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# The public sector's role in Norwegian network cooperation: triple helix or laissez-faire?

Øyvind Heimset Larsen<sup>1\*</sup> , Jon Gunnar Nesse<sup>2</sup> and Synnøve Rubach<sup>3</sup>

\* Correspondence: [ohl@vestforsk.no](mailto:ohl@vestforsk.no)

<sup>1</sup>Technology & Society,  
Vestlandsforskning, PO Box 163,  
N-6851 Sogndal, Norway  
Full list of author information is  
available at the end of the article

## Abstract

The concept of triple helix (TH) cooperation was introduced about two decades ago, as a method of enhancing innovation and value creation. A good networking practice for knowledge-based development should identify the correct balance between business, research and government. The TH model for cooperation embodies an argument for public initiatives in business networks. The purpose of this paper is to test the public role in TH efforts in Norway. This paper therefore poses the following question: What is the public sector's role in network development and cooperation in Norway when the initiative is based on the triple helix model? Data from five different business networks in Norway has been collected and analysed to answer this question. The results indicate that the public engagement in the different networks varied with the life cycle phase of the network and the public sector's position in the value chain. The balance between the public and private sphere may vary from as little engagement as possible (laissez-faire) to being an equal TH partner.

**Keywords:** Norwegian Innovation Clusters programme, Triple helix, Public role

## 摘要

三螺旋(TH)合作概念大约二十年前被提出,作为加强创新和价值创造的一种方法。一个以知识为基础的发展的好的网络实践,应该确定在商业、研究和政府之间的正确平衡。TH合作模式体现了商业网络中的公众活动(public initiatives)的论点。这项研究旨在考察在挪威TH努力中公众的作用。本文因此提出下面的问题:当公众活动基于三螺旋模式时,公共部门在挪威的网络发展和合作中的作用是什么?为了回答这个问题,我们收集和分析了来自挪威五个不同商业网络的数据。结果表明,不同网络中的公众参与随着网络的生命周期阶段和公共部门在价值链中的位置而变化。公共和私人领域之间的平衡可能会从尽可能少的参与(自由放任)变为平等的三螺旋合作伙伴关系。

### Résumé

Le concept de coopération de la Triple Hélice a été introduit il y a environ deux décennies comme méthode d'innovation et de création de valeur. Une bonne pratique des réseaux pour un développement basé sur la connaissance devrait identifier le bon équilibre entre le monde des affaires, la recherche et les services publics (gouvernement). Le modèle de coopération de la Triple Hélice incarne un argument en faveur d'initiatives publiques dans les réseaux d'entreprises. Cet article vise à tester le rôle des services publics dans les efforts de type Triple Hélice en Norvège. Il pose la question de recherche suivante : Quel est le rôle du secteur public norvégien dans le développement de réseaux et la coopération au sein des réseaux lorsque ces initiatives sont basées sur le modèle de la Triple Hélice ? Des données collectées sur cinq réseaux d'entreprises différents en Norvège ont été analysées pour répondre à cette question. Les résultats indiquent que l'engagement public dans les différents réseaux varie selon la phase du cycle de vie du réseau et la position du secteur public dans la chaîne de valeurs. L'équilibre entre la sphère publique et privée peut varier de "aussi peu d'engagement que possible" (laissez-faire) à "partenaire égal de la Triple Hélice".

### Resumo

O conceito de cooperação de hélice tripla (TH) foi introduzido há cerca de duas décadas, um método de melhorar a inovação e a criação de valor. Uma boa prática de networking para desenvolvimento deve se basear no conhecimento e deve identificar o equilíbrio correto entre pesquisa e governo. O modelo TH de cooperação incorpora um argumento para iniciativas públicas em redes empresariais. O objetivo deste trabalho é testar o público alvo nos esforços da TH na Noruega. Este artigo, portanto, coloca a seguinte questão: Qual é o papel do setor público no desenvolvimento e cooperação de redes na Noruega, quando o iniciativa baseia-se no modelo de hélice tripla? Dados de cinco redes de negócios diferentes na Noruega foram coletados e analisado para responder a essa pergunta. Os resultados indicam que o engajamento público nas diferentes redes variou com o ciclo de vida fase da rede e da posição do setor público na cadeia de valor. O equilíbrio entre a esfera pública e privada pode variar desde o menor envolvimento possível (laissez-faire) para ser um parceiro TH igual.

### Аннотация

Теория кооперации в рамках тройной спирали (ТС) была предложена несколько десятилетий назад как способ поддержки инноваций и создания ценности. Успешные практики сетевого взаимодействия в целях обеспечения развития, основанного на знаниях, свидетельствуют о необходимости равновесия между бизнесом, наукой и властью. Модель ТС подтверждает необходимость привлечения публичных инициатив в бизнес-сообществах. Целью настоящей статьи является изучение роли общества в развитии ТС в Норвегии. В работе ставится следующий вопрос: какова роль общественного сектора в сетевом развитии и кооперации в Норвегии при условии генерации инициатив в рамках модели ТС? Данные, полученные в пяти независимых бизнес-сообществах, были проанализированы в целях поиска ответа на данный вопрос. Результаты показали, что степень публичного вовлечения в различные сети отличается в (Continued on next page)

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зависимости от стадии жизненного цикла сети и места общественного сектора в цепочке ценности. Баланс между частной и публичной сферами может варьироваться от крайне незначительного (*laissez-faire*, или принцип невмешательства) до равноценного партнерства в рамках ТС.

### Resumen

Desde has dos décadas, la Triple Hélice (TH) reconoce que la cooperación entre actores es un elemento clave en la innovación y la creación de valor. Por tanto, prescribe que la gobernanza de redes para el desarrollo basado en el conocimiento debe fomentar un balance de cooperación adecuado entre las empresas, las organizaciones de investigación, y el gobierno. De esta manera, la Triple Hélice acepta iniciativas públicas dentro de redes empresariales. En este artículo preguntamos: ¿Cuál es el papel del sector público en el desarrollo de redes y la cooperación en Noruega cuando la iniciativa se basa en el modelo de triple hélice? Nuestra respuesta está basada en el análisis de cinco redes comerciales en Noruega. Los resultados indican que el compromiso público varía a lo largo de las diferentes redes en función de la fase del ciclo de vida de la red y la posición del sector público en la respectiva cadena de valor. Encontramos que la esfera pública puede ser efectiva, ora con un rol mínimo en las redes privadas (*laissez-faire*), ora en paridad con el sector privado.

### Multilingual abstract

Please see Additional file 1 for translation of the abstract into Arabic.

### Introduction

When describing established forms of cooperation between enterprises and other stakeholders, there is often reference to the concept of triple helix (Etzkowitz 2008). This involves representatives from three main groups: industry (companies), the public sector and academia (research and education institutions). In addition, the concept of network is frequently used to describe the relationships between the participants of a triple helix (TH) cooperation.

In this paper, the interpretation of the network concept is based on studies by Törnqvist (1997), Borell and Johansson (1996) and Castells (2000). A network is thus understood here as being composed of interconnected, but independent nodes. The nodes in the network are individuals or groups of actors (both human and technical), and the network ties consist of different types of relationships between the actors. The network is bound together by common interests or the communication of ideas and impulses (Castells 2000; Healey et al. 1999; Törnqvist 1997) as relational resources. The primary groups of involved actors will be the same as those in the TH mentioned above. Accordingly, a network will be understood here to be the concentration of knowledge, businesses (suppliers, competitors, and customers), cultures and institutional arrangements within a region. In Norwegian practice, however, the cluster is the term more popularly used for this type of concentration of businesses, even if it does not meet the strict requirements in Porter's (2000) definition. In the following, the terms TH networks and clusters will therefore be used interchangeably.

Since the concept of TH was introduced two decades ago, it has gained a political breakthrough in Europe as well as in South-East Asia and Latin America (Strand 2016) as a collaborative means of stimulating innovation and value creation. Accordingly, good networking practice for knowledge-based economic development ought to include advice on identifying the right balance between business, research and government. In order to stimulate innovation in business, the Norwegian Government has initiated several measures directed towards business networks. One of these is the Norwegian Innovation Clusters programme (NIC). This programme finances clusters at different “levels”: *Arena* for immature clusters, *Norwegian Centres of Expertise (NCE)* for mature clusters with a national position and *Global Centres of Expertise (GCE)* for mature clusters with a global position. The programme is funded by Innovation Norway, SIVA and the Research Council of Norway. NIC aims to trigger and reinforce collaborative development activities within clusters, thus increasing the clusters’ dynamics and attractiveness and raising levels of innovation and competitiveness within the individual companies involved.

The publicly funded network initiatives typically encourage the triple helix actors (Etzkowitz and Leydesdorff 2000) within a region to collaborate and thus bridge the gaps between the actors. Former research has shown that the private sector actors do not necessarily value these public endeavours. Firms may, for example, perceive participation in such networks as a non-core activity, as documented by Brekke et al. (2014), Furre and Flatnes (2010), Nesse et al. (2014), Rubach (2011, 2013) and Rubach et al. (2014). Accordingly, these public initiatives may encounter various types of challenges.

The preconditions in the regional environment and in existing business networks will influence the operation and the legitimacy (Aldrich and Ruef 2006) of new networks. In addition, research into business networks shows that economic transactions are key elements within strong business networks (Håkansson et al. 2009). Thus, one of the challenges for the publicly funded network initiatives is to launch activities that are perceived as strategically relevant—moving the network towards an increase in economic transactions between the network members. This is found, for instance, in mature networks, such as the maritime and marine clusters (thus named by the actors themselves) identified by Bergem et al. (2013), Hervik et al. (2012) and Oterhals et al. (2010). In these networks, the relationships are long-lasting and strong, in both a social and an economic sense. Networks thus depend on the different actors within them to take an active role and eventually produce results through their common endeavours. It therefore seems appropriate to add more knowledge through contemporary investigations of the perceived strategic relevance of publicly funded network initiatives, as viewed from the point of view of the various actors and looking at their actual contributions to innovation.

In order to improve public initiatives, stakeholders need a deeper understanding of the way in which these initiatives are perceived. Hence, the following research question is posed: What is the public role in network development and cooperation in Norway when the initiative is based on the triple helix model? The investigation of this is aided by posing two sub questions:

1. How do network participants describe the roles played by the public sector when asked about important network functions? Is the model for relationships a statist model, a laissez-faire model or a triple helix model?

2. How do network participants perceive the varying role of the public sector in promoting innovation possibilities in the networks during the course of the network's life cycle?

The main difference between the two research questions is that the first brings up different network functions without asking directly about public roles, while the second one is a direct question about the timing of public roles in promoting innovation. To answer these questions, data from participants in five networks has been collected. Since the network cases are in varying life cycle stages and drawn from three different industries, it is of interest to investigate the impact of such differences on the perception of the public actors' roles.

The data collection has been part of the Regional Challenges and possibilities–Innovation and value creation in business networks (RECIN) research project. The research project was funded by the Research Council of Norway within the Instruments of Regional R&D and Innovation (VRI) programme and co-funded by four regional funds, in addition to resources from the participating research actors. The aim of the overall research project is to contribute to the VRI programme's goal by investigating and generating knowledge as to how interactions with different types of networks (mature<sup>1</sup> and emergent<sup>2</sup>) contribute to knowledge generation, innovation, and value creation for the firms involved. Moreover, the aim is to investigate and increase the knowledge about how publicly funded network construction programmes<sup>3</sup> can stimulate and facilitate network-based innovation. The findings have relevance for publicly funded innovation networks based on the TH model.

The paper is organised as follows: The second section presents relevant theory. The research methods used are explained in the “[Design and methods](#)” section. Thereafter, in the “[Presentation of the networks](#)” section, the main findings are presented. In the “[Results](#)” section, the two research questions are discussed taking into consideration the theory and findings. Finally, the “[Discussion](#)” section concludes this study, and implications for policy are drawn.

## Theory

The relevant theory is presented in two sections. Firstly, theory and research are presented with regard to three primary models for regional and local development: top-down, market solutions and bottom-up. The role of the public sector in each of these models is discussed. Theory and research on network life cycles are then presented and discussed, along with possible public sector roles in the different stages of the life cycle. In this paper, the term public sector refers to central government and two other levels of authority as well as a set of public support agencies.

### The role of the public sector in regional and local development

Stöhr (1990, p. 39) makes a distinction between three dominant types of politics for regional and local development: central initiatives (top-down), private initiatives (market solutions) and regional or local initiatives (bottom-up). These three types are not mutually exclusive and may even complement one another.

Behind the central initiatives stands the state, represented by either the government or the majority in parliament. Central initiatives may be measures within a redistribution

policy where lagging regions are supported by investments in infrastructure or by establishing public offices or state companies. In Western Europe, such measures were typical during the first 20–30 years after World War II. According to Stöhr (1990), this policy was able to have a certain degree of success as long as economic growth was high, but when the growth levelled out in the 1970s, the disadvantages of the central initiatives became clearer. In short, this policy had little flexibility, was not adjusted to local needs and appeared to be an obstacle to, rather than an engine for, local initiatives. Many, though not all, state establishments were perceived as alien elements without local integration. It was not possible through such a top-down policy to build up innovative climates from scratch (Pike et al. 2006, pp. 14–16; Stöhr 1990, pp. 40–41). Another problem was the dependence on external decision-makers in big cornerstone companies with their offices geographically far away, to make policy regarding local needs. In addition, a third type of problem arose with the possibility of destructive competition between local communities calling for central initiatives to solve *their* problems (Pike et al. 2006, pp. 10–15).

Because of these problems with state initiatives, many countries were looking for alternatives during the 1970s and 1980s. With conservative governments in countries such as Australia, Canada, Great Britain and the USA, the market emerged as the most important tool in regional and local development (Higgins and Savoie 1997, pp. 395–96). Market solutions imply that initiatives are taken by private companies, and not the public sector. From a neoclassic economic point of view, central initiatives will have suboptimal effects by inhibiting mobility, reducing efficiency and slowing down the adjustment of the economy. On the other hand, deregulations will lead to greater differences between regions (Pike et al. 2006, pp. 6–9), and the ‘solution’ for the weaker region’s problems will be migration to more attractive regions (Higgins and Savoie 1997, p. 396).

A broad local or regional development process initiated from the bottom is the alternative in which Stöhr (1990) had the greatest faith. Among the success factors for individual entrepreneurs is a functional network that constitutes a supporting structure throughout the entrepreneurial process (Aldrich and Ruef 2006, pp. 68–74; Stöhr 1990, p. 43). The prerequisites for broad, local mobilisations to succeed are local enthusiasts with legitimacy, competence and contacts and the ability to mobilise both local and external resources (Arbo and Bukve 1990). These resources may take the form of economic capital, competence and social networks. Arbo and Bukve (1990) distinguished between three types of local initiatives, depending on the particular driving force, whether it be political initiatives (from the local municipality), corporate initiatives (from private companies) or local community initiatives (from voluntary organisations).

As in the rest of the Western world, central initiatives characterised Norwegian regional politics the first 25–30 years after World War II. This was the golden age for “acquisition” as strategy, with local communities fighting for money from different state programs in order to lure new companies to their municipalities (Bukve 2001; Isaksen and Mattland Olsen 1995). The problems connected with acquisition were shown to be the same in Norway as in many other countries: little local integration, dependence on an external top management with a global perspective, and vulnerable local communities (Karlsen 1997).

The negative experiences connected with the central initiatives also led to a shift in politics in Norway towards private initiatives and a more *laissez-faire* approach, with market mechanisms being the most important tool for resource allocation. At the same time, a new movement in local development politics gained prevalence. It rejected

acquisition and argued for local initiatives based on local resources (Bukve 2001; Isaksen and Mattland Olsen 1995). This alternative could secure local control, local affiliation and a more sustainable development.

From the late 90s on, literature on the TH of university-industry-government cooperation shed new light on the understanding of the actors' roles and the relationships between the actors in regional development (Etzkowitz and Leydesdorff 2000; Leydesdorff and Etzkowitz 2001). With increasing economic globalisation, the laissez-faire approach seemed as inadequate as the central state dominance had been earlier:

A redefinition of the public/private divide is unavoidable in a knowledge-based economy because academic knowledge is a public good, whereas entrepreneurship requires conditions for private appropriation. In contrast to neo-liberal expectations, the direction is thus not toward laissez-faire. There is an important, but not dominant, role for government and an enhanced role for the university in the Triple Helix. What drives this change in the role of these institutional spheres and their networks of relations is the need to sustain a high level of innovation (Leydesdorff and Etzkowitz 2001, p. 2).

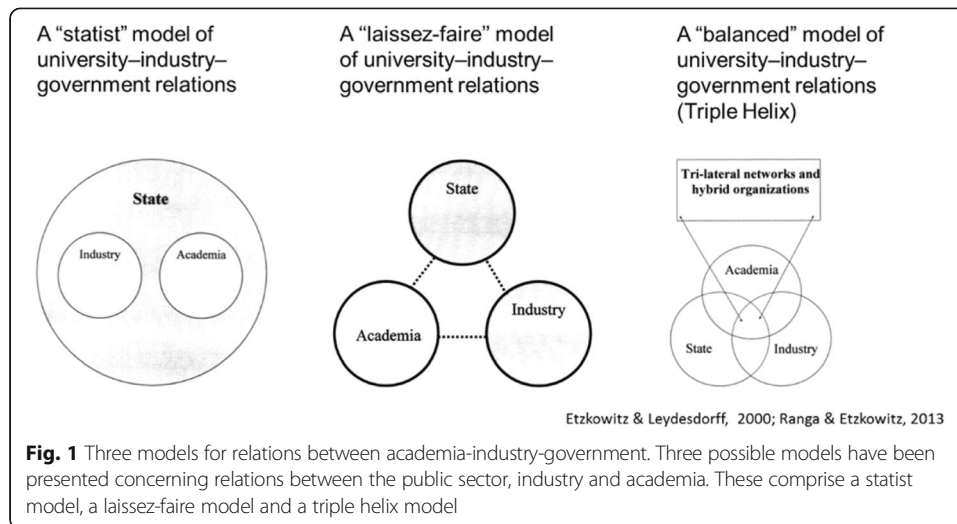
In the laissez-faire relationship model, the government's role is reduced to a minimum, limited to being a regulator and a customer (Etzkowitz 2003). When moving towards a more dynamic TH cooperation however, institutions from university, industry and government will tend to overlap one another, and actors from different spheres will be able to take on the roles of the others (Etzkowitz and Leydesdorff 2000). This means that, in a modern TH, governments can play an active role in innovation and entrepreneurship. Accordingly, TH cooperation is an interesting alternative to both the old "statist" model with a dominant government and the laissez-faire model. See Table 1 for an overview of the three models, the government role and possible problems with each model. See also illustration in Fig. 1.

Ranga and Etzkowitz (2013) put forward an analytic framework for TH systems, containing the principal elements, components, relationships and functions. The components comprise universities, industries and government, and the relationships are those that develop between the components, such as technology transfer, cooperation, substitution of roles and networking. According to Ranga and Etzkowitz (2013, p. 241), the main function of TH systems is "generation, diffusion and use of knowledge and innovation". In order to broaden this picture, network functions mentioned by Bergek et al. (2008) will also be discussed. These include providing benefits for participating parties, building legitimacy, mobilising resources and creating positive externalities (utility for others than the members of the network).

During the last 10 to 15 years, the public sector has been active in building different types of TH networks in Norway, through measures such as the NIC programme. At a regional level, county councils, like Sogn og Fjordane County Municipality

**Table 1** Models and government role

Model	Government role	Possible problems
Statist	Dominating	Lock-ins/path dependency Sub-optimal solutions
Laissez-faire	At a minimum; regulator and customer	Greater differences between regions
TH	Active role (e.g. in innovation and entrepreneurship)	Mixture of roles—for businesses understand public role?



(Sogn og Fjordane fylkeskommune, 2014), have made plans for value creation and have been active in supporting the establishing business networks. As the R&D funding system in Norway have adopted a strong triple helix approach (projects involving all three actor groups get higher ranking), this reinforces the actor groups involvement with each other.

The mutual expectations of the primary actors in TH networks are hardly touched upon in the TH literature, and in a meta-study of the TH literature over a 15–20-year period, Meyer et al. (2014) do not mention research on public sector roles. Universities' roles, on the other hand, are extensively covered. Besides the work of Asheim et al. (2015) on new path development, there has been little focus on the public sector's role in this line of research. They argue that new regional economic path development requires a broad-based policy approach, able to stimulate cross-fertilising effects between different industrial activities within and beyond the region.

The TH model has some acknowledged weaknesses: "there are systematic reasons why the Triple Helix may not materialise, particularly in less developed regions. In most cases the three actors do not align their goals, overlap their meanings, and move together. They constitute separate corners of a triangle, rather than strains in a dynamically active helix. Actors stay at (*sic*) their own corner and pull forces in their direction" (Bonaccorsi 2009, p. 6). Aligning the three "actors" takes time, trust and place-based leadership to craft a collective sense of purpose.

#### Policy measures and network life cycle

Literature on cluster evolution is limited, predominantly to the topic of cluster life cycle (Martin and Sunley 2011). As Martin and Sunley (2011) point out, this approach might not always be the best, but for the purposes of this paper, the network life cycle approach seems appropriate. Network life cycle is illustrated by several development stages, these being the formative (initial), growth (expansion), maturity (mature) and decline (transformation) phases (Brenner and Schlump 2011; Fornahl et al. 2015). The names of these stages vary, however, depending on different authors. Insights into the requirements within the various stages of the life cycle are crucial to improving policies with regard to network development (Boschma and Fornahl 2011; Suire and Vicente, 2014).



The authors have found several articles relating to network life cycles, but very few of these connect policy measures to the phases. Most relevant here is that of Brenner and Schlump (2011), who employed a literature study and a mathematical model as methods for investigating the effects of several possible policy measures in the different stages of networks' life cycle. Their chief conclusion was that the adequacy of a policy measure depends on a network's stage in the life cycle. They also found that policy measures mentioned in the literature rarely related to networks' life cycles. The results from the literature study and the mathematical model were only a partial match. In the mathematical model, Brenner and Schlump (2011) applied six policy measures: education, public research, supporting R&D, supporting start-ups and supporting networks, as well as infrastructure and other local conditions. They defined three stages of development, these being the initial phase, the expansion phase and the mature phase. The principal results from the test of the model using data from seven industries in Germany were as follows: education, best in the growth phase; public research, good impact in all phases; supporting R&D, best in the formative and maturity phase (especially for avoiding decline); supporting start-ups, best in the formative and growth phase; supporting networks, best in the formative and maturity phase (especially for avoiding decline); and other local conditions, best in the growth phase.

The results above indicate that some measures, such as supporting start-ups, are actor-based and others, such as supporting networks, are system-based. These represent the two main policy approaches (Isaksen and Jakobsen 2017). Clearly, the results show that the impact of the various measures vary according to phases in the networks' life cycle. It is tempting to draw the conclusion that system-based measures, such as supporting network development, might be more important in the formative and maturity phase than in the growth phase. This would mean a closer TH engagement in these critical phases for the public sector, in assisting the building up of new networks, and the finding of new paths for mature networks. As an idea, this is not at all new, as Selvik (1984, pp. 206–207) proposed that the public engagement in companies and industries should be strong in the formative and decline stages, while the public role should be more relaxed in the growth and early maturity stages.

It should be noted, however, that Brenner and Schlump (2011) did not include the decline phase in their analyses. A line of research that is particularly focused on late maturity and the decline phase is that shown in studies on path renewal and new path creation (e.g. Asheim et al. 2011). Interestingly, a special edition of *European Planning Studies* (Vol 25, No. 3) is devoted to path renewal and new path creation. As guest editors, Isaksen and Jakobsen (2017) sum up the central findings presented in this special issue. Their conclusion is that a mixture of actor-based and system-based policy is needed in order to create new paths, but they argue that in practice, however, there is too little system-based policy. In addition, many Norwegian regions are dominated by path extensions, and not new path creation. It seems as if the current policy measures are strengthening the already strong industrial milieus and thereby contributing to path extension (Njøs and Jakobsen 2016). Such faults in network policies are not confined to Norway; it is well known that former success may hinder innovation (Fornahl et al. 2015; Hassink and Shin 2005) and that this can be a negative aspect of networks. This indicates that if the intention is to prolong the life cycle of networks, policy measures should “focus on supporting the adaptability and changes of a cluster” (Fornahl et al. 2015, p. 1928).

Suire and Vicente (2014) suggests that network policy should not just “connect people”, but rather “target missing links”. This implies that policies should be directed at building bridges over structural holes (Burt 1992). As an example, a way of renewing a declining network could be to initiate contact between the core and the periphery of the network and/or between the different triple helix actor groups. New ideas might evolve in the periphery or come from new members of the network, and the implementation of the ideas could be said to be easier if the more mature firms are involved (Suire and Vicente 2014).

Staber and Sautter (2011) studied cluster identity and life cycle in two cluster cases in Germany. Both cases had a long history connected to tradition and quality but was now threatened by an increasing international competition. Only one of the cases managed to survive and grow through new path creation. This has implications for policy measures, particularly in the formative and decline phase. As stated by Asheim et al. (2015, p. 1): “While cluster policies are well suited to support the growth and sustainment of existing industries, policies for new path development should aim at regional diversification and variety creation, preferably based on existing strengths and expertise in the region.”

A summary of the role of the public sector in network development and cooperation in the different life cycles is shown in Table 2.

### Design and methods

This study forms part of a larger research project within a national regional innovation mobilisation and research programme in Norway known as VRI. The data was collected as part of the RECIN research project (Regional Challenges and possibilities-Innovation and value creation in business networks). The research project was funded by the Research Council of Norway and co-funded by four regional funds, as well as resources from the participating research actors. The research actors employing the RECIN project are situated in the four different regions.

A comparative study of different clusters has been conducted in RECIN, within four different geographical regions (North-West, West, South-West and East) in Norway. The clusters studied span a broad range of industries, motivations and network maturity. Initial understanding of the single cluster’s base was investigated with cluster classifying techniques developed by the Centre of International Manufacturing (CIM), University of Cambridge (e.g. Srari and Gregory 2008). Results from this work formed the basis for further investigations within the project. Some fall into the theoretical definition of a cluster, while others are to a greater or lesser extent defined by a cluster project and the programme funding itself. All the cluster projects aim to mobilise companies to cooperate with others.

This paper focuses on five cluster projects. The research design could be classified as a comparative case study (Jansen and Rodgers 2001). The cases include three maritime

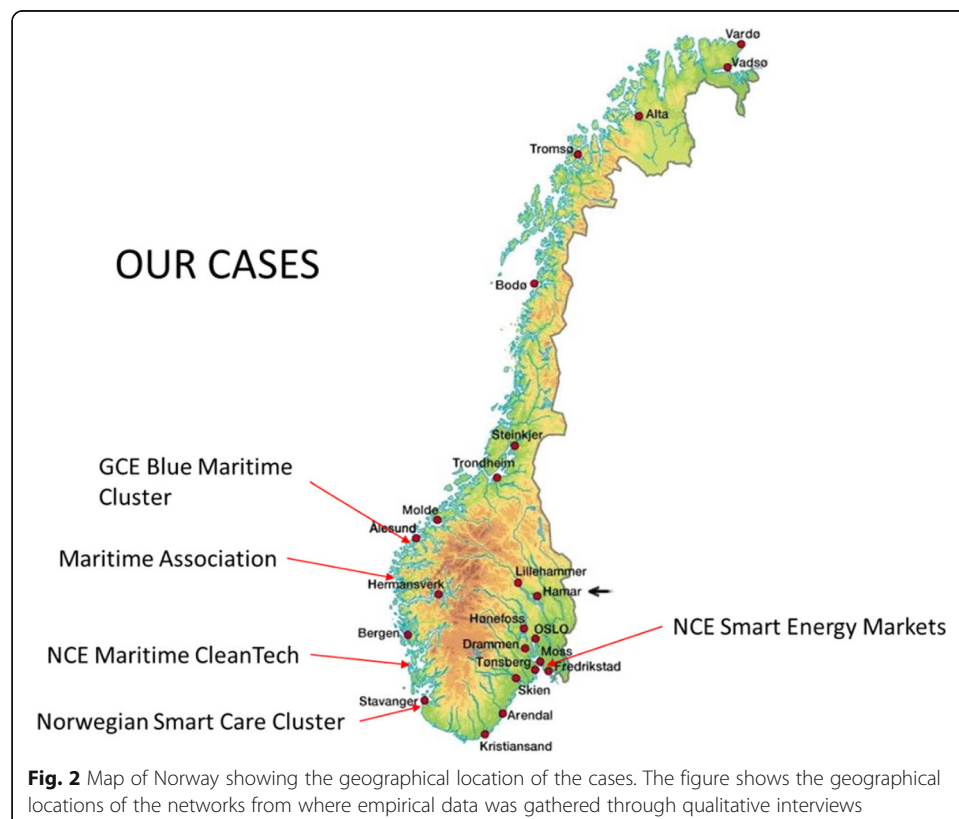
**Table 2** Possible roles of public sector in different life cycles of a network

Life cycle	Formative (initial)	Growth (expansion)	Maturity (mature)	Decline (transformation)
Role of public sector based on				
Statist				
Laissez-faire		X (leave alone)	X (leave alone)	
Triple helix	X (start-help)		X (help to avoid decline)	X (help to finding new path)

networks, located on the west coast of Norway: Maritime Association, GCE Blue Maritime Cluster and NCE Maritime CleanTech. While Maritime Association is a new and aspiring network, NCE Maritime CleanTech and GCE Blue Maritime are acknowledged as more mature networks. This is mirrored in the funding they receive from the cluster programme. In addition, two networks based in other industries are included: the NCE Smart Energy Markets and the Arena Norwegian Smart Care Cluster. Four of the cases have a formal, national network status as GCE, NCE or Arena in the Norwegian Innovation Clusters programme. Figure 2 shows the geographical locations of the networks.

Empirical data has been gathered through qualitative interviews with carefully selected representatives from all the regions.<sup>4</sup> Each research community gathered data on all the topics within its own region, as shown in Table 3.

Each interview lasted between 1 and 1.5 h.<sup>5</sup> In addition, Table 3 shows how many interviews were performed in the different networks, the partners responsible for interviewing and data processing and how the data was processed. In all, there were 34 interviews with business leaders, 9 interviews with members of the network managements, 6 interviews with representatives of the respective county councils and 12 interviews with other public actors at a regional level, such as Innovation Norway and the Norwegian Research Council. The interviews were conducted during the summer and autumn 2015. The interviewees did not receive a list of topics for the interview in advance.<sup>6</sup> The questions that are most relevant to this paper are shown in Table 4. Row 2 in Table 4 contains questions relating to research question 1, while row 3 shows the questions relating to research question 2.



**Table 3** Interviews and data processing

	Maritime association	GCE Blue Maritime Cluster	NCE Maritime CleanTech	NCE Smart Energy Markets	Norwegian Smart Care Cluster
Interviews with company leaders	9	5	9	5	6
Interviews with network management	2	1	2	1	3
Interviews with county municipality	1	1	1	2	1
Interviews with other public actors at regional level	1	2	1	5	3
Partner responsible for interview, transcribing/ taking notes and coding	Vestlandforskning, Sogn and Fjordane University College	Mpreforskning	Polytec	Ostfoldforskning, Ostfold University College	BI Norwegian Business School Stavanger, Polytec
Data processing	All interviews except 1 were transcribed from recordings. Notes from 1 due to recording failure. Coding/sorting according to Table 4	8 of 9 interviews recorded. Separate notes from two interviewers. Coding/sorting according to Table 4	All interviews transcribed from recordings. Coding/sorting according to Table 4	4 of 13 interviews recorded. Notes. Coding/sorting according to Table 4	2 of 13 interviews recorded. Notes. Coding/sorting according to Table 4

**Table 4** Coding/sorting of data from interview transcriptions/notes

Research questions	Maritime association	GCE Blue Maritime Cluster	NCE Maritime CleanTech	NCE Smart Energy Markets	Norwegian Smart Care Cluster
Public roles mentioned in connection to important network functions (incentives, knowledge sharing, innovation, legitimization, resource mobilisation, externalities)					
View on public roles regarding innovation in the network: <ul style="list-style-type: none"> <li>• National level</li> <li>• Regional and local level</li> <li>• Policy implementation system (funding, advising, training)</li> </ul>					

All the interviews that were recorded were subsequently transcribed. The researchers who had partaken in the interview wrote a detailed report based on the notes taken. Each partner carried out the first reduction of the data (Miles and Huberman 1994). This was achieved by picking out key text blocks from the transcribed interviews and interview notes. The text blocks could be a citation or interpretation and a summary of the reply. The text blocks were then put into a table similar to Table 4, which was shared between the partners. The authors, aiming at finding patterns (similarities and differences) with regard to the research questions across the networks, analysed the text blocks in the table. This is a “pattern matching” method of analysis (Yin 2009). While this work led to a new reduction of the material, at the same time, it also led to an increase, as it could be seen that other questions than those included in Table 4 could have answers that were relevant to the research questions. In addition, directly after the interviews, the researchers reflected upon the received answers and what had been learnt from the interviews, singling out similarities and peculiarities. Notes made on these reflections were used as an additional source when analysing the data. The collected material, analyses of the interviews and the researchers’ reflections were discussed in workshops where all the involved researchers in the RECIN project took part.

It could be seen to be a weakness that so many different people interviewed and reduced the material. There were, however, many joint meetings where mutual clarifications were made possible, results made available for all involved researchers to review and use, and additional data material from all research partners provided when necessary. Another possible source of errors is that interviewees from different sectors, e.g. maritime and “smart” clusters, may have different worldviews. If so, different perceptions of and opinions on public roles in clusters could be reflected in their answers. Again, the mutual clarifications mentioned above was the tool used to avoid misinterpretations of the material.

### Presentation of the networks

In this section, the five case networks are presented: The Maritime Association, The GCE Blue Maritime Cluster, The NCE Maritime CleanTech, The NCE Smart Energy Markets and The Norwegian Smart Care Cluster. For simplicity, these names will be abbreviated as follows: Maritime Association Sogn og Fjordane (MA), Blue Maritime, CleanTech, Smart Energy and Smart Care.

It is important to emphasise that each of the studied networks is in a different phase. As previously discussed, there is a distinction between a formative phase and a growth phase (Bergek et al. 2008). Moreover, it can be convenient to include several phases, such as a maturity stage (established networks) and a decline stage (Adizes 1988), after the growth phase. MA and Smart Care are the most recently established networks, and these could thus be evaluated as still being in a formative phase. Smart Energy, having been in operation since 2006, is now in a growth phase. CleanTech has developed over a 30-year period and could thus be evaluated as being in a late growth phase or reaching maturity. This network is however an example of new path creation. This is due to its being a spin-off from a maritime cluster, with a focus on claiming a position within technology that is more environmentally friendly, and to the fact that the cluster is targeted towards global sea transport. Having operated since 2008, it could be evaluated as being in a growth phase. Blue Maritime can track its starting point back to the early 1900s and could thus be evaluated to have reached a late maturity phase. Summarised, one can say that two of the networks are evaluated to be in the formative phase, two in the growth phase and one in the maturity phase.

It should be noted that the data collection was carried out before the start of the major setback in the maritime industry. In 2015, when the data was collected, the industry was aware of a coming crisis but still seemed to be quite optimistic. The real consequences of the crisis were not seen until late 2015 and in 2016. The surroundings in which MA operates could be characterised as “organisationally thin” (Tödtling and Tripple 2005) in the areas of R&D and technological competence. The other networks are located in more populous areas and have an organisationally “thicker” environment than MA, even if similar deficiencies can probably also be discovered there.

### The Norwegian industries

The maritime and energy sectors are important industries in Norway, as shown in Statistics Norway overview from 2016 (Table 5) Norwegian production account and income generation, by industry, contents in 2016. The network members will typically

**Table 5** Norwegian output at basic values in 2016

Statistics Norway <a href="http://www.ssb.no">www.ssb.no</a>	Output at basic values 2016	Percent
Numbers corrected 21.02.2018	Current prices (NOK million)	
Agriculture and forestry	46,135	1%
Fishing and aquaculture	90,468	2%
Manufacturing and mining	796,907	15%
Oil and gas industry	549,546	11%
El and water	128,048	2%
Construction	531,764	10%
Wholesale and retail	403,041	8%
Transport	399,807	8%
Accommodation and food service activities	89,193	2%
KIBS	1,300,184	25%
Public sector	891,392	17%
Total industry	5,226,485	100%

operate in more than one of the sectors with their portfolio of products and services. And even though they may be classified as transport, this will often be transport commissioned by the oil and gas sector.

#### **National cluster program**

Norway has had a strategy to strengthen industry clusters through a national cluster program since the beginning of the 2000s. The Arena program 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 14 projects. In 2014, Arena and NCE were merged into one program, 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.

NCE and GCE offers support for up to 10 years. The grant per project is normally NOK 4–6 million per year for NCE and NOK 8–10 million per year for GCE. The cluster programme had a total budget of NOK 166 million in 2016.<sup>7</sup> The three clusters with GCE status are mature clusters that have a well-developed knowledge sharing and a strong international market position, i.e. they are regarded as networks strongly representing the TH model. The 14 clusters with NCE status is expected be close to representing the TH model and to have ambition to become GCE.

#### **Maritime Association Sogn og Fjordane (MA)**

MA was founded in 2012 and is an industry association for companies with ocean-based activity in Sogn and Fjordane County. MA has 64 members located in 14 of the county's 26 municipalities. The purpose of MA is to assist the members in strengthening their innovation and competitiveness in order that they can realise increased value creation. To this end, MA organises various gatherings for suppliers. At these meetings, MA seeks to achieve a balanced mix of businesses, public employees and academia. Moreover, MA has created a net-based directory where member companies are presented. It has also contributed to the establishment of college education in Florø relating to ocean space, and it is closely integrated with a Sogn and Fjordane based node of NCE Subsea Bergen. MA has also commissioned a value analysis limited to 152 oil-related businesses, which showed that in 2014, the enterprises had a turnover of NOK 5.5 billion, had 2057 FTEs and accounted for a value creation (earnings before interests and taxes + wage costs) of 1.7 billion NOK (MA and PwC 2016).

#### **GCE Blue Maritime (Blue Maritime)**

The maritime cluster in Møre and Romsdal is one of the largest clusters in Norway. Modern industrial history in this county began with the design, production and maintenance of larger fishing vessels at the beginning of the 1900s. The age of oil initiated a new phase from 1970 onwards, with a focus on supply boats and equipment providers. Companies in the cluster are divided into four groups, originating from their location in the value chain. In 2014, the cluster included 13 companies concerned with ship design, 169 equipment suppliers and subcontractors, 14 shipyards and 20 shipping companies (Oterhals et al. 2016). The total turnover was at that point NOK 55 billion, and the number of employees

was approximately 22,000. The growth in the 10-year period from 2004 until 2014 was extensive, as the turnover more than tripled. Rolls-Royce Marine, Farstad Shipping and VARD are examples of strong enterprises within the cluster. The cluster has the status of a Global Centre of Expertise within the Norwegian Innovation Clusters programme. The growth has also resulted in development in knowledge communities. These have developed within finance, classification, research and development, education and other support activities.

#### **NCE Maritime CleanTech (CleanTech)**

CleanTech has 140 members with an overall turnover in 2014 of NOK 52 billion. The cluster extends from Karmøy in the south to Stord in the north. In this region, there are innovative and world-leading businesses from all parts of the maritime value chain. These include shipyards, shipping, shipping consultants, shipbrokers, subsea companies and equipment suppliers. The network also includes suppliers of renewable energy, research and educational institutions and the Norwegian Maritime Authority (NMA). One of the primary purposes of the cluster is to build arenas and networks so as to create future-oriented, innovative and competitive solutions in the maritime sector, while reducing harmful emissions both at sea and on land.

#### **NCE Smart Energy Markets (Smart Energy)**

NCE Smart Energy Markets is based in the county of Østfold. It emerged from an environment of competence in the fields of energy and ICT. This was particularly stimulated by the early deregulation of the Norwegian Energy market in the late 1990s. One of the R&D institutions in the region then developed an IT system for the energy industry, thus creating the first national electricity power exchange. The formal organisation can be traced back to 2006, but under different names. Smart Energy's intention is to create smart energy solutions through innovation and business. The centre aims to maintain competence at a world-class level in this area, with Silicon Valley, among others, as a model. Smart Energy has 20 members from the private sector, 11 from the public sector and 6 from the public-private sector, as recorded in November 2015. The principal activities arranged by the cluster management can be viewed as a set of bridging and building activities, promoting collaboration, learning and innovation among the entire group of participants. The most significant activity, however, is working up, applying for and managing R&D projects on behalf of the cluster members.

The main activities in Smart Energy were in November 2016:

1. Innovation, green growth and internationalisation
2. Commercial-oriented research into Smart Energy Markets and smart settlements
3. Commercial-oriented training and education in analysis and visualisation of big data

#### **Norwegian Smart Care Cluster (Smart Care)**

Smart Care is a relatively new network receiving Arena status in 2014. Although Smart Care is based in the county of Rogaland, the cluster is open to members from all over the country. In September 2016, Smart Care had more than 100 members, and over



three-quarters of these were private companies. The rest were public bodies and educational institutions. The vision is for the cluster to become a significant player before 2020, within the field of welfare technological solutions in Europe. The primary objective is to develop an innovative cluster that can be successful in commercialising welfare technology. Smart care has a variety of activities relating to:

1. General networking of an informal nature
2. Specific innovation projects, which have in part a high degree of research content
3. Training activities

In addition, Smart Care has expressed a commitment to the creation of a “Living Lab”. This will be a laboratory where suppliers and users can test new solutions together before they are put out on the wider commercial market. This approach can be described as systematic user co-creation, integrating research and innovation processes.

### **Network overview summary**

Table 6 shows a summary of the overall characteristics of the different networks.

## **Results**

The principal results for each network are presented in Tables 6, 7 and 8.

Table 6 sums up the chief reasons as to why the network is important to member companies. With regard to the network functions, Table 7 shows where and in what

**Table 6** Network overview

Cluster/ network project	Member/ membership alliances (2015/16)	Coincide with a physical value chain	Main activities in addition to: Seminar/conferences Arenas for networking	Reason why important (according to companies) in addition to: Innovation Relationship building Create/share/collect/use knowledge
Maritime Association S&F	64	Yes	GAP analyses Supplier database	Meeting place business policymakers Meet new/important customers
GCE Blue Maritime Cluster	157 of 220 in the value chain	Yes	Representation (market and policymakers) Facilities funding opportunities	Branding Representation Networking arena Conferences
NCE Maritime CleanTech	55	Springs from one, but only relevant for part	Facilitate R&D Apply for public grants Lobbying	Branding/reputation Mobilise R&D projects Networking Lobbying
Arena Norwegian Smart Care Cluster	100+	No	Stage arenas for idea/ project development	Network/learning seminars (bringing private and public actors together)
NCE Smart Energy Market	37	No	Lobbying Competence brokering/ facilitate R and D Stage arenas for idea/project development	Develop relations, ideas and research for business dev. Collaborative experimenting with disruptive tech. Branding + build/lend credibility Lobbying

**Table 7** Public roles and network functions

Functions	MA	Blue Maritime	CleanTech	Smart Energy	Smart Care
Incentives to become member	Opportunity to meet politicians for informing/lobbying	Lobbying towards public sector	Public sector as target for lobbying	Public sector sees network as an opportunity to meet private companies	Public sector sees network as an opportunity to meet private companies
Knowledge sharing					Sharing of knowledge between municipalities and companies
Innovation					Public-private cooperation, pilots Public budgets decide future market
Legitimation		Membership gives good reputation in public sector	More visible for public sector		
<b>Mobilisation of resources</b>	Network leaders direct companies to public funding agencies for financial support			Public sector represented in network's board	Good relations to Greater Stavanger and county municipality
Externalities				Business development as a general goal	

way the interviewees see the public sector as an important contributor. It is important to emphasise that the interviewees were not specifically asked about the role of the public sector, but only to give their evaluation of the various network functions.

As seen in Table 7, many of the cells are blank, meaning that in those cases, the respondents did not mention any role for the public sector. The business leaders saw the opportunity of lobbying towards the public sector as an important reason for joining the networks. Typical areas mentioned for lobbying were funding, changes in the laws and improved business conditions. The building of legitimacy of the network is assumed to be a critical success factor for lobbying. By joining the networks, the companies improved their reputation and had a better chance of convincing the actors from public sector to change their policies. Another interesting aspect of Table 7 is the difference between the maritime networks on the one hand and the Smart Energy and Smart Care networks on the other. The public sector is much more deeply involved in the Smart Energy and Smart Care networks than in the maritime networks. In the two “smart” networks, the public sector is an important customer, as well as being a partner in business development. This is not the case in the maritime networks. This point will be further developed later in the paper.

Table 8 shows the respondents' evaluation of the public role with regard to innovation within the networks. This data derived from the questions posed to the interviewees, specifically concerning their evaluation of the roles of the public actors. The data in Table 8 shows the same trend as in Table 7, for the maritime networks and the “smart” networks with respect to the perception of the public role.

Business leaders in MA and Blue Maritime do not perceive the public sector to be important at a national level. MA, as a new network, views the public sector at a

**Table 8** Public roles for innovation in networks

	MA	Blue Maritime	CleanTech	Smart Energy	Smart Care
Public sector, national level	Not mentioned	Not important	Important. Roles: regulator, customer, target for lobbying	Important. Roles: regulator, target for lobbying	Important. Roles: customer of welfare technology products
Public sector, regional and local level	Important at county level. Roles: facilitator. Varying importance at local level, depending on resources available	Somewhat important. Roles: facilitator, target for lobbying and legitimacy building	Not important	Important. Roles: partners, customers, trendsetter (county level)	Important. Roles: customers, partners, competence broker (county level)
Public policy implementation system (funding, advising, training)	Varying evaluation. Roles: funding. Main critics: too bureaucratic routines	Somewhat important. Roles: funding incubators, training	Important. Roles: funding	Important. Roles: funding	Important. Roles: funding, advising

regional level as having been very important. In order to build up a new network, the county authority has played an important role as facilitator. In Blue Maritime, the public sector at a regional level has had a certain importance, both as a facilitator and a target for lobbying. In CleanTech, on the other hand, the public sector at a national level has most significance, as both regulator and customer. CleanTech is, for instance, lobbying the national government for higher environmental standards, as this will increase its market. When it comes to the policy implementation agencies, the evaluation varies among the business leaders within MA. Some are satisfied with funding and advice, while others criticise the public funding agencies for being too bureaucratic. Within Blue Maritime, the public funding agencies have supported business incubators and the training of personnel. In addition, the leaders in CleanTech see the financial support from the public funding agencies as important.

When one looks at the two “smart” networks, the results in Table 8 strengthen the impression given in Table 7. In the Smart Energy and Smart Care networks, the public-private cooperation is far closer than in the maritime networks. At a national level, the public sector is important for these two actor groups both as regulator and customer. It also has a significant role at a regional and local level as partner and customer, as well as being a trendsetter and competence broker. Competence brokering involves bringing in complementary competence to companies within the network and may be understood as a way of building bridges over structural holes (Burt 1992). Lastly, the policy implementation agencies also have significance in the “smart” networks, both in relation to funding in both networks and in advising within the Smart Care network.

## Discussion

The principal role of public sector actors, as identified in the answers in the interviews, is to be a target for lobbying (Table 7). The primary areas for lobbying refer to the public sector’s role as a regulator and a funder. The networks thus become an important arena for building private-public relations. Representatives of the public sector ought therefore to participate in the networks and be both visible and accessible. In addition, the public sector has a role to play as a facilitator in the establishment and running of

networks. This is because it is often too demanding for the industry to do this on their own, as they have to tend to their daily business operation as number one priority in order to stay in business (Rubach 2011; Rubach et al. 2017). One of the reasons for building up network legitimacy is that a good reputation makes lobbying more effective and arena attendance a priority for the members and worthwhile.

The role of the public sector was investigated with regard to possibilities for innovation within the networks. Here, the responses produced both overlapping and supplementary information (Table 8). The chief roles identified for the public sector are regulator, funder and facilitator. The roles customer, trendsetter and partner in relation to the private sector are also identified in some cases, where the subject matter is of particular relevance for the public sector. In addition, competence brokerSMing is an important public role in the “smart” networks.

Building on studies of Etzkowitz and Leydesdorff (2000) and Ranga and Etzkowitz (2013), three possible models have been presented concerning relations between the public sector, industry and academia (Fig. 1). These comprise a statist model, a laissez-faire model and a triple helix model. Most of the identified roles for the public sector coincide with a laissez-faire model of relations between the private and public sector (Etzkowitz 2003, 2008) (Ranga and Etzkowitz 2013).

More thorough investigations of the results, however, in Tables 7 and 8 uncovered some interesting variations. The public sector is far more engaged in the Smart Energy and Smart Care networks than in the maritime networks. The reason for this being most probably the fact that the public sector is an important stakeholder and customer for the “smart” networks. The public sector has, for instance, a special interest in finding cheaper and better solutions within areas such as energy and health care. The public sector is therefore a more important customer in the “smart” networks than in the maritime networks. Through multiple and interwoven roles in the actual value chain, the public sector also becomes more involved in the networks. Also, the “smart” networks are in a blooming business development phase, with not yet well-established value chains. All kinds of public support therefore seem welcome. The Smart Energy and Smart Care networks are therefore closer to the TH model (Etzkowitz 2003, 2008) (Ranga and Etzkowitz 2013) of cooperation than the maritime networks. These actors constitute a dynamically active helix, with aligned goals, overlapping perspectives and coherent movement.

The findings are summarised in Table 9.

There are, however, also differences between the maritime networks, and these should be mentioned. None of the interviewed business leaders in MA referred to the public sector at a national level in their answers. MA members are typically small and independent companies that have little experience with lobbying at a national level.

**Table 9** Results of comparison of network and their subject matter vs. life cycle and relations between private and public sector

	MA	Blue Maritime	CleanTech	Smart Energy	Smart Care
Life cycle	Formative (initial)	Maturity (mature)	Growth (expansion)	Growth (expansion)	Formative (initial)
Relations between private and public sector	Laissez-faire	Laissez-faire	Laissez-faire	Triple helix	Triple helix
Subject matter of network seems important for public sector	No	No	No	Yes	Yes

The county council is, however, very important as a facilitator in getting the new network MA up and running. Blue Maritime have other grounds for considering the national level as unimportant. This mature network has been thriving for many years and has been regarded as world-class in its field. For this reason, Blue Maritime has not needed any help from the national government. On the contrary, the network has been proud to be independent of national support. Now however, with the maritime sector facing a crisis, this may have to change. It could be that the “success trap” (Levinthal and March 1993; March 1991) hit parts of the maritime industry in Norway. Examples like this show the need for a more active public cluster policy towards path renewal and new path creation (Asheim et al. 2015). For the CleanTech network, the public sector at a national level is very important. This is because laws and regulations concerning environmental standards have a direct impact on the demand for the member companies’ products and services. The higher the environmental standards, the greater the demand for environmentally friendly products, and it is largely this that creates the difference between CleanTech and the two other maritime networks. As a consequence of the maritime crisis (post-study), the market is presumed to have changed from offshore activities to ocean space. The strengthening of relationships with the public sector at a national level will therefore in all likelihood also increase in importance for MA and Blue Maritime. This will imply changes from a *laissez-faire* model towards a TH model of cooperation. The result of this study also shows that the public sector’s engagement in business networks varies according to the stage of the networks’ development. In the formative and restructuring phases, the public sector will have a significant role, while the public sector will be more in the background when the networks are growing and doing well.

## Conclusions

In this paper, the overall research question posed has been this: What is the public sector’s role in network development and cooperation when the initiative is based on the triple helix model?

This has been aided by posing two sub-research questions:

1. To what degree do business leaders specifically mention the public sector’s roles when asked about important network functions? Is the model for relations a statist model, a *laissez-faire* model or a triple helix model?
2. How do network participants perceive that the public sector’s role in promoting innovation possibilities within the networks varies during the network life cycle?

The most noticeable factor regarding the roles of the public sector was the availability for lobbying in relation to regulations and funding. The networks are an important arena for building private-public relations.

With regard to the possibilities for innovation within the networks, the identified roles fulfilled by the public sector are as regulator, funder, and facilitator. When the subject matter of the network is of major relevance for the public sector, the roles customer, trendsetter and partner can also be identified.

The networks receiving public financing are expected to be triple helix networks, but there are still strong elements of *laissez-faire*. There is little evidence to suggest that “one size fits all” in this context. An important conclusion from this study is that the

relationship between the private and public sector is not a foregone conclusion, as it does not depend on the networks' stage in the life cycle but rather on the public sector's interest in the subject matter (position in the value chain). The "smart" networks that have not yet matured into being full-cycle value chains are closer to the TH model of cooperation than the maritime networks. Some maritime networks have even been proud to be independent of public support. Now however, with parts of the maritime industry in Norway facing a crisis, maybe an example of a "success trap", this may have to change. They may be in need of a more active public cluster policy towards path renewal and new path creation.

In all the networks, the public sector's role as a regulator and a funder is highlighted. Triple helix cooperation does not emerge out of thin air. The networks thus offer an important arena for the building of private-public relations, and thus, moving all networks closer to the triple helix is ideal. Representatives of the public sector ought, therefore, to participate in the networks, be visible, and lend an ear to the challenges and needs of the participating companies.

There is a lack of available research on the topic addressed in this paper, and it is therefore recommended that further research be conducted. Evaluations of the publicly funded networks ought to include evaluation of the role played by different actors within the public sector the point at which they choose to take that role. In particular, it would be interesting to investigate the public role in facilitating the green shift in maritime sector. In addition, the public role in facilitating the crossover innovations from the maritime industry to new marine and onshore businesses could be investigated.

## Endnotes

<sup>1</sup>Here understood as networks having strong interdependencies (i.e. contractual-based) developed organically across time and space

<sup>2</sup>Here understood as networks having generally weaker interdependencies, being policy-driven, project-based and mainly regional

<sup>3</sup>The term network construction programme is here used as a label for project-based clusters developed and funded through NIC and other public efforts towards facilitating and stimulating network based innovation

<sup>4</sup>These representatives are drawn from significant companies, from the facilitating network organisation, and from other institutional actors such as the Research Council of Norway, the regional county councils and Innovation Norway. The selection of interviewees was made as follows: The various research partners made lists of interesting companies within the networks. This list was then discussed with key players in the corresponding network, and the final list was drawn up with a contact person from each company. To enable analysis of the similarities and peculiarities of the different networks, the team of researchers decided to establish a common semi-structured interview guide for data collection within the different networks.

<sup>5</sup>When a recorder was used, there could be one or two interviewers. When a recorder was not used, there was always at least two interviewers so that one could ask questions and one could take notes.

<sup>6</sup>The researchers communicated with the contact person to make an appointment. In some cases, it proved more convenient to interview someone other than the contact person. A few actors on the lists (approximately 1 in 10) were not interviewed for various

reasons. For example, it could be difficult to get an appointment, and one company did not want to participate. The authors do not believe that this has significantly influenced the results, as valuable information was obtained from these interviews.

<sup>7</sup>See summary in [https://www.regjeringen.no/contentassets/377067362c2d4f5e87cd87063bce7a62/evaluation-of-norwegian-innovation-clusters\\_.pdf](https://www.regjeringen.no/contentassets/377067362c2d4f5e87cd87063bce7a62/evaluation-of-norwegian-innovation-clusters_.pdf)

## Additional file

**Additional file 1:** Translation of the abstract into Arabic. (PDF 72 kb)

## Abbreviations

Arena: Part of NIC-level one; Blue Maritime: GCE Blue Maritime; CleanTech; NCE Maritime CleanTech; GCE: Global Centres of Expertise. Part of NIC-level three; MA: Maritime Association Sogn og Fjordane; NCE: Norwegian Centres of Expertise. Part of NIC-level two; NIC: The Norwegian Innovation Clusters programme; R&D: Research and Development; RECIN: Regional Challenges and possibilities–Innovation and value creation in business networks; SIVA: Public enterprise owned by the Norwegian Ministry of Trade and Fisheries; Smart Care: Norwegian Smart Care Cluster; Smart Energy: NCE Smart Energy Markets; TH: Triple helix; VRI: Instruments of Regional R&D and Innovation

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## Availability of data and materials

Information about the programme can be found on the Research Council of Norway, VRI Home Page. [http://www.forskningsradet.no/prognett-vri/Home\\_page/1224529235237](http://www.forskningsradet.no/prognett-vri/Home_page/1224529235237). Accessed 26 January 2018. The RECIN project summary report is available (in Norwegian) at <https://www.vestforsk.no/en/node/4874>. Accessed 26 January 2018.

## Authors' contributions

All authors participated in the case studies and developed the research framework, wrote parts of the initial manuscript and read and approved the final manuscript.

## Competing interests

The authors declare that they have no competing interests.

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## Author details

<sup>1</sup>Technology & Society, Vestlandsforskning, PO Box 163, N-6851 Sogndal, Norway. <sup>2</sup>Faculty of Social Science, Western Norway University of Applied Sciences, PO Box 133, N-6851 Sogndal, Norway. <sup>3</sup>Østfoldforskning, Stadion 4, N-1671 Kråkerøy, Norway.

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