and value added during the first three years after enrolment in a cluster project. We have compared members of cluster projects receiving support from Norwegian Innovation Clusters with firms not participating in a cluster project, but which are otherwise similar firms with regard to the number of employees, geographical region and support from public schemes apart from the cluster programme.

Our econometric results are in line with what we would expect from the theory of public cluster support, the rationale for Norwegian Innovation Clusters and previous evaluations of effects on firms' performance of participation in the Norwegian cluster programme. Our interpretation is that the cluster projects trigger unresolved dynamic processes in the respective cluster projects.

Our results are also in line with previous evaluations of participation in the Norwegian cluster programme (Cappelen, et al. 2015) and evaluations of international cluster programmes, e.g. Innovation Networks Denmark. An evaluation of the latter shows that firms participating in the programme tend to grow faster than non-participants. Furthermore, the study shows that the effects of participation vary, depending on prior experience of the innovation system. Firms with prior involvement in the innovation system thus experience more profound results in the short run.

Based on the above, it is our clear recommendation that Norwegian Innovation Clusters continues to support both new and existing cluster projects. However, it is our interpretation that the cluster projects primarily have a "kick-off" effect. We therefore recommend a more limited period of public funding of cluster projects that today, e.g. the termination of Arena projects after three years and NCE projects after seven (3+4) years.

11.3 Positive changes in organisation

On the implementation of Norwegian Innovation Clusters (NIC), and in the years thereafter, several organisational changes were made. We consider both the re-introduction of the advisory board and the introduction of regional account managers to enhance the professionalisation of the operation of the programme. Furthermore, we consider the introduction of joint calls for proposals and the use of the programmes' professional services across cluster levels to be an efficiency improvement.

Compared to the number of firms supported, the programmes' annual budget is relatively modest. Given our results concerning the effect on firms' performance of participating in a cluster project, we find that the additional value added exceeds the programme's social costs after only two years. This also hold true when we account for the members' own costs associated with participating in a cluster project.

Our review of international cluster programmes shows increased focus on industrial diversification and the stimulation of cross-sectoral clustering. This is in line with the changes we have observed in Norwegian Innovation Clusters' selection of new cluster projects.

Despite mostly positive organisational changes, one challenge remains. The cluster programme is not clear on how public funding of different cluster projects should or will be ended. Several cluster organisations are positioning themselves to increase the likelihood of continuation in the cluster programme. From their point of view this is rational, but it may inhibit the development of innovation-relevant collaboration that members still wish to finance, even in the absence of public funding. If too many cluster projects do this, the overall impact of the programme will diminish over time.

The problem seems to be greatest when the cluster project is a NCE project. In such cases, the project organisation has been funded for several years and it seems that they have difficulties in understanding that, during these years, the members have not become aware of the benefits which further membership funding would provide.

It is our assessment that the programme would benefit from making it clear from the start that funding beyond the agreed number of years is impossible at NCE level, and only exceptionally for Arena clusters. Our recommendation not to allow for continuation after an NCE project has ended follows our assessment of GCE.

The three existing GCE projects have clearly shown that they initiate many relevant activities that are likely to be important for the further development of the clusters, and – not least – have been very important for the conversion process of the clusters. The latter has been important because the current GCE clusters are very closely linked to the rapid restructuring of the oil and gas sector. However, we have not been able to find theoretical arguments for supporting cluster projects beyond the 10 years of support possible within NCE.

When we ignore the GCE clusters' (important) conversion efforts, it is only the development of common goods, such as enhancing their knowledge infrastructure, that really justifies the long-term support, but this could be supported through other, more targeted schemes.

11.4 Alternative use of funds

As discussed above, we do not find support for the long-term funding of cluster organisations in themselves. However, there is a need for more long-term support in situations where cluster organisations initiate larger common good projects that are of a size and complexity that leads to long development periods. Examples of such common good projects are the development of new knowledge or research institutions, and testing or laboratory facilities available to the entire cluster. The development of a better and more relevant knowledge infrastructure clearly has the character of common goods of the type that would normally require public funding.

Our evaluation has revealed clear gains when the cluster projects manage to organise improvements in the relevant knowledge infrastructure. However, it is not obvious that the public funding of such activities should be limited to ongoing cluster projects.

It is our assessment that both established and new clusters, outside or within the cluster programme, can help to reveal which knowledge infrastructures do not work optimally, and what can be gained from establishing a long-term collaborative project to strengthen these common goods. If Norwegian Innovation Clusters establishes application-based funding schemes for such activities, the cluster programme will help to promote activities that firms are rarely able to undertake alone.

In practice, the above can be achieved by expanding Sivas' newly launched Norwegian Catapult scheme as part of Norwegian Innovation Clusters, or by creating something similar which also include efforts to strengthen clusters' knowledge infrastructure as part of the cluster programme.

It is nonetheless important that measures to support common good projects in clusters are application-based. Applications require the applicant to clarify the project and applications can be submitted by more clusters than those which are part of the cluster programme at the time of application.

The advantage of restricting eligible applicants to clusters (with or without support from the cluster programme) is that this increases the probability that the project will be relevant for a large group of firms that have revealed their growth potential. Over time, it will probably be the clusters which work continuously to strengthen the dynamics of their own cluster that will win such application-based competitions.

12 References

Amaral, L.A.N., A. Scala, M. Barthélémy, and H.E. Stanley. "Classes of small-world networks." *Proceedings of the National Academy of Sciences of the United States of America*, 2000: 11149-11152.

Asheim, B. T., and A. Isaksen. *Location, agglomeration and innovation: Towards regional innovation systems in Norway.* Oslo: STEP rapport 13-96, 1996.

Asheim, B. T., and A. Isaksen. "Politikk for sterke næringsmiljøer: den nordiske "Centre of Expertise"-strategien." 2010.

Asheim, Bjorn, Helen Lawton Smith, and Christine Oughton. "Regional innovation systems: theory, empirics and policy." *Regional Studies*, 2011: 875-891.

Becattini, Giacomo. *Lo sviluppo economico della Toscana.* Firenze: IRPET, 1975.

Blundell, R., and M. Costa Dias. "Alternative Approaches to Evaluation in Empirical Microeconomics." *Journal of Human Resources 44(3)*, 2009: 565-640.

Brito, Carlos Melo. "Towards an institutional theory of the dynamics of industrial networks." *Journal of Busniess & Industrial Marketing, Vol. 16 Issue: 3*, 2001: 150-166.

Brusco, Sebastiano. "The Emilian model: productive decentralisation and social integration." *Cambridge Journal of Economics, Volume 6, Issue 2*, 1982: 167-184.

Cappelen, Ådne, Erik Fjærli, Diana Iancu, and Arvid Raknerud. *Effect on firm performance of support from Innovation Norway.* Reports, Statistics Norway, 2015.

Dahmén, Erik. "Development blocks in industrial economics." In *Industrial Dynamics. Studies in Industrial Organization, vol 10*, by B. Carlsson, 109-121. Dordrecht: Springer, 1989.

Delgado, Mercedes, Michael E. Porter, and Scott Stern. "Clusters, convergence, and economic performance." *NBER Woking Paper Series, Woking Paper 18250*, July 2012.

Durst, S., and P. Poutanen. "Success factors of innovation eco-systems: A literature review." *Alto University Publication series Science and Technology No 15/2013*, 2013: 27-38.

Econ Pöyry and Damvad. *Evaluering av NCE-programmet.* Econ Pöyry, 2011.

Ellison, Glenn, Edward L. Glaeser, and William R. Kerr. "What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns." *American Economic Review*, 2010: 1195-1213.

European Cluster Observatory. *Cluster Programmes in Europe.* European Commission, 2015.

European Comission. *Smart Guide to Cluster Policy.* European Union, 2015.

European Commission. *How to support SME policy from structural funds – Smart Guide to Cluster Policy.* Guidebook Series, Belgium: European Union, 2016.

Fershtman, Chaim, and Neil Gandal. "A Brief Survey of the Economics of Open Source Software." In *The New Palgrave Dictionary of Economics*, by Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan, 2011.

Fornyings-, administrasjons- og kirkedepartementet. "EØS-avtalens regler om offentlig støtte." 2010.

Gooble, M. "Charting the Innovation Ecosystem." *Research Technology Management*, 2004: 55-57.

Iacobucci, Dawn, and Nigel Hpkins. "Modeling Dyadic Interactions and Netweoks in Marketing." *Journal of Marketing Research, Vol. XXIX*, 1992: 5-17.

Innovation Norway. "Annual report ." 2009.

Innovation Norway. "Annual report." 2012.

Innovation Norway. "Annual report." 2016.

Innovation Norway. "Program description (Norwegian Innovation Clusters)." 2015.

Innvation Norway, Siva and the Research Council of Norway. "Nytt helhetlig klyngeprogram. Rammeverk for innhold og organisering." 2012.

Izsak, K, and J Romanainen. *Regional industrial policy in Tampere – Case study conducted within the project "Future of Manufacturing in Europe".* For Eurofond, 2016.

Izsak, Kincso, Paresa Markianidou, and Alasdair Reid. *Scottish Cllusters Mapping 2015. Report for Scottish Enterprise.* Technopolis Group, 2016.

Jacobs, Jane. *The economy of cities.* Random House, 1969.

Jakobsen, Erik, and Rolf Røtnes. "Cluster programs in Norway – Evaluation of the NCE and Arena programs." 2011.

Jakobsen, Erik, Lisbeth Iversen, Olav R. Spilling, and Una Sjørbotten. *Arena-programmet – Stimulerer klyngebasert næringsutvikling.* Menon Economics, 2011.

Krugman, Paul. *Geography and trade.* MIT press, 1991b.

Krugman, Paul. "Increasing Returns and Economic Geography." *Journal of Political Economy*, 1991a: 483-499.

Krugman, Paul, and Anthony J. Venables. "Globalization and the Inequality of Nations." *The Quarterly Journal of Economics*, 110.4 1995: 857-880.

Marshall, Alfred. *Principles of Economis.* London: Macmillan and Co., 1920.

Martin, Philippe, Thierry Mayer, and Florian Mayneris. "Public support to clusters – A firm level study of French "Local Productive Systems"." *Regional Science and Urban Economics*, 41 2011: 108-123.

Martin, Ron, and Peter Sunley. "Deconstructing clusters: chaotic concept or policy panacea?" *Journal of Economic Geography, Volume 3, Issue 1*, 2003: 5-35.

Meier zu Köker, Gerd, and Lysann Müller. *Cluster Programmes in Europe.* European Cluster Observatory, 2015.

Meld. St. 27 (2016-2017). "Industrien – grønnere, smartere og mer nyskapende." 2016.

Meld. St. 27 (2016-2017). "Industrien – grønnere, smartere og mer nyskapende." 2016.

NOU 1996:17. *I Norge – for tiden? Konsekvenser av økt internasjonalisering for en liten åpen økonomi.* Oslo: Finansdepartementet, 1996.

OECD. "Regional Innvation Reviews Competitive Regional Clusters: National Policy Approaches." 2007.

Onsager, Knut, Helge Svare, Anne Haugen Gausdal, Anders Underthun, Bjørg Langset, and Øyvind Pålshaugen. "Regional nettverksorganisering og innovasjon. En studie av fem næringsmiljøer på Østlandet." Samarbeidsrapport NIBR/AFI/HSN 2017, 2017.

Orkestra. "A new step in cluster policy evaluation in Basque country." Orkestra working paper series, 2009.

Porter, Michael E. "Clusters and the new economics of competition." *Harvard Business Review*, Vol. 76. No. 6 1998.

—. "Competitive advantage, agglomeration economies, and regional policy." *International regional science review*, 19.1-2 1996: 85-90.

—. *The Competitive Advantage of Nations.* London: Macmillan, 1990.

Porter, Michael E., and Willis M. Emmons. "Institutions of Collaboration: Overview."

Harvard Business School Background Note, 2003: 703-436.

Reve, Torger, and Amir Sasson. *Et kunnskapsbasert Norge.* Oslo: Universitetsforlaget, 2012.

Reve, Torger, and Erik W. Jakobsen. *Et verdiskapende Norge.* Oslo: Universitetsforlaget, 2001.

Roelandt, Theo, and Pim den Hertog. "Cluster analysis and cluster-based policy making in OECD countries: an introduction to the theme." In *OECD Boosting Innovation: the cluster approach*, by OECD, 9-23. Paris, 1999.

Smith, Adam. *An Inquiry into the Nature and Causes of the Wealth of Nations.* London, Edwin Cannan, ed.: Methuen & Co., Ltd., Pub. Date 1904, 1776.

St.meld. nr. 20 (2004-2005). "Vilje til forskning." 2004.

Storper, Michael. *Keys to the city: How economics, institutions, social interaction, and politics shape development.* Princeton, USA: Princeton University Press, 2013.

Storper, Michael, and Allen Scott. "The wealth of regions: market forces and policy imperatives in local and global context." *Futures*, 27.5 1995: 505-526.

Strøm, Steinar, and Jon Vislie. *Effektivitet, fordeling og økonomisk politikk.* Oslo: Universitetsforlaget, 2007.

Sölvell, Ö., G. Lindqvist, and C. Ketels. *Cluster Initiatives in Developing and Transition Economies.* Stockholm: Ivory Tower AB, 2006.

Venables, Anthony J. "Equilibrium locations of vertically linked industries." *International Economic Review*, 1996: 341-359.

Wennberg, Karl, and Göran Lindqvist. "The effect of clusters on the survival and performance of new firms." *Small Business Economics, Vol. 34, No. 3*, 2010: 221-241.

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Appendix 1: Overview of cluster programmes in Europe

Cluster programme	Rationale/Objectives	Form of support	Number of clusters	Most recent priorities
National				
Denmark, Innovation Networks Denmark[69] and Cluster Excellence Denmark	- Strengthening the research, development and innovation activities of Danish companies - Strengthening interaction between private companies and publicly supported knowledge institutions - Cluster Excellence Denmark is a national platform that collects information for cluster management organisations.	Support for innovation networks as cluster organisations that offer services to member companies such as: - Matchmaking and creating collaboration - Initiating specific development projects - Conferences, seminars - Help with fundraising - Export promotion - Cluster labelling according to ECEI	Around 50	Internationalisation of firms through clusters More professional cluster organisations
France, Pôles de Compétitivité[70]	- Extend the clusters' mission to bringing R&D projects to market - Increase cluster support for SME ecosystems through contacts with investors, anticipation of skills needs, and export capacity development - Focus financing towards more productive clusters for better efficiency of clusters' policy	Support to cluster framework policies enhanced by: - Granting financial aid to the best R&D and innovation platform projects via the single inter-ministerial fund (FUI), during calls for projects - Partially financing the cluster organisations - Providing financial support for thematic collective actions initiated by the clusters in a wide range of fields - Involving various partners	71 competitiveness poles	Link to the "Future of Manufacturing" initiative Supporting industrialisation Internationalisation Access to private funding Skills development Links between SMEs and large companies

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[69] Innovation Networks Denmark. Available at: http://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/collaboration-between-research-and-industry/innovation-networks-denmark
[70] Les pôles de compétitivité, moteurs de croissance et d'emploi en France. Available at: www.competitivite.gouv.fr

Cluster programme	Rationale/Objectives	Form of support	Number of clusters	Most recent priorities
Germany, Leading Edge Cluster Competition[71], Go-cluster programme, 'Internationalisation of leading edge clusters'	▪ Strengthen cooperation between industry and science ▪ Make location more attractive – for skilled personnel, for investors and for those involved locally ▪ Internationalisation	Support for cluster framework policies enhanced by: ▪ Enhancing research and innovation projects ▪ Development of cluster structures ▪ Improving cluster excellence ▪ Fostering innovative cluster support services	15 leading-edge clusters (selected in 3 rounds). The go-cluster programmes unite 92 innovation clusters from all German regions	Fostering research, especially of SMEs (Mittelstand) Professionalisation of cluster structures Internationalisation Supporting cross-sectoral clustering
Czech Republic, Clusters – Cooperation[72]	▪ Support of the cooperation of the clusters ▪ Internationalisation & Development of clusters ▪ R&D activities	Support for innovation networks as cluster organisations that offer services to member companies such as: ▪ Funding ▪ Technical assistance the in the form of the provision of training and consultancy services ▪ Initiating specific development projects ▪ Support for internationalisation ▪ Cross-clustering activities ▪ Cluster management excellence ▪ Cluster labelling according to ECEI	Around 40 clusters listed in the NCA[73]	Strengthening the role of clusters in innovation processes and development strategies Boosting dynamic development in key sectors and emerging technology-based clusters Harnessing the potential offered by social capital and innovation based on shared knowledge and relationships of trust among SMEs, industry leaders, the public sector and universities Internationalisation Cross-sectoral clustering
Netherlands, TopSector programme	▪ Maintain the competitiveness of the Netherlands and keep its international top position.	The top sector funding can include: ▪ Tax benefits ▪ Innovation credits ▪ Grants, ▪ Other.	9 top sectors selected	Open innovation Internationalisation

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[71] The Leading-Edge Cluster Competition in Germany. Available at: https://www.research-in-germany.org/en/research-landscape/research-organisations/networks-and-clusters/the-leading-edge-cluster-competition.html
[72] Ministry of Industry and Trade of the Czech Republic. Available at: https://www.mpo.cz/en/
[73] National Cluster Association of the Czech Republic. Available at: http://www.nca.cz/en/nca

Cluster programme	Rationale/Objectives	Form of support	Number of clusters	Most recent priorities
	▪ The policy framework allows authorities to coordinate and steer companies, universities and research centres through funding that encourages cooperation.			
Portugal, Competitiveness Clusters[74]	▪ Support cluster policy, now strategically oriented for the consolidation or creation of competitiveness clusters ▪ Mobilisation of economic actors for collaborative knowledge sharing	Support for innovation networks as cluster organisations that offer services to member companies such as: ▪ Funding ▪ Technical assistance in the form of the provision of training and consultancy services ▪ Initiating specific development projects ▪ Support for internationalisation ▪ Cross-clustering activities ▪ Cluster management excellence	About 20 clusters identified by IAPMEI	Increase competitiveness Internationalisation Supporting cross-sectoral clustering
Regional				
Catalan Cluster Programme[75]	▪ Systematise the action of the Catalan government in the field of cluster policy ▪ Contribute to rationalising the map of existing cluster organisations	Support for innovation networks as cluster organisations that offer services to member companies such as: ▪ Technical assistance in the form of the provision of training and consultancy services ▪ Cluster labelling according to ECEI ▪ Support for internationalisation	30	Boost the competitiveness of the Catalan economy Systematise the actions of the Government of Catalonia in the field of cluster policy Streamline the clusters' map in Catalonia

[74] Portuguese Agency for Competitiveness and Innovation, I.P. Available at: https://www.iapmei.pt/
[75] Catalan Cluster Programme. Available at: http://accio.gencat.cat/cat/estrategia-empresarial/clusters/inici.jsp

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Cluster programme	Rationale/Objectives	Form of support	Number of clusters	Most recent priorities
Basque Cluster Policy[76]	▪ Promotion of greater added value activities to revitalise economic growth and job creation	Support for cluster framework policies enhanced by: ▪ Funding ▪ Support for internationalisation	20	Inclusion of new enabling technologies into the productive processes and final products; EICTs, BIO, NANO, Sustainable energy and green economy Development of new business models and access to new areas of inter-cluster opportunities combining existing capabilities and converging technologies Continue aligning cluster actions with the Smart Specialisation strategy Internationalisation
Walloon clusters, Competitiveness Clusters[77]	▪ Increase members' visibility ▪ Help partnerships and collaborations between the members of the clusters	Support for cluster framework policies enhanced by: ▪ Funding ▪ Support for internationalisation ▪ Conferences, seminars ▪ Technical assistance in the form of the provision of training and consultancy services ▪ Networking and partnering	12	Integration into global value chains Cross-sectoral linkages
Scotland[78], support for key growth sectors	▪ Supporting economic growth in Food and Drink, Financial and Business Services, Life Sciences, Energy, Tourism and Creative Industries ▪ Support within existing industries and within them, emerging new activities	The support is not given to cluster organisations as such, but to activities that support clustering and the development of selected key sectors and industries. Funding ▪ Technical assistance in the form of the provision of training and consultancy services	12 key sectors	Cross-sectoral linkages Integration into global value chains Supporting diversification

[76] Competitive transformation of Basque industries. Available at: http://www.euskadi.eus/plan-pcti-2020/web01-a2lehiar/es/
[77] Walloon Clusters: Competitive clusters. Available at: http://clusters.wallonie.be/federateur-en/index.html?IDC=36
[78] Scottish government. Available at: http://www.gov.scot/Topics/Statistics/Browse/Business/Publications/GrowthSectors

Cluster programme	Rationale/Objectives	Form of support	Number of clusters	Most recent priorities
		▪ Support for internationalisation		
Lombardy[79]	▪ Strengthening the role of the cluster as a facilitator to boost the competitiveness of Lombard companies ▪ Steady their role as intermediate governance, also within the RIS3 implementation process	Support for innovation networks as cluster organisations that offer services to member companies such as: ▪ Funding ▪ Technical assistance in the form of the provision of training and consultancy services ▪ Initiating specific development projects ▪ Support for internationalisation ▪ Cross-clustering activities ▪ Cluster management excellence ▪ Cluster labelling according to ECEI	Around 10 clusters	Supporting new industrial value chains Supporting inter-regional value chains

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[79] Technological Cluster Lombardy. Available at: http://www.s3.regione.lombardia.it/cs/Satellite?c=Page&childpagename=DG_Industria/MILayout&cid=1213792091374&p=1213792091374&pagename=DG_INDWrapper

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Appendix 2: International case studies

go-cluster

Programme rationale

The "go-cluster" programme is the successor programme to "Kompetenznetze Deutschland" (Networks of competence Germany), which was originally initiated by the German Ministry of Education and Research (BMBF) in 1999. In 2012, it was transferred to the Ministry of Economics and Energy (BMWi) and got the new name of "go-cluster". This also led to some adjustments to the funding scheme. While the Kompetenznetze Deutschland programme was aimed at the generation of clusters, the go-cluster programme is more focused on the proliferation of existing clusters. Following the new focus, go-cluster aims to combine the most powerful innovation clusters in Germany, in order to promote their further development by expanding the needs-oriented cluster structures and services for cluster management. While the core aspects of Kompetenznetze were adopted in "go-cluster", such as "Club of the best innovation networks", "further development of cluster excellence", "networking", "increase visibility through public relations and cooperation, as well as events", other aspects were additionally introduced:[80]

- Support of the most powerful innovation clusters through demand-oriented consulting services and the introduction of the **quality criteria of European Cluster Excellence Initiative (ECEI)[81],** with the silver label as a minimum quality standard.

- Establishment and operation of the **cross-cluster platform Germany**, which is jointly supported by BMWi and the BMBF and aims to contribute to greater transparency in national and European cluster policy.

- **Proportional grants for model projects** for the development and implementation of innovative services by cluster managements for their members ("go-cluster Services") and cross-cluster collaborations.

With the new design of the programme. the provided service structure has been changed. Whilst in the Kompeteneznetze programme there was an organising office (Geschäftsstelle), that mainly provided administrative services, in the new go-cluster programme that office was replaced by a pro-active service provider that is in charge of actively supporting cluster managements in their development. Furthermore, the selected service provider VDI/VDE-IT also delivers general information to the BMWi by observing and analysing national and international trends regarding clusters, and cooperating with the federal states and federal cluster programmes.

The objectives of the "go-cluster" programme are: to further increase the quality of cluster management organisations towards international cluster excellence, to increase the international visibility of German cluster initiatives, and to support the German Federal Ministry of Economics and Energy in shaping its cluster policy, as well as its activities regarding clusters at federal and EU level.

Essentially, the programme pursues the following five objectives:

1) **Increase of the reputation** of the clusters (clusters are entitled to carry the "go-cluster"-label).
2) **Professionalisation** of the cluster management by obligatory benchmarking and support in the development of cluster-management service concepts (clusters to meet ECEI standards).
3) **Higher national and international visibility** of clusters through events and presentation of clusters at the cluster platform (e.g. annual cluster conference).

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[80] Evaluation des Programms go-cluster, 2016, Conabo; InterVal.
[81] ECEI (European Cluster Excellence Initiative) is a benchmarking tool for cluster organisations to improve their internal management process and the way they offer services. The ICEI offers a uniform set of cluster management quality indicators and a quality labelling system with three levels (Bronze, Silver and Gold).

4) **More transparency** in publishing all relevant information on German clusters on one home page (all ministries collaborate on that platform).

5) **Stronger cross-linking of cluster-initiatives** (both nationally and internationally).

In addition, in the framework of the programme, the cluster platform Deutschland, the joint information portal of the BMWi and BMBF, is implemented. Go-cluster is an "award-programme" with the ECEI-classification as guiding standards, meaning that the main activities lie in supporting the clusters to reach higher levels of development. There is only limited financial support for the clusters which are part of the programme. The only direct support to the clusters is distributed through a competition on measures to enhance the quality of the management of clusters. Clusters can annually apply for cluster-specific projects and a total of €0.5m is allocated to the awarded projects. The competition is open for all clusters which have a ECEI label and are not "in a critical observatory status".

There was no major discussion regarding market failure prior to the implementation of the go-cluster programme. The main argument for the initiative was that the most powerful cluster initiatives should be integrated in a single measure to promote performance and competences in numerous strong sectors and technology fields within the German economy. Another explicit motivation for setting up the programme was the need to move from "learning by doing" in the direction of professionalising and recognising the "cluster managers" and establishing horizontal learning between clusters.

Cluster policy in Germany is implemented on two levels. The federal states introduce new regional cluster initiatives, whereas the activities of the Federation target the stabilisation of existing structures and foster the increased quality of clusters (e.g. in R&D projects or by stimulating internationalisation). Hence, **domestic clusters are the geographical range of the go-cluster programme**, addressing clusters in every federal state. However, only clusters which have reached a very high level of maturity are included in the go-cluster programme.

Go-cluster is part of the joint activities of BMBF and BMWi, which are labelled the "Cluster Platform". In this joint action, BMBF is responsible for the research-based cluster policy, whilst go-cluster (which lies under the responsibility of BMWi) aims mainly at the improvement of cluster organisation and management. While there, in theory, exists a clear division of labour between ministries, an evaluation in 2016 revealed that stakeholders perceive the go-cluster programme as not sufficiently cross-linked with programmes and initiatives governed by other institutions/ministries.

Key figures on the programme and key activities funded

There are no specific sectors targeted by the programme, but clusters are expected to be directed towards innovation. At present, 90 cluster entities are included in the programme, which collectively gather close to 15,000 active members. These include approximately 10,000 small and medium-sized enterprises, 2,000 large enterprises, more than 900 chairs and institutes at universities and 600 independent research institutes. The number of organisations per cluster varies from less than 20 to more than 200 members per cluster.

The clusters are classified in 35 different fields of technology, with most of them operating in areas such as industry 4.0, automotive and production technologies. The financing of cluster management organisations is heterogeneous. Some are fully financed by the private sector, while others are financed mainly by grants from the respective federal state in which the cluster management is based. The main sources of funding are membership fees, stakeholder contributions, paid services, sponsorship and public funding. The individual projects within the clusters have additional funding sources.

The main activities by the go-cluster programme are in the field of service provision and consultancy. Grants are only a small part of the overall programme. Hence, go-cluster is a programme which is focussing on technical support for cluster managements to further develop the most eminent clusters according to

international standards. For all activities, the ECEI standards are the aspired benchmark. In more detail, the programme consists of the following services and activities:

- An ECEI quality and efficiency certificate for cluster management organisations applying uniform assessment criteria that comply with European quality standards

- Reimbursement of the costs of the Bronze or Silver Label of the ECEI

- The right to use the brand "go-cluster: Exzellent vernetzt!" as quality label

- Participation and higher visibility in government economic initiatives

- Increased national and international visibility to decision-makers representing government, business and administration

- Public presentations of cluster activities and selected success stories on innovation projects (events, newsletters, websites and clusters' success stories "ClusterERFOLGE")

- Networking activities with other innovation clusters from Germany and Europe

- Participation in seminars on topical matters of clusters and management, individual counselling of cluster managements on strategy development and entitlement to apply for funds

Cluster categories: rationale, relevance, effectiveness

As the programme only targets high-capacity clusters, which have all already achieved a high level of professionalisation, differences in maturity play only a minor role. However, one aim of go-cluster is to support clusters to reach higher levels within the benchmark framework of the ECEI. Consequently, after being accepted to the programme, clusters are obliged to participate in a benchmarking aligned with the quality criteria of the ECEI. Depending on the initial position, the clusters are then either required to achieve the silver or the gold label. Clusters possessing the latter must retain their gold label.

Clusters are offered individual consulting equivalent to their status regarding the ECEI. To support clusters in their seeking to develop and achieve higher labels, go-cluster entails two different kinds of activities:

1. Individual support by experts from VDI/VDI-IT who offer site-visits and tailor-made consulting.
2. Events that focus on the exchange of experience between clusters taking part in the programme. The meetings gather cluster managers from 4-6 clusters engaged in a topic with cross-sectoral and cross-technology relevance.

Selection procedure and criteria

All innovation clusters are entitled to become part of the programme, granted that they comply with the admission criteria for the programme. Clusters can apply for admission at any time. In the first phase of the programme (2012–2015), a total of 48 applications were submitted and 25 applicants were approved and included in the programme. During this first phase, an assessment was made solely based on a written application. If 50 percent of the admission criteria were fulfilled, the BMWi was advised to include the applicant in the programme.

Since the second phase of the programme (from July 2015), the admission criteria have been extended and the entire admission process has become more formalised. In the application for admission, the cluster management is required to *inter alia* provide information on the quality criteria (depicted in Table 1). The quality criteria are oriented towards the ECEI criteria. Further review of the cluster's communication activities and publications are also part of the admission process. After an initial evaluation by the VDI/VDE-IT based on the application, an interview with representatives of the cluster management organisation is conducted.

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Table 2 Admission criteria for go-cluster (minimum requirements)

Structure and composition	
Engagement of the stakeholders in the innovation cluster	At least 30 engaged cluster members
Composition of the cluster	At least 50% SMEs Sector-specific engagement of R&D facilities
Regional focus of the cluster members	At least 60% within 150km of the cluster management office
Cluster management and supervision	
Age and equipment of the management	At least three years in office since the formal foundation Appropriate number of people working in the cluster management
Integration of stakeholders in the cluster management	Appropriate representation of the different stakeholder in the supervision and decision-making processes
Existence of a cluster strategy and its implementation	Cluster stakeholders must be involved in the strategy process The strategy must be in the form of a written document Draft concept for revision must exist
Sustainability of financing	Contribution of the cluster members and the economic revenues must be at least 20% of the total budget of the cluster management Provide proof of funding for at least 24 months
Activities and cooperation	
Activities and services	Spectrum and intensity of the services must be adapted to the needs and the strategy
Cooperation and internal communication	Existence of sustainable operational structures (e.g. organisation of working groups or cluster members) Development of internal communication structures
Visibility and impact	
Unique selling points	Knowledge of the three most important competitors Identify the individual characteristics/ special features of the clusters
External communication	Appropriate external communication and public relations
Visibility	Proof of visibility for external operators (frequency in the press/presentation on platforms/ trade fair participation, etc.)
Previous effect of the cluster work	Presentation of three success stories during the last 24 months
Contribution to the ability to innovate	Anchoring in the regional innovation system Support for cluster operators in the innovation process Implementation of innovation projects

Source: BMWi.

The assessment after review of application and interview is summarised in an admission report and a recommendation is given to the BMWi and the accompanying advisory committee, but only if at least two thirds of the admission criteria are fully met. The advisory committee enrols domestic and European experts on cluster policy. The members come from public institutions, universities and companies. In addition, to further secure the cluster perspective, two cluster managers and two international representatives are part of the committee.

Since the second phase of the programme, ten applications have been submitted, of which two were positively evaluated and included in the programme. Since the implementation of the programme, however, some 20 cluster initiatives have also had to leave the programme, failing to meet the quality criteria.

While for some criteria it is relatively simple to determine whether they are fulfilled or not, for others, the assessment must take a more qualitative approach. For instance, "an appropriate number of people working in the cluster management" is assessed on a case-by-case basis. One interviewee stated that "if the cluster has 100 members, but only allocates a 0.5 full-time position for the cluster management, it is doubtful that the cluster can respond to the needs of its members. On the other hand, if there are only 20 members, but 3 full-time positions in the cluster-management, this might be an indication that the organisation is over bureaucratic".

The cluster strategy is an important document used in the review process. The application process requires a cluster strategy which is valid as at the date of the application and the information in the cluster strategy is used to assess whether the strategic activity fields are aligned with the services offered to the members. Another issue that is thoroughly assessed is the geographical anchoring of the cluster. The selected clusters are required to have a strong regional focus and a critical mass present at the location. Networks (containing organisations with little or no geographical proximity) are not relevant for the programme (this is a change from the original programme, which also supported networks). The financing structure can give information on the commitment of its members: "the higher the private share, the more members are expected to be involved in the cluster's activities because they are actively contributing" one interviewee says.

After a successful application and admission, it is mandatory for all clusters in the programme to participate in the benchmarking processes of the ECEI. To stay in the programme, the cluster management organisations must commit themselves to meeting the quality criteria of the Silver Label of ECEI within two years. Clusters awarded with an ECEI gold label are included in the programme without further examination, as the fulfilment of the admission criteria is confirmed by the possession of the label. Innovative clusters which do not yet have an ECEI bronze label at the time of the programme entry must make up for this as soon as possible after admission, by means of appropriate benchmarking.

Monitoring system

The development and achievements of the clusters are monitored within the framework of the labelling-process for the ECEI. It is expected that the cluster achieves a higher label during its participation in go-cluster. Or, if the gold label has already been obtained, constant development is required to keep the label. Hence, the improvements to the clusters in different areas are monitored by VDI/VDE-IT and then separately assessed.

Moreover, VDI/VDE-IT is engaged in the development of the general cluster monitoring for the BMWi in which structural data on the participating clusters is collected and presented to BMWi. Beyond that, VDI/VDE-IT collects best practice examples from participating clusters on a monthly basis. The results of VDI/VDE-IT's monitoring are discussed in the advisory board sessions and benchmarked against developments in other countries.

There are two ways in which the monitoring system fits the decision-making process for the continuation of support. First, each cluster's performance is reviewed every second year and if the cluster shows a lack of progress in comparison to the previous assessment, VDI/VDE-IT will commence a more comprehensive review.

On the other hand, the performance development in the ECEI can lead to a more specific assessment by VDI/VDE-IT, namely if the silver label has not been achieved in the period foreseen. In the reassessment process, the cluster under consideration schedules a meeting with VDI/VDE-IT to jointly identify the reasons for the lack of development. Depending on the area in which the cluster needs to further develop, a plan and an according timeframe are set up in which the improvements must take place. VDI/VDE-IT also regularly screens clusters where members do not make use of the services offered. In the quality assurance process, VDI/VDE-IT screens the internal data and compares it with other available data, and if there is an accumulation of fields in which the cluster does not fulfil the quality criteria any more, the head of the programme will visit the cluster to have a validation dialogue. Following the meeting, the head of the programme writes a report with a clear recommendation to either continue to support the cluster, or exclude it from the programme. The assessment and recommendation are forwarded to the ministry, as well as the advisory board, for further action. As a consequence of this process, last year go-cluster excluded 13 clusters from the go-cluster programme. Either the organisations failed to further develop their activities, or voluntarily wished to no longer participate in the programme. An evaluation in 2016 revealed that since 2006, in total 91 clusters have been excluded from the programme for various reasons.

Programme evaluations are conducted at irregular intervals. The latest evaluation, published at the beginning of 2016, was an overall assessment of the go-cluster programme in the 2012–2015 period, with the following mandate:

- Presentation and assessment of the objectives of the go-cluster programme and the cluster platform Germany, based on the services offered and their effects (ex-post evaluation). As a result of these steps, recommendations for the possible continuation and quality assurance of the programme.

- Comparative assessment of the current concept of the programme with an external programme service provider, in contrast to the business concept in the predecessor initiative "Kompetenznetze Deutschland".

- Elaboration of criteria and procedures for future performance controls and future evaluations in relation to Section 7 (2) of the Bundeshaushaltsordnung (BHO)[82].

The methodological framework of the evaluation was an ex-post evaluation combining quantitative and qualitative methods. *Table 3* depicts a sample of the indicators used in the evaluation, classified under the different modules of the programme. The results of the evaluation are described in further detail below.

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[82] Bundeshaushaltsordnung (Economic regulation of the federal state) Section 7 aims at evaluation of the adequate use of tax money in the programme.

Table 3 Examples of output and outcome indicators used in the evaluation of the go-cluster programme (2016).

Evaluation modules	Output indicators	Outcome indicators
National and international cross-linking	Number and type of activities initiated by VDI/VDE-IT, which aim to gear go-cluster activities with regional, national and international events	Objective fulfilment of cross-clustering projects Effects of participation in the programme (perceived increase in the attractiveness of the cluster after participation in the programme, benefits for members, etc.)
Composition of the cluster	Share of new content on the website Number and kind of newsletters sent	Development of numbers of visitors to the homepage classified by actor type and geographical location
Excellence impulses for the national innovation cluster	Type and number of events for information and professionalisation of cluster managers, individual support services	Demand for and participation of the clusters in the activities Reasons for participation and non-participation Experienced benefits of the benchmarking process Clusters' intentions to apply for silver/gold labels (or not)
Grant support (competitive projects)	Subsidy amount per project Thematic area of the subsidised projects	Number of project applications submitted Number of cluster members involved in the projects Transferability of developed services (use of information channels, number of services adopted in other cluster initiatives, etc.)

Sustainability of clusters

There is no predetermined period of support for the clusters included in go-cluster. As described above, only a small part of the support services are delivered in the form of grants. Most of the return from the programme consist of the ECEI assessments, learning activities, consultancy services, increased visibility and positive reputation that follows from being labelled as a "go-cluster: Exzellent vernetzt!". In cases where grants are given to clusters, a clear time framework is established. There is an annual call for competitive grants for which "go cluster" organisations are eligible to apply. The grants are intended for small projects with a clear duration and objective. The aim of the support is not to sustain clusters financially, but rather to function as complementary funding for specific development projects. Consequently, no transition process is needed for clusters exiting the go-cluster umbrella, and clusters are generally able to "live on" following the exit of go-cluster. As explained above, the programme only targets mature clusters which have a high competence profile and often have a sustainable business model prior to entering the programme.

Lessons learned from the cluster programme

Which lessons learned from the go-cluster programme can be of relevance for the Norwegian Innovation Clusters Programme? On the one hand, some activities of the two programmes seem to be almost identical (such as expert services and links to the ECEI standards). On the other hand, the Norwegian Innovation Clusters programme also integrates financial support, which only plays a minor role in the go-cluster programme. In Germany, this financial support – especially for "targeted and time-limited development projects" is mainly offered under other programmes – either at the federal level or in programmes which are dedicated to specific thematic topics (e.g. internationalisation, R&D cooperation, cooperation between SMEs, etc.). Go-cluster is a "reward-programme" with a strong focus on increasing the reputation and visibility of the cluster and fostering the professionalisation of cluster management. Hence it only partly overlaps with the NIC programme. The following performance goals are partly shared by both programmes:

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Norwegian Innovation Clusters programme	*go-cluster*
International focus	Greater national and international visibility
Attractiveness and profile	Increase of the reputation of the clusters Professionalisation of the cluster management
Cooperation and collaboration	Stronger cross-linking of cluster initiatives (domestic and international)

The greater national and **international visibility** of the clusters in "go-cluster" is *inter alia* aimed to be achieved through events and presentation of clusters at the website "Cluster Platform Deutschland". The interviewed stakeholders of the go-cluster programme generally assess the established cluster platform to be effective. Moreover, they claim that the platform can assist in delivering information about other clusters and, hence, facilitate cooperation. User statistics show that the visibility of the website is significant, both in terms of domestic and foreign users. The website of the Norwegian Innovation Clusters programme is only partly in English, e.g. an overview of all available clusters is missing. Apart from facilitating cooperation and knowledge between the clusters, international visibility could be increased, and the international focus strengthened.

In contrast to the NIC programme, the **networking** aspect of "go-cluster" exclusively refers to external contacts (and not within the cluster) by fostering a stronger cross-linking of cluster initiatives. Nearly half of the cluster managers surveyed see positive networking effects through new contacts with other cluster initiatives (through conferences, network activities, etc.). Furthermore, the fostering of "cross-clustering" projects has helped several clusters to establish sustainable cooperation with other German clusters. In the evaluation, it was recommended, however, to provide access to some of the programme activities for external (also international) participants, to avoid lock-in effects and to increase the visibility of the programme.

The "go-cluster" label was established as an additional quality label for the clusters, to increase their **reputation among sponsors, stakeholders and decision makers**. The evaluation revealed that the go-cluster programme has positive reputation effects for the clusters, but only to a limited degree. Moreover, participants assessed the benefits to be higher in terms of outreach to the political sphere, than to other sectors. Effects of visibility were identified sporadically, yet most of the effects on visibility were mainly linked to the ECEI label, rather than as an effect of being part of the go-cluster programme.

Clusters with the ECEI gold label expressed a higher reputational benefit than those attaining a silver label. To increase the reputation and visibility of the programme, the evaluators recommended strengthening the interaction and cooperation with other national cluster programmes, to push for more publications in English, and to use the "go-cluster" label more prominently on the cluster websites. The overall conclusion is that focusing on the ECEI criteria as a quality label might be sufficient, and the establishment of a further quality label can prove to be ineffective.

Regarding the ECEI criteria as a reference point for the go-cluster benchmarking, the evaluators recommended that these criteria should be reviewed and complemented, as some stakeholders criticised that the ECEI criteria are too generic to correctly depict the development of the heterogeneous set of clusters included in the go-cluster programme. The evaluation also suggested that the assessment criteria could not determine the extent to which the cluster management development provided benefits to the members of the clusters. It was therefore suggested to add more "dynamic criteria" to the benchmarking, in order to draw conclusions regarding the benefits for the members, such as growth of the member base, development of R&D intensity and self-financing.

With regard to the objective **professionalisation of cluster management**, the evaluation revealed that the technical know-how of the cluster managers in general increased after participation, and the evaluation specifically identified the customised consultancy services as effective.

The evaluation of the go-cluster programme also entailed a brief **profitability analysis** which denoted the activities to be overall cost-efficient. The total costs of the programme (€3.3m for a three-year period) were divided by the average number of cluster members (14,439) for all 100 clusters which benefited from the initiative. This led to an average cost of €228 per cluster member for a period of three years, and an annual cost of €80 per member. Combined with the overall positive assessment of the programme, this cost was seen as justified, according to the evaluation.

Within the advisory committee, there is continuous discussion of the implementation of the admission criteria and how to assess the performance of the clusters. The linkage to the ECEI criteria was one of the adjustments made after reviewing the overall concept of the programme. The open dialogue between the committee and the representatives of the Ministry is seen as a major advantage by one of the interviewees, as it has made the entire process more transparent and effective.

Sources

Referenced documents

Conabo; InterVal (2016) „Evaluation des Programms go-cluster", Studie im Auftrag des Bundesministeriums für Wirtschaft und Energie (BMWi), https://www.bmwi.de/Redaktion/DE/Publikationen/Studien/evaluation-des-programms-go-cluster-studie-im-auftrag-des-bmwi.html

List of interviewees

Claudia Buhl, VDI/VDE IT, Project manager of "go cluster"

Axel Bauer, Fraunhofer-Institut für Lasertechnik ILT, member of the accompanying advisory committee

Innovation Networks Denmark

Programme rationale

Clusters and innovation networks are an important part of the work conducted by the Danish Government and the regions to strengthen growth, innovation and research collaboration among companies. A *cluster* is defined in the Danish context as a group of enterprises that have teamed up with research and educational institutions and other operators, because collaboration offers competitive advantages that an individual enterprise cannot achieve on its own. The *innovation networks* have the additional task of building bridges between knowledge institutions and businesses within areas where Denmark has strong competences and growth opportunities. The cooperation must be based on a clearly defined professional or technological focus area, as defined by the innovation network itself. This might, for example, be a particular technology, a key business strength, a problem relating to a defined business area, or a sector, cluster, business segment, or similar.

The national Danish cluster programme, Innovation Networks Denmark (Innovationsnetværk), was launched in 2013 and is a permanent building block in the national research and innovation system. The initiative was the first nationwide strategy for supporting clusters and innovation networks, involving central actors such as the Ministry of Higher Education and Science, all Danish regions and the association and interest organisation of the 98 Danish municipalities, LGDK (Local Government Denmark).

The Ministry of Higher Education and Science (Uddannelses- og Forskningsministeriet) oversees the innovation network and supports the establishment of network and cluster organisations on a national level. An innovation network has the participation of all relevant Danish universities and technology institutes within a specific technological area, a business sector or a cross-disciplinary theme. Each network has pools for innovation projects whereby firms and researchers work together to solve concrete challenges. The innovation networks also carry out idea generation processes and matchmaking activities, and they hold theme meetings and specialist events.

Prior to the Innovation Networks programme, clusters and innovation networks were one of many focus areas in the Danish research and innovation policy. The principal rationale for focusing on clusters and innovation networks was to create platforms for matchmaking, knowledge transfer and collaboration between research institutions and private companies. With the 2013 initiative, the Innovation Networks programme was defined as a key instrument for achieving the government's objectives:

- Danish companies and public institutions to be among the most innovative in the world

- Denmark to be among the countries that are best at converting research results into new technologies and processes

- The private sector's research and development activities must be increased

The cluster strategy has evolved over time and was last updated in 2016.[83] The updated strategy holds new ambitions and objectives for the continuing efforts of supporting clusters and innovation networks. The overall objective of the Innovation Networks initiative, as defined by the updated strategy, is (1) to strengthen public-private collaboration and knowledge transfer between public universities and private companies on research and innovation; and (2) to strengthen innovation and research in Danish companies and thus promote knowledge-based growth in business and industry.

The programme aims to overcome organisational, cultural, and operational barriers regarding knowledge transfer and collaboration between businesses and knowledge institutions. Furthermore, the Innovation

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[83] Klyngestrategi 2.0 – Strategi for Danmarks klynge- og netværksindsats 2016–2018, 2016, Ministry of Higher Education and Science.

Networks programme aims to manage the tendency of SMEs to under-invest in R&D activities in relation to the potential gains for the companies and society at large.

Innovation Networks are national and nationwide. This does not exclude the innovation networks from playing a role in regional development, although this will typically require the networks to receive separate funding for this purpose, for example from the regional growth forums. Denmark has more than 50 clusters and innovative networks which aim to create growth and innovation nationally or regionally.

Denmark has set up a national support function for clusters and innovative networks through the Cluster Forum (Klyngeforum), Cluster Excellence Denmark. It provides a number of services for the clusters and innovative networks, in order to ensure optimum working conditions. The initiative is co-funded by the Danish Agency for Institutions and Educational Grants and the regions. The Ministry of Higher Education and Science administrates the Cluster Forum and other participants are the Ministry of Foreign Affairs, the Ministry of Business and Growth, the Ministry of Environment and Food, the Ministry of Energy, Utilities and Climate, The Ministry of Health, all six regional growth forums, Danish regions, Local Government Denmark (LGDK), as well as Copenhagen, Aarhus and Aalborg municipalities. The Cluster Forum was established in 2013 with the aim of supporting cluster development in Denmark and creating cohesion between local, regional, national, and international cluster and network efforts.

Key figures on the programme and key activities funded

It is up to each innovation network to define the exact target group for its activities, but the defined target group must have critical mass in terms of the number of companies. The primary target groups for the innovation networks in general are companies within the network's focus area, especially SMEs, and research and knowledge institutions and technological intermediaries that operate within the network's focus area. There are currently **22 innovation networks** included in the programme, distributed on nine different sectors, listed in *Table 4*.

Table 4 List of networks currently included in the programme

Sector (number of networks)	Networks (granted public funding in DKK million)
Production, new materials and design (5)	Innovation Cluster for Production (14) Lifestyle & Design Cluster (14) Innovation Network RoboCluster (14) Danish Material Network (14) Danish Lighting Innovation Network (12)
Service (4)	Service Cluster Denmark (14) Innovation Network for knowledge-based experience economy (12) Innovation Network for Market, Communication and Consumption – BRAND-BASE (12) Innovation Network for Finance IT (10)
Health (3)	Innovation Network for Biotech – Biopeople (12) Innovation Network for Health and Welfare Technology – Welfare Tech (12) Innovation Network for Biomedical Engineering – MedTech Innovation (12)
Energy (3)	Offshoreenergy.dk (14) Innovation Network for Biomass – INBIOM (14) Innovation Network for Smart Energy – Inno-SE (14)

Environment (2)	Innovation Network for Environmental Technology – Inno-MT (14)
	Innovation Network Water in Urban Areas (12)
ICT (2)	The Danish ICT Innovation Network – InfinIT (14)
	Danish Sound Innovation Network – Danish Sound (12)
Food (1)	Innovation Network for the Food Sector – FoodNetwork (14)
Construction (1)	Innovation Network for Energy Efficient and Sustainable Construction – Inno-BYG (14)
Transportation (1)	The Transport Innovation Network –TINV (14)

Source: Bevillingsoversigt over godkendte innovationsnetværk 2014–2018, Ministry of Higher Education and Science.

The funding of innovation networks consists of three parts: governmental support, private self-financing and other co-funding. The governmental co-funding may account for maximum 050 per cent of the costs of the activities of each innovation network, described in *Table 5*. This share of the networks' funding may be used primarily to cover the costs of the participating knowledge institutions that work on disseminating knowledge and technology, and to a lesser extent to cover other expenses. The total allocation of governmental co-funding for the 22 networks during the 2014–2018 period amounts to DKK 278 million.

Table 5 Activities of innovation networks that are publicly co-financed.

Pillars	Activities
The operation of a network secretariat	Preparation of strategies, analyses and reports within the network's focus area
	Financial management
	PR work
Matchmaking and knowledge dissemination activities	Assist companies and researchers to find concrete cooperation partners
	Conferences, seminars, experience-exchange groups, etc.
	Communication activities
	Development of new courses of education or technological services
Development projects	Related to the innovation network's professional focus area
	Development of new knowledge, and dissemination and utilisation of the knowledge of research and knowledge institutions, based on the companies' concrete requirements
Internationalisation	Collaboration with foreign clusters and knowledge institutions

Source: Guidelines for the Danish Ministry of Science, Technology and Innovation's "Innovation Networks Denmark" programme, 2009, Ministry of Higher Education and Science.

Private funding (which must at least cover the costs of participating companies) is required to amount to a minimum of 80 per cent of the state funding. This often takes the form of in-kind contributions whereby

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companies are incentivised to participate in the network's activities and account the time spent as part of their co-funding. Other co-funding includes financing from regions, municipalities, other public institutions, EU programmes and participating knowledge institutions, etc.

The size of the clusters and innovation networks in Denmark varies considerably. The largest cluster involves close to 400 companies and the smallest around 20 companies. But the benefits of the networks should not be exclusive to the participating members. Knowledge dissemination and matchmaking activities are open for any company to participate in, and the collaborative projects supported by the networks are required to ensure a broad dissemination of results.

Cluster categories: rationale, relevance and effectiveness

The innovation networks may receive funding for up to four years at a time. After the first two years, the Council for Technology and Innovation will assess whether the network has lived up to the agreed goals, milestones and other criteria for the success of the network. After four years it will be possible to apply for the continuation of the innovation network, but this will be in competition with the other innovation networks, as well as applications to establish completely new networks.

Companies are encouraged to take active part in the activities offered by the networks. The fundamental idea is that participating companies gradually step upwards on the "knowledge ladder", as they increase their R&D intensity, knowledge and networks. Clusters comprise companies that range from inexperienced actors with a low degree of innovation capacity, to advanced actors with a very high degree of innovation capacity and knowledge intensity within the organisation. By establishing platforms for companies with different levels of R&D maturity, the networks become arenas for the efficient exchange of knowledge and experience related to issues of relevance for companies within common sectors.

The innovation networks are categorised in accordance with the European Cluster Excellence Initiative's labelling system, which presents three levels for quality achievement: Bronze, Silver and Gold. Denmark's innovation networks are required to reach at least the Bronze Label, with the ambition and opportunity to achieve and maintain a Gold Label, or at the very least a Silver Label.

Consequently, the categorisation of the innovation networks does not take place within the Innovation Networks programme. All clusters in Denmark are labelled within the framework of ECEI, coordinated by Cluster Excellence Denmark. The labelling of clusters is motivated by the objectives in the Strategy for Clusters and Networks, which are to increase the professionalisation of Danish clusters and innovation networks, giving them a greater ability to create growth, nationally and within relevant business sectors. All clusters, regardless of the label obtained, are offered regular training to develop competences at all three levels, through the national support function of Cluster Excellence Denmark.

Selection procedure and criteria

When the Innovation Networks programme was launched in 2013, the Ministry of Higher Education and Science received 28 applications from various cluster organisations across Denmark. Of these 28 applicants, 22 clusters met the criteria and were granted funding through the programme. The main criteria for being included in the Innovation Networks programme in 2013 was the same as for the current phase of the programme, which is building bridges between knowledge institutions and businesses to increase collaboration in terms of research and innovation, and strengthening research and innovation activities in Danish businesses in order to develop knowledge-based growth.

In order to be considered an innovation network, the clusters also have to contribute to the establishment of efficient matchmaking features, granting businesses across Denmark an easy route towards research and knowledge in a professional field, and which goes beyond existing knowledge institutions. Furthermore, the networks should serve as a focal point for relevant stakeholders within the network's focus area. This also includes providing members with relevant activities and services, as well as national and international

visibility. An innovation network should also be a factor in creating long-term collaboration between businesses, knowledge institutions and other relevant partners (e.g. in the public sector), in order to increase the use of research-based knowledge and contribute to the solving of concrete challenges.

An innovation network is expected to work towards increasing corporate international orientation (especially among SMEs), grant companies access to internationally leading knowledge institutions, and promote international cooperation by facilitating participation in international research and knowledge clusters. Through the innovation networks, the research of knowledge institutions should increasingly be addressed to the needs of society. It is also the intention that the networks will increasingly serve as a turning point for consistency in research and innovation efforts in the network's area of expertise. This also applies to other governmental efforts and project activities, and in relation to relevant regional initiatives. Thus, it is expected that the networks remain informed about other important initiatives and projects, to keep the members of the network up-to-date on relevant results within relevant topics of the operating area.

For each innovation network, there is a set of criteria that have to be met in the selection process.[84] In short, the assessment of applications will give weight to the following criteria:

- The innovation network's rationale and professional focus
- Target company group
- The network's position in the innovation promotion system
- Partner structure
- Company participation – and support
- Organisation
- Useful effect of the concrete development projects
- Useful effect of matchmaking and knowledge dissemination activities
- Future activities
- Economy and co-funding

According to the interviewed representative at the Ministry of Higher Education and Science, all criteria stated above are of equal importance in the selection process. However, there is a special focus on how the network can facilitate interaction between research institutions and the intended business target group (especially the SME collective). In 2014, a renewal of the innovation networks was implemented, but the criteria in the main proceedings of the selection process were left unchanged.

Monitoring system: effectiveness of the monitoring system and efficiency

To monitor the progress with the implementation and achievement of clusters, Denmark has established a centralised feedback system. This means that the innovation networks are responsible for reporting their progress to the Ministry of Higher Education and Science on a regular basis. Among other things, the feedback system requires the innovation networks to develop an annual action plan. The guidelines for reporting are briefly specified in *Table 6*.

More specific requirements for the action plan are that it should be divided into various sections, namely "General activities", "Action plan for academic themes" and "Major development projects". The plan for the general activities should include management of the network, the establishment of new collaborations, matchmaking activities and communication. The other activities of the network are divided into a number of appropriate and cohesive academic themes or areas of activity. Each field of activity must have its own

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[84] Guidelines for Innovation Networks (Retningslinjer for innovationsnetværk), Ministry of Higher Education and Science.

action plan that gathers the smaller activities planned within this theme. Individual activities and development projects for which a deduction of more than DKK 200,000 of the annual network grant is expected are to be described in a separate action plan.

Table 6 Overview of innovation network reporting requirements

Deliverables	Frequency	Delivery time
Action plan and budget for the entire year	Annually	No later than 2 weeks before the end of the current action plan
Interim report and financial statement	Every six months	No later than 3 months after the end of the six months
Annual report and financial statement – including status	Annually	No later than 3 months after the end of the fiscal year
Accountant's statement/ statement from the financial controller	Annually	No later than 3 months after the end of the fiscal year
Mid-term evaluation	After 2 years	2-2.5 years into the 4-year period
Final report	After 4 years	No later than 3 months after the end of the 4-year period

Source: Vejledning til udarbejdelse af årlige handlingsplaner og budgetter samt afrapportering af innovationsnetværk, Ministry of Higher Education and Science.

At programme level, the Cluster Forum is responsible for monitoring, evaluating and measuring the impact of the cluster policy, partly by means of an annual set of performance indicators that shows the overall progress of the networks. To ensure the same high standard of impact assessments, the Ministry of Higher Education and Science commissioned the Central Innovation Manual on Excellent Econometric Evaluation of the Impact of Interventions on R&D and Innovation in Business (CIM). This is a general-purpose tool for assessing and evaluating the implementation of innovation policy instruments. The Manual was updated in 2014 (CIM 2.0) and states the minimum standards and requirements for the implementation of excellent econometric impact analyses.

The Innovation Networks programme was subject to an impact analysis in 2011. [85] The programme was also part of a short-term impact assessment in 2014.[86] The short-term impact assessment uses various estimation methods to quantify productivity growth and analyses of differences between participating companies and non-participants, with the aim to isolate the impact of the instrument in relation to external factors. This was done by first constructing a control group of non-participating companies, with similar traits to the participants. By this method it is possible to argue that the identified effects can be attributed to participation in the instrument. Secondly, certain assumptions are made to conclude that the effects found are significant. The impact study from 2011 used a similar matching approach, in accordance with the CIM standard for impact assessments. This study was carried out from two different perspectives:

1. A general perspective that attempts to identify the overall participation effect by using the full sample of participating companies in innovation networks, disregarding the variation in participation type.

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[85] The impacts of cluster policy in Denmark – An impact study of behaviour and economic effects of Innovation Networks Denmark, 2011, the Danish Agency for Science, Technology and Innovation.
[86] The Short-run Impact on Total Factor Productivity Growth of the Danish Innovation and Research Support System, 2014, The Danish Agency for Science, Technology and Innovation.

2. A perspective that sub-divides participation according to participation type and conducts the impact analysis for each type separately.

There are a number of quantitative indicators put in place for the Danish cluster policy, in order to monitor the development towards the objectives set for the 2016-2018 strategy. The first one states that at least 2,000 companies annually have developed new innovations as a result of the cluster activities. The status in 2014 was that 1,600 enterprises had reached this goal. Another indicator is that there is an appropriate regional distribution of the companies that have developed new innovations, reflecting that the policy benefits the whole of Denmark. Furthermore, at least 2,500 enterprises participate annually in partnership projects with knowledge institutions through clusters. The follow-up of this indicator in 2014 showed that 1,800 companies had participated in such partnership projects through clusters. The cluster policy for 2018 also states the indicator that at least 1,500 companies participate annually in international activities through clusters. The status of such participation in 2014 was 900 companies. The last indicator is that Denmark has at least 10 Gold and 10 Silver clusters in 2018, certified by the European Cluster Excellence Initiative.

Sustainability of clusters

The Innovation Networks programme operates with calls for tenders in conjunction with the programme phases that run for four years, so that the grant is predetermined for a four-year period, but the innovation networks have every opportunity to apply for continued support from the programme for future programme periods, but in competition with others. In the call for tenders in 2014, most of the established innovations networks remained and a handful of new networks where granted support. The interviewed official at the responsible Ministry points out that the financial support for innovation networks is not to be considered as base funding, but rather as a project grant for the networks' specified activities. For the next call for tenders, the Ministry has the ambition to consolidate and decrease the number of networks and increase the critical mass among the networks' secretariats.

Considering that the financial support for the programme is intended to function as top-up funding for specific activities, the aim of the measure is not to sustain the networks financially. Consequently, there is no transition process in place for the networks that will exit the Innovation Networks programme after the end of this funding period, given the ambition to scale down the number of networks. Since the programme targets networks that at least have obtained the Bronze level qualification of the ECEI, they are assumed to have a sustainable business model even prior to entering the programme. This means that exiting of innovation networks is likely to continue, even without the financial support from the government.

Lessons learned from the cluster programme that could be of relevance for Norway

The impact assessments of the Innovation Networks programme reach the same conclusion, which is that companies participating in the programme tend to grow faster than non-participants. The aforementioned short-term impact analysis shows that companies participating in innovation networks achieve growth and productivity that is 3.6 per cent higher than for those which do not participate. The impact study from 2011 shows similar results:

- Participation increases the probability to innovate by more than 4.5 times in year 1 after participation
- Participation increases the probability of R&D collaboration by 4 times in year 1 after participation

Furthermore, the study shows that the effects of companies taking part in the Innovation Networks programme vary depending on their prior experience of the innovation system. Hence, companies without prior involvement in the innovation system will experience more profound results in the short-term than

companies with a higher degree of experience in terms of innovation and R&D activities. The share of companies participating in the programme that are considered to be innovative is also significantly higher than for the non-participant group, as depicted in *Table 7*.

Table 7 Impact on innovativeness of participants in Innovation Networks.

Status	Share of innovative companies 2004	Share of innovative companies 2007
Participating companies in innovation networks	51.2%	73.1%
Non-participants	42.0%	42.8%

Source: The impacts of cluster policy in Denmark – An impact study on behaviour and economical effects of Innovation Networks Denmark (2011).

This not only shows that companies participating in innovation networks are more innovative than Danish companies in general, but also that the share of companies which are innovative is much more likely to grow if they participate in innovation networks. The share of companies performing R&D activities is also significantly higher among companies participating in innovation networks compared to the control group. Out of 641 participating companies investigated, 438 carried out R&D activities. That corresponds to 68.3 per cent, compared to only 35.8 per cent of the control group.

The Innovation Networks programme has proved to be successful in promoting small or medium-sized companies' innovation capacity. This is shown by the fact that 58 per cent of the companies participating in the innovation networks have less than 20 employees, while only 11.3 per cent have more than 250 employees.

Sources

Referenced documents

Guidelines for the Danish Ministry of Science, Technology and Innovation's "Innovation Networks Denmark" programme

Retningslinjer for innovationsnetværk

Analysis of the Danish Research and Innovation System – A compendium of excellent systemic and econometric impact assessments

The impacts of cluster policy in Denmark – An impact study on behaviour and economical effects of Innovation Networks Denmark

Vejledning til udarbejdelse af årlige handlingsplaner og budgetter samt afrapportering af innovationsnetværk

List of interviewees

David Grønbæk, Head of Section, Innovation Networks

Pôles de compétitivité

Programme rationale

The French cluster policy ("politique des pôles de compétitivité") was launched in 2004, with the overall objective of improving the competitiveness of the French economy through innovation. Competitiveness clusters ("pôles de compétitivité") were established, to foster innovation and contribute to economic growth and employment, notably on flourishing markets. The policy was primarily designed in reaction to a report prepared for the Prime Minister, advocating support for ecosystems of growth and competitiveness, and to create competitiveness clusters (Blanc 2004). The report labelled existing national innovation systems as "top-heavy and vertical". They were depicted as fossilised systems that were fit for the 30-year post-war boom period, but had not evolved to adapt to the current needs. This situation was assessed to impede interactions between research, education and companies, from which innovation and competitiveness take birth. The report also underlined the importance of further devolution, with the involvement of the regional authorities, and the strengthening and concentration of universities to support innovation and competitive business sectors.

A competitiveness cluster is defined as a catalyst for innovation **in a defined territory and on a specific theme**, mobilising companies, both SMEs and groups, Public Research Organisations and Higher Education Institutes, for shared development strategies and collaborative projects. It aims at giving partner firms the chance to become first in their markets, both in France and abroad.

In the early 2000s, traditional State interventions with support for industrial policies through innovation mostly took place via national and sectoral policies for building research programmes onto large companies and large research organisations. This model began to evolve during the 1980s, due to globalisation, European integration and decentralisation. Unlike this traditional model at that time, the cluster policy aimed at creating or developing existing local specialised innovation ecosystems, stimulating cooperation links between different types of stakeholders, and supporting collaborative innovation projects. For some of the clusters, the policy strived to create global players with international visibility.

Overall, the implementation of the policy aimed at increasing the innovation efforts of companies, while strengthening activities, mostly industrial, with a high-value content, and improving French attractiveness by reinforcing international visibility. This was also the first time that an innovation policy had a territorial planning component.

In 2009, another programme on business clusters ("grappe d'entreprises") was launched by the inter-ministerial delegation for territory planning and regional attractivity, DATAR (then CGET). These business clusters gather SMEs specialised in a sector, with the objective of animating territorial industry in order to contribute to commercial development, and all sorts of innovative development. In comparison to competitiveness clusters, this notably focuses on actions closer to the market (and less on technological or R&D aspects) and in territories where the critical mass is insufficient to support the creation of a competitiveness cluster. DATAR/CGET aims at ensuring complementarity and collaboration between business clusters and competitiveness clusters. The 2015 evaluation of the business cluster policy noted that the technological positioning of business clusters (concentrating on low to medium-low sectors) is complementary to the positioning of competitiveness clusters, although the territorial complementarity is heterogenous. As the scope of the missions asked of the competitiveness clusters broaden over time, there might, however, be some overlapping in the services offered by the two kinds of stakeholders. From an external point of view, the report notes that there is a risk of a ranking between these categories of clusters, in relation to the amount of State money provided to each policy, which is more important for the competitiveness cluster.

In addition, some initiatives appeared at the regional level. For instance, in 2006, the region Provence Alpes Côte d'Azur decided on the creation of PRIDES ("Pôles Régionaux d'Innovation et de Développement Economique Solidaire") to complete the national policy by offering a better geographical and thematic

meshing of the regional territory. Some of these PRIDES are also competitiveness clusters (10 out of 29). Similarly, the Nord-Pas de Calais region created 12 "pôles d'excellence régionaux" in 2010, with the objective of structuring priority sectors in the region.

The competitiveness cluster policy has evolved over time. Currently, the policy is in its third phase:

- The objectives of the **first phase** (2005-2008) were as follows:
    - Concretise partnerships between different complementary stakeholders.
    - Support the emergence of strategic collaborative R&D projects that could benefit from public aid, including the only inter-ministerial fund "Fonds Unique Interministériel (FUI)".
    - Promote a global environment in favour of innovation and of the clusters' members through activation, resource pooling and members' support for private funding, international development, intellectual property and human resources management.
- The objectives of the **second phase** (2009-2012) were as follows:
    - Reinforce the activation and the strategic steering of the cluster, notably through the implementation of "performance contracts" and the reinforcement of the State correspondents.
    - Develop structuring projects, notably innovation platforms.
    - Support even more the development of the growth and innovation ecosystems of the companies, by using more private funding and seeking better territorial synergies.
- The objectives of the **third phase** (2013-2018) were as follows:
    - Transform the clusters from a "project plant" to a "products for the future plant", in order to support project holders in placing their innovative solutions on the market.
    - Reinforce the support for the development of SMEs and medium-sized groups (access to funding, international development, training needs, etc.).

Clusters' activities were developed and implemented over time to adapt to the evolution of these objectives, with a current trend towards the development of supporting services for the development and SMEs, and not only geographical and sector activation and emergence of R&D projects, as was the case on the inception of the policy.

Until the second phase, the policy was mostly steered by national administrations. Over time and given the ongoing devolution process[87], regional authorities have been further involved in the policy steering. In order to enhance the effectiveness of the public activities, regional authorities are represented within the two national steering bodies:

- The steering committee, the operational body for the management of the cluster policy
- The technical committee, its technical adaptation

In these two bodies, regional authorities are represented by the Association of French Regions, but also by representatives of some regions (Île-de-France, Auvergne-Rhône-Alpes, Occitanie, Hauts de France). There is no uniformity of the region speech.

DATAR/CGET is the national administration in charge of activating the competitiveness cluster policy, alongside the General Directorate for Companies (DGCIS, former DGE) from the Ministry of Economic

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[87] Promulgated in 2015, the law on the new territorial organisation of the Republic "loi portant sur la Nouvelle Organisation Territoriale de la République (NOTRe)", gave new competences to the regions (notably in terms of economic development) and redefined the competences linked to each link of the territorial authorities.

Affairs. Besides CGET and DGE, other State administrations or entities represented in the steering committees include the Ministries of Research, Agriculture, Defence, and Health and Transport, and the national agency for research and public financial entities (Caisse des Dépôts et Consignations and Bpifrance).

Further to these two steering committees, a national orientation committee provides recommendations on the competitiveness cluster policy. This consultative body includes institutional stakeholders (ministries, local authorities, public entities), qualified persons and clusters' representatives. At the local level, coordination committees exist, under the mutual presidency of the regional prefect (representative of the State) and the president of the regional council. They allow for regular exchanges between public authorities and clusters, on themes such as strategy, projects progression, funding …

An association, "Association française des pôles de compétitivité (AFPC)", was created in 2013. It aims at federating French competitiveness clusters by developing innovation ecosystems and representing its members towards national and European authorities. It is an offshoot of a previous association uniting the biggest clusters, under the categories of "global" and "global vocation". Even though its members represent the majority of the competitiveness clusters, not all clusters are represented. The association is sometimes criticised for not being representative and for being the spokesperson of the bigger clusters.

Key figures on the programme and key activities funded

The thematic coverage of the clusters is broad, and some clusters may cover several themes. They include:

- Aeronautics and space (4 clusters);
- Agriculture and agrofood (12 clusters);
- Consumption goods (4 clusters);
- Bioresources (4 clusters);
- Biotechnology and health (7 clusters);
- Chemistry (4 clusters);
- Ecotech/environment (7 clusters);
- Energy (12 clusters);
- Engineering/services (7 clusters);
- Materials (11 clusters);
- Mechanics (6 clusters);
- Optics/photonics (2 clusters);
- Information and communications technology (11 clusters);
- Transportation (7 clusters).

There are currently 68 competitiveness clusters (see *Figure 1: Map of competitiveness clusters in April 2017* Figure 1). There were previously up to 71 clusters, but six were merged during the second and the third phases to form 3 clusters.

Figure 1: Map of competitiveness clusters in April 2017

Source: CGET.

There is no defined size for a cluster, and there is great variation between clusters. Some clusters are responsible for the development of a small community of members, while for others, the community could amount to 400 members. Overall, the 2012 evaluation notes that 72 per cent of the members are companies, with SMEs representing 80 per cent of this number. On average in 2011, a cluster counted 187 members, including 13 research organisations, 4 training organisations, 14 research and training organisations, 108 SMEs, 16 medium-sized companies, 13 large companies and 19 other members.

One of the core missions of the competitiveness clusters is to contribute to the emergence of collaborative R&D projects. Some "funding windows" require their label for the selection of the projects they support. This label is perceived as an effective way of pre-screening, and potentially reorienting, the project. The competitiveness clusters have their own dedicated funding window, with the FUI, but can also label projects for other funding windows.

Overall, since 2005, the 22 FUI calls for proposals[88] supported 1,681 collaborative R&D projects, for a total of €6.8 billion, including €2.7 billion in public support (€1.7 billion by the State and €1 billion by local authorities). In addition, the National Research Agency funded more than 2,200 projects labelled by clusters, with €1.5 billion between 2005 and 2015, roughly one third of its budget.

The support for the policy by the State takes place in two ways:

- Financial support for the functioning of the cluster and the development of the ecosystem. Initially, the annual State contribution was €12 million as support for activation and currently comprises between €15 and €20 million, which represents about 15 per cent of the overall State support for the policy[89].

- Co-funding of R&D projects, through an inter-ministerial fund ("Fonds Unique Interministériel"). Over the period 2014–2015, the amount given by the State to the FUI represented about 1 per cent of all public support for the innovation policy (including indirect support).

After the evaluation of the first phase showing satisfactory results, the State decided to continue with a second phase and allocate a total of €1.5 billion for "Cluster 2.0", an amount equivalent to the first phase.

Over time, clusters have been invited to look for additional co-funding, both public and private. Private funding is expected to reach 50 per cent, in line with the State Aid rules. Although there is no target for the participation of other public funders, the regional authorities have been allocating an increasing amount, both as direct resources (including financial resources), but also as contributions to the financing of some R&D projects, through the FUI.

Despite the growing participation of regional authorities in the financing of the FUI, the overall level of funding dedicated to collaborative R&D projects labelled by competitiveness clusters has decreased over time. The public contribution to R&D project support through this channel was €256 million in 2008 and €149 million in 2011, and reached a record-low of €76 million in 2017 during its 23rd call for proposals.[90] In the meantime, the Programme for Future Investments ("Programme d'Investissements d'Avenir PIA") has emerged since 2010, without any clear link with the decrease in the FUI. The programme funds R&D projects and structures, including projects that are potentially interesting for competitiveness clusters, and are even sometimes dedicated to this, and structures that could collaborate with competitiveness clusters (e.g. Technological Research Institute, Institute for Energy Transition). However, this raises the question of the complementarity of the competitiveness cluster policy with the emergence of these new tools, and also its sustainability, especially in the light of the decrease in the amount of support provided for the competitiveness cluster policy.

Cluster categories: rationale, relevance and effectiveness

Initially, the programme formed three different categories of clusters during the announcement of the results. These categories were, however, not mentioned in the call for proposals. The policy distinguished between "global" clusters, "global vocation" clusters and "national" clusters. This categorisation aimed to identify clusters of a significant size, able to have great international visibility and to become a focal point

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[88] The analysis of the 24th call for proposals is currently ongoing.
[89] Between 2013 and 2015.
[90] Between 2008 and 2013, the number of projects funded by the FUI decreased by 36% and the average amount of funding decreased by 27%.

in their sector. Several criteria were used, including the weighting of research and laboratories in the territory. These criteria were not made public and generated criticism. Initially, 7 clusters were labelled "global", 10 "global vocation" and 54 "national".

In 2008, an evaluation was conducted, both at the overall policy level and at the individual cluster level. The evaluation recommended the abolition of the "global vocation" category, retaining only the "global" and "national" categories, the former to be reserved for clusters whose innovation capacities in their field are among the world-leading stakeholders and whose themes are sufficiently broad to ensure global visibility. The "national" category should be given to all clusters not complying with one of these two conditions. The evaluation recommended to have 16 clusters in the "global" category, and 55 in the "national" category. Despite this recommendation, the initial "global", "global vocation" and "national" categories were kept. In the 2012 evaluation, two categories were proposed, "international competitiveness cluster" and "innovation and competitiveness cluster", as well as the re-classification of the clusters based on explicit and impartial criteria.

Over time, the initial classification of "global", "global vocation" and "national" clusters has become ineffective, mostly due to fact that this classification was not based on clear criteria known by the stakeholders. The evolution of the markets, the clusters' dynamic, but also the structure of the clusters and the national strategy, also contributed to rendering it ineffective over time. For instance, the categorisation did not consider clusters belonging to one of the 12 strategic sectors identified by the 2010 General State of the Industries. Furthermore, the underlying idea of a competitiveness cluster was to take part in international outreach, and the label "national" could present an image barrier for national clusters. At this point, a willingness was expressed by the national authorities to avoid differentiated treatment and to set all clusters on an equal footing. In addition, a modification of the cluster classification was considered to be politically damaging, and the classification was simply abandoned.

During the existence of this classification, the transition from one category to another was not planned. However, the two evaluation reports in 2008 and 2012 proposed evolution to only two categories, with the suggestion of promotion for some clusters. However, during the time of its existence, the clusters kept the categories they were assigned during the inception of the policy.

Selection procedure and criteria

In 2005, the government launched a call for proposals for competitiveness clusters, to foster synergy between research laboratories and training organisations, on the one hand, and companies on the other, defined by geographical territory and a business sector related theme.

The competitiveness cluster label was attributed by a decision of an inter-ministerial committee in charge of spatial planning and territory competitivity, chaired by the Prime Minister.

The specifications of the call for proposals established by the government in 2004 indicated four main criteria:

- A development strategy consistent with the economic development strategy of the territory
- Sufficient international visibility, on an industrial or technological level
- A partnership between stakeholders and structured and operational governance
- An ability to create synergies in terms of research and development, and thus bring new wealth with strong added value

These broad criteria were not further defined and were not operationalised. This corresponded to the will of the government to provide the State with a high degree of freedom in the selection process and in determining the number of clusters to be supported.

The selection process included a triple analysis:

- The analysis at the regional level, under the responsibility of the regional prefect

- The expertise of an inter-ministerial working group

- The expertise of an independent panel formed of qualified people, from the business and university sectors

Initially, regional authorities were not involved in the selection of the clusters, although their ownership of the cluster project was one of the underlying selection criteria. Similarly, their views could also contribute to the selection of a cluster. Most projects included a covering letter from regional and/or local authorities. Several presidents of regional councils wrote to the government in order to support the establishment of competitiveness clusters in their territory.

At the end of this selection procedure, three committees in 2005, 2006 and 2007 selected a total of 71 clusters. The number is higher than was initially expected (about 15), but given both the enthusiasm in response to the call for proposals and the lobbying from regional actors, it was deemed preferable to support more territorial initiatives.[91] In total, 105 proposals were submitted.

While launching the second phase of the policy in 2008, the government expressed its intent to cover the themes linked to eco-technologies. In 2009, a new call for proposals was thus launched. In May 2010, six new clusters were labelled as competitiveness clusters, in the fields of water, waste management, building and energy. Unsuccessful candidates were invited to submit a proposal to the "company cluster" label ("grappes d'entreprises").

Monitoring system

Evaluations
The only common system to monitor the progress of the clusters is the periodic evaluations. At the end of the first (2008) and second (2012) phases, evaluations were conducted, covering both the national policy and the individual performance of the clusters. In both cases, it was recommended to pursue the policy with a new phase. In 2012, for the third phase the evaluation also recommended the establishment of contracts between the agent and the clusters, connected to the monitoring of performance through a mid-term evaluation.

The steering committee for the national policy is piloting these evaluations, under the operational guidance of CGET and DGE. Evaluations include desktop analysis (including databases), interviews with stakeholders at the national (e.g. ministries) and cluster levels, surveys, on-site visits and meetings with clusters' stakeholders and public financiers.

In terms of results, the 2008 evaluation classified the clusters in three groups, in order to rank the individual performances of clusters:

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[91] At this time, the devolution process had recently given the regional authorities (22 in metropolitan France) the competences of coordinating economic development activities. Clusters were deemed as a tool to undertake these activities. Almost all regions were awarded a competitiveness cluster on their territory.

- Clusters that have met the objectives of the policy (39)
- Clusters that have partially met the objectives of the policy (19)
- Clusters that would benefit from re-organisation (13).

The classification by individual performance led to the de-labelling of 6 clusters in 2010. At the same time, a new call for proposals was launched, leading to six new clusters, with one entering the "world vocation category".

In the 2012 evaluation, the clusters were again classified, from high-performing to non-performing. Due to their recent establishment, the six new clusters were not classified. The clusters belonging to the non-performing category were given a probationary period of one year to establish a remedial plan, and risked losing the competitiveness cluster label if performance was not improved. No individual cluster lost their label, but some of them were invited to merge. Furthermore, the level of performance in some cases affected the level of co-funding from local authorities.

In 2016, a mid-term evaluation covering the individual performances of the clusters was conducted for the 2013-2015 period. It was designed as a tool for clusters to measure their trajectory towards the achievement of the performance targets set for 2018. This evaluation did not establish a categorisation of the clusters, but instead focused on the alignment of each cluster to the specifications of the third policy phase. As the classification of clusters could potentially have strong impacts on both the actions and the visibility of the affected clusters, no overall ranking was conducted. Given the recent regulatory evolution towards devolution ("Loi NOTRe"), there was a fear shared by clusters and regions that the State would only support high performance clusters in the future, and that less productive clusters would be transferred entirely to the regions. The evaluation concluded that most clusters achieved the objectives set in their performance contract signed with the State and the regional authority. At the end of 2015, an average of 77 per cent of their objectives were met, with four clusters below 50 per cent fulfilment of the objectives.

Performance indicators
In terms of indicators, the policy lacks a set of joint indicators to evaluate the performances of the clusters. On the inception of the policy, the clusters' business models were not assessed. Over time, however, this issue has become increasingly more important. A self-financing indicator is now common to all clusters. In addition, the third phase of the policy was supposed to tend towards better harmonisation of performance indicators. Guidelines were established in support of this process, and clusters were given the opportunity to add additional indicators to a set of around ten common indicators. Eventually, due partly to adjustment of the performance contract to sector/cluster specifics and the involvement of the regional authorities, this harmonisation has not been fully effective. Beside "standard" indicators[92] used during the periodic evaluations, there are discrepancies between what is monitored by the clusters, both in terms of volume and content.

In addition to the evaluation, the DGE (Ministry of Economic Affairs) undertakes an annual survey to collect data on a joint set of indicators. The indicators include resources (human, financial), number of projects funded, budget in relation to activities conducted, number of members, etc. This provides an overview of the clusters' activities, although there is the issue of a lack of uniformity for these indicators over time. For

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[92] Such as the number of R&D projects labelled or funded, within the framework of the FUI or not, the number of IP titles, the share of time spent on different kind of activities, the number of international partnerships, the evolution of members, the proportion of SMEs among members or in the governing bodies…

instance, one cluster might d count a university as one partner, while another cluster might count institutions and laboratories of the same university as multiple partners. Recently, some of the results of this survey have been shared with other administrations under the technical committee.

Sustainability of clusters

There is no predetermined period of support for the clusters from the programme. The policy has been prolonged at two occasions. The decision on the renewal of the policy at the end of the third phase is due in 2018.

Although there was no set period for the duration of the policy, the State Aid regime used was valid for ten years. Since 2014, the exempted aid for innovation clusters is used to support clusters in their activation activities at up to 50 per cent. The understanding of the legal offices is that each new label given to clusters will renew the ten-year period. Renewal of the competitiveness cluster label is given after the cluster has been evaluated and exhibited satisfactory performance. The use of a new call for proposals to foster competition among established clusters and new candidates is being considered for the possible fourth phase of the policy.

At the individual cluster level, the continuity of the support might differ, depending on the results of the individual evaluation. Individual contracts between the clusters, the State and the regional authorities have been established since the third phase of the policy. After the first evaluation in 2008, and a probationary period of one year, six clusters lost the competitiveness cluster label, due to insufficient performance. Some of the activities of these clusters were integrated into other competitiveness clusters, while others were reoriented towards the business cluster label or invited to transform into national centres, through other sources of public funding. Later, during the implementation of the policy, some clusters were invited to merge, with the threat of otherwise losing the label.

The exit strategy of the business cluster policy

Unlike the competitiveness cluster policy, the business cluster policy had a set period. Since the call for proposals, it was indicated that the State support for the clusters would last for only two years, during the inception phase, and that clusters would then be expected to self-finance their activities. This forced the clusters to develop charged services in order to survive. In some cases, regional authorities partly replaced the State when it withdrew its participation, to a level that was, however, insufficient to sustain the entirety of the original animation activities. While it withdrew direct support, the State contributed to the funding of an association, France Cluster, to support the network of business clusters and thereby sustain the policy it initiated. This allowed the State to decrease its support to less than 10 per cent of the initial yearly funding.

For the third phase of the policy, the State has set an objective for all clusters to improve their share of self-financing, with a bottom line of 50 per cent to be achieved. Self-financing might come from different sources, including annual subscriptions or the provision of charged services for participating organisations.

There are strong disparities between clusters in terms of subscription level and the development of services. Some clusters might provide a service for free to an individual member, while another cluster might charge for the same service. When forming consortiums for project proposals in response to calls for proposals issued by the FUI, some clusters impose a membership fee for one or even for all consortium members, including over several years if the project is selected.

In addition to membership subscriptions and the provision of individual charged services, it should be noted, however, that self-financing might also include contributions in-kind. There are differences, however, in the policy for contributions in-kind between clusters, since some do not allow contributions in-kind, due to fears of a potential takeover by large companies better able to provide such contributions.

During the mid-term evaluation of the third phase conducted in 2016, it was noted that the average self-financing rate was 46 per cent in 2015, with 28 clusters (out of 70 at the time of the evaluation) above the objective of 50 per cent and ten clusters which had not yet found an adequate business model allowing them to decrease their dependence on public funding.

Lessons learned from the cluster programme

The different evaluations of the competitiveness cluster policy noted the effectiveness of the clusters' actions in terms of structuring the regional innovation ecosystem. Clusters act as R&D&I catalysts and contribute to breaking down barriers in the field of R&D collaboration between large companies, SMEs and research organisations. The policy has contributed to addressing some of the issues affecting the competitiveness of the French economy. The structural costs provided for activating the different territorial networks are below €20 million per year, which is quite low (per supported entity) compared to other innovation policies, especially given the number of projects that have emerged and the international visibility this has generated. R&D projects contributed to intellectual property and innovation, with an average of five intellectual property titles submitted per ten members, and five innovations per ten members during the 2013–2016 period.

The policy was re-oriented during its third phase, in order to increase the level of performance, but the 2016 mid-term evaluation showed that few clusters had succeeded in the process of transforming projects into products. This is partly due to a lack of the skills and competences needed by companies to absorb results generated in R&D projects. The activities undertaken by the clusters have thus evolved over time, from an initial strong emphasis on support to collaborative R&D projects, and to the increased focus on assisting SMEs in their development.

The new missions could, however, blur the positioning of the competitiveness clusters, especially in a changing ecosystem. Indeed, the competitiveness cluster policy was initially one of the major instruments of innovation support in France, but major evolutions have occurred recently, notably under the Future Investments Programme, PIA. New structures have emerged to sustain innovation and the articulation of the competitiveness clusters needs to be improved.[93] Although coordination between competitiveness clusters and these new structures was deemed possible, some of their activities might overlap and blur the legibility of the overall innovation ecosystem for external stakeholders.

Although the share of self-financing is increasing, competitiveness clusters remain too dependent on public funding. Some clusters have difficulties in finding an adequate and sustainable business model. The dedicated fund to support collaborative R&D projects labelled by competitiveness clusters has been instrumental to the success of the policy, with 1,700 collaborative R&D projects supported in a 12-year period. This fund has diminished over time, however, and clusters fear the loss of this devoted instrument, which in turn could undermine their relevance and offering to the members. The extension of PIA to the regions could potentially be used in the future to fund R&D projects involving SMEs. It is, however, to be noted that the competitiveness clusters' members have already secured a significant amount of the PIA funds.

Although competitiveness clusters can be useful tools to stimulate innovation and collaboration between stakeholders, the State needs to better determine its role, whether in support of downstream R&D or in support of innovation ecosystems. In the light of this experience, it is instrumental to clarify the positioning, the missions and the articulation of the clusters in the national ecosystems. Another point of improvement

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[93] The PIA has notably led to the creation of 14 "Société d'Accélération du Transfert de Technologies" (SATT), a type of French company that facilitates and develops the transfer of innovations derived from public academic research to the socio-economic markets, 8 "Instituts de Recherche Technologiques" (I.R.T.), technological research institutes based on long-term partnerships between higher education organisations and companies in order to improve the Industry/Research/Training dynamic, and 12 "Instituts pour la Transition Energétique" (ITE), technological research institute in the field of energy transition.

is the international and European dimensions, which only a minority of clusters have been involving actively.

The competitiveness cluster policy has, however, contributed to the creation of collaborative dynamics between private companies and research organisations concerning R&D projects in different territories and in different sectors. However, the economic impact of these projects and subsequent innovations, and their impact on the market, is uncertain at this point, however.

Overall, the economic impacts of the French competitiveness clusters are still vague. An econometric analysis of the economic impacts is currently being conducted and results are expected at the end of 2017. The previous evaluations in 2012 or 2016 focused on following the clusters' activities and did not measure the direct and indirect impacts of the clusters in a wider context.

The cluster policy has a positive effect on companies' R&D expenditures, with substantial leverage compared to non-cluster members: for one euro of additional public funding, almost three euros were disbursed in R&D spending. However, no significant results were detected further down the value chain of innovation (e.g. turnover, number of IP titles, increase in staff, etc.)

An INSEE study notes that companies that are members of competitiveness clusters have received more subsidies and benefited from more tax exemption through the "Crédit Impôt Recherche" (CIR), a fiscal tool that was set up in around the same period as the policy. In 2009, an average member of a cluster had expenditures on R&D amounting to €116,000, a substantial upshift of the subsidies received.

Sources
Referenced documents

BCG-CMInternational 2008, *Evaluation des pôles de compétitivité*, Rapport global pour la Délégation interministérielle à l'aménagement du territoire et à l'attractivité régionale (DATAR) et la Direction générale de la compétitivité, de l'industrie et des services (DGCIS).

Bearing Point-Erdyn-Technopolis|ITD| 2012, *Etude portant sur l'évaluation des pôles de compétitivité*, Rapport global pour la Délégation interministérielle à l'aménagement du territoire et à l'attractivité régionale (DATAR) et la Direction générale de la compétitivité, de l'industrie et des services (DGCIS).

Bellégo C (DGCIS et Crest) and Dortet-Bernadet V (INSEE) 2013, « La participation aux pôles de compétitivité, quelle incidence sur les dépenses de R&D et l'activité des PME et ETI ? »

Ben Hassine H. and Mathieu C. 2017, *Évaluation de la politique des pôles de compétitivité : la fin d'une malédiction ?*, Document de travail, France Stratégie.

Blanc C. 2004, Pour un écosystème de la croissance, Rapport au Premier Ministre.

Comité interministériel d'aménagement et de développement du territoire 2010, *CIADT – 11 mai 2010*, Dossier de presse.

Commissariat général à l'égalité des territoires (CGET) 2017, *Des pôles de compétitivité performants et structurants pour les territoires*, En bref.

Commissariat général à l'égalité des territoires (CGET) and Direction générale des entreprises (DGE) 2016, *Politique des pôles*, http://competitivite.gouv.fr/politique-des-poles-471.html

Commission Nationale d'Evaluation des Politiques d'Innovation 2017, *Avis sur la politique des pôles de compétitivité*.

Conseil Général de l'Environnement et du Développement Durable 2016, *Les pôles de compétitivité : Leur apport pour les politiques du MEEM,* Ministère de l'Environnement, de l'Energie et de la Mer.

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Houel M. and Daunis M. 2009, *Les pôles de compétitivité : bilan et perspectives d'une politique industrielle et d'aménagement du territoire*, Rapport d'information au Sénat.

Technopolis-Erdyn 2015, *Évaluation de la politique des grappes d'entreprises*, Rapport pour le Commissariat Général à l'Egalité des Territoires.

List of interviewees

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