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The evolution of knowledge-intensive innovation ecosystems: co-evolving entrepreneurial activity and innovation policy in the West Swedish maritime system

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ABSTRACT

This paper contributes insights into the debate concerning the emergence of innovation ecosystems. More specifically, we propose a knowledge-intensive innovation ecosystem. Building on prior research on collective action, innovation governance, and knowledge-intensive entrepreneurship, we elaborate on existing theory by presenting a conceptual framework to articulate why ecosystems require the combination of top-down exploration of policy alternatives by policymakers, together with bottom-up knowledge-intensive entrepreneurial activity in order to progress towards sustainable development. Through our case study of the Maritime Cluster of West Sweden, we propose that sustained incentives for knowledge-intensive innovative entrepreneurship, along with more experimentation and new forms of collaboration by policymakers in the Maritime Cluster, are needed in order for progress towards innovation-led sustainable development to occur.

KEYWORDS

Innovation ecosystems; knowledge-intensive entrepreneurship; innovation governance; collective action; sustainability; illustrative case study

1. Introduction

Stimulating the emergence of a new innovation ecosystem in order to renew a traditional industry requires both a bottom-up approach to entrepreneurship and a top-down approach to public policy. This is something that at first glance appears to be an inherent contradiction. An intriguing question is, why are entrepreneurship and public policy necessary to stimulate a traditional industry to shift towards sustainable development goals? This has been discussed in recent innovation policy literature on public policy for transformative change through system transitions (Schott and Steinmueller 2018). Previous literature has outlined the importance of both entrepreneurship and systemic attributes in innovation ecosystems (Stam 2015; Guerrero et al. 2016; Witte et al. 2018; Foray 2019; Granstrand and Holgersson 2019), but less is known about the focus of this paper, namely how ecosystems emerge, and the extent to which they evolve out of prior structures and organisational forms through the co-evolution of entrepreneurial activities and policy initiatives.

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Much of the literature that deals with the renewal of traditional industries addresses the role of entrepreneurship in this process. Approaches like Smart Specialisation (Foray, David, and Hall 2011) and the notion of 'functions' within an innovation system (Hekkert et al. 2007) focus upon the system level, but also highlight the importance of the entrepreneur for the technological base of this system. However, literature also suggests entrepreneurial activities – as well as entrepreneurs per se as individuals – are a necessary but not sufficient element to stimulate change within the economic system, primarily through testing different business innovations in reaction to market forces (Schumpeter 1934; Dahmén 1989; Hekkert et al. 2007; Stam 2015). We need to develop a better understanding of entrepreneurial activities in relation to the emergence of an innovation ecosystem, particularly those in which new science and technology may lead to tackling societal challenges that have implications outside the given ecosystem.

A recent review broadly defines an innovation ecosystem as the 'evolving set of actors, activities, and artefacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors' (Granstrand and Holgersson 2019, 3). Previous related literature further emphasises value creation (Adner 2006; Jacobides, Cennamo, and Gawer 2018), stimulation of entrepreneurship (Autio et al. 2018), and innovation policy for transformation change (Geels 2004; Mazzucato 2016; Hof et al. 2020) within an ecosystem context. Coordination issues in an ecosystem between public actors and private actors are known in other literature to relate to innovation governance. Borrás and Edler (Borrás and Edler 2014, 14) define innovation governance as: 'The way in which societal and state actors intentionally interact in order to transform [social-technical and innovation systems], by regulating issues of societal concern, defining the processes and direction of how technological artefacts and innovations are produced, and shaping how these are introduced, absorbed, diffused and used within society and economy.' Our article contributes to these wider debates.

The purposes of this article are: (1) To elaborate theory by presenting an initial, and revised conceptual framework. We label the resulting conceptual framework as knowledge-intensive innovation ecosystems, focused upon about the provision of new science and technology to achieve sustainable development goals, seen as a collective action[1] problem for innovation governance, involving both public and private goods; (2) To explore the evolutionary dynamics between bottom-up entrepreneurial activities and top-down policy processes through a case study.

Our contributions reflect our purposes, and are two-fold. Firstly, we further develop our understanding of the public–private interface for sustainability through the notion of innovation governance and policy alternatives (McKelvey and Saemundsson 2018). In this specific situation, we discuss collective action in relation to stimulating new science and technology, which can in turn be used by both public and private actors for sustainable development goals. In doing so, we argue that a particular type of entrepreneurship is necessary, namely knowledge-intensive entrepreneurship (KIE) (Malerba and

[1]Collective action has been defined as 'any action which provides a collective good' (Oliver 1993, 273), where a collective good is similar to a public good in sense of non-excludability and non-rivalry. In a broad sense, social science literature following Olson (1965) and Hardin (1968) found collective action resulting in public goods to reach sustainable goals like welfare and food for a growing population to be problematic, and later research in this view (Ostrom 1990) focused on conditions and incentives for communities to govern a commons.

McKelvey 2019, 2020), for the renewal of a traditional industry towards sustainability goals (Gifford and McKelvey 2019).

Secondly, our case study helps generate theory to improve the conceptualisation of how and why both public actors and private actors are part of an intertwined process of policy learning and entrepreneurial action. The maritime cluster consists of predominantly traditional industrial sectors. However, the goals of both entrepreneurs and public policy is to change the existing ecosystem, in order to improve sustainable development and modernisation. To this end, we analyse these dynamics through the renewal of traditional industry, namely a case study of the smart specialisation-focused[2] Maritime Cluster in West Sweden, and provide testable propositions and policy implications for the ecosystem based on our conclusions.[3]

2. Theoretical considerations and conceptual framework

This section draws upon separate discussions of ecosystems (2.1) and of the interactions between entrepreneurs and public policy in innovation governance (2.2). We do so in order to propose an initial conceptual framework, found in sub-section 2.3.

2.1. Defining entrepreneurship in an ecosystem

The ecosystem has become a popular conceptual tool within policy as well as social science. Some concepts and insights in the ecosystems tradition resonate with previous literature on regional, national and sectoral systems of innovation. That literature established that innovation processes require input by a variety of actors working within particular institutional arrangements, combined with public policy stimuli (Freeman 1987; Nelson 1993; Braczyk, Heidenreich, and Cooke 1995; Edquist and McKelvey 2000; Malerba 2002; Freeman 2008; Weber and Rohracher 2012). Our purpose here, while we acknowledge the vast literature on both innovation systems and ecosystems, is limited to extracting elements related to entrepreneurship, which are relevant for our conceptual framework.

The business strategy literature on ecosystems is more focused upon the large firm, and occasionally considers the entrepreneur in relation to business models across the supply chain (Jacobides, Cennamo, and Gawer 2018). Key tenants of the business strategy ecosystem literature include the distinct role of actors with multilateral relationships, complementarities, and technological interdependencies (Kapoor 2018). This strategic management literature uses the concept of ecosystems in order to understand how the large pivotal firm can control supply chains, with a distinguishing factor being a lack of clear hierarchical structures (Jacobides, Cennamo, and Gawer 2018). Thus, a key insight is the focus on the complementarities amongst firms' business models, along a supply chain in the innovation process (Kapoor 2018; Bogers, Sims, and West 2019; Ganco, Kapoor, and Lee 2019). Much of the empirical foci has been upon activities facilitated by online activities, cloud computing and digitalisation.

[2]Smart specialisation is considered a theoretical concept in Sections 1 and 2 but also used as a policy instrument in our case study in Section 4.

[3]The Maritime Cluster is the name given by the regional government in West Sweden, Region Västra Götaland. We do not appropriate the conceptual meaning of a cluster (cf. Delgado, Porter, and Stern 2010; Porter 2000).

Relatedly, work on entrepreneurial ecosystems within regions by Stam (2015), Spigel (2017), and Stam and Spigel (2017) define key actors, institutions and relational characteristics to explain why certain regions trigger entrepreneurial action through a combination of elements, subsequently leading to increased value creation. Many do take into account the role of the entrepreneur for the generation of new innovations, new markets and new opportunities (Nambisan and Baron 2013; Autio et al. 2014; Guerrero et al. 2016). Autio et al. (2018, 75), expand on how entrepreneurs exploit opportunities arising from affordances of new technologies, and the 'potentiality that needs to be discovered and articulated'. While they are interested in nascent entrepreneurs,[4] their characterisation largely focuses upon specific attributes such as the role played by accelerators, and physical spaces that facilitate experimentation in business models. Recent work on entrepreneurial ecosystems (Stam 2015; Spigel 2017; Stam and Spigel 2017) explores how and under what conditions entrepreneurial action can lead to increased entrepreneurial activity, and thereby increased value creation, primarily related to advanced technologies.

From extant literature, we take our point of departure from the definition of entrepreneurial activity as 'the process by which individuals create opportunities for innovation' (Stam 2015, 1765). In doing so, we follow the theoretical tradition of viewing entrepreneurship as including, but not limited to the individual entrepreneur, and hence view the individual entrepreneur as acting within a series of social, economic and innovation processes (Carlsson et al. 2013). However, in contrast to the majority of studies on science and advanced technologies in ecosystems, our empirical context is a traditional industry experiencing industrial renewal and modernisation, in this case towards more sustainable practice.

2.2. Relating entrepreneurship and public policy in the ecosystem

So, what type of entrepreneurship and public policy do we mean is needed within such an ecosystem? And, how can entrepreneurship be related to policy, given that entrepreneurship cannot strictly be controlled or governed by policy efforts? To reach SDGs, literature on system transition suggests that policy goals can be used to put pressure on established market actors and structures, in order to force change, require new forms of collaboration, and to re-allocate resources to work towards new sustainability solutions (Smith 2017; Schott and Steinmueller 2018). However, this view of policy to some extent assumes that goals are known. Instead, our view of innovation governance assumes that neither the market nor the government alone can stimulate new science and technology, but instead rely upon coordination and collaboration in a knowledge-intensive ecosystem (Gifford and McKelvey 2019).

We aim to further develop a more dynamic and explicitly evolutionary perspective on policy. One starting assumption is that a policymaker (individual or organisation) does not and cannot possess sufficient knowledge of what is actually needed within the market structure and cannot realistically provide all the incentives upfront. There is no

[4]In this paper, we focus on activities of newly started ventures and small firms, i.e. those already in existence. While the paper has implications for new ventures that have yet to be started by nascent entrepreneurs (Davidsson 2006) or serial entrepreneurs with regions and key sectors (Etzkowitz 2012), here we focus on insights gathered from those already running a business in the system we analyse.

centralised decision-maker overseeing public policy (Nelson 1995; Metcalfe 1998) but instead an entrepreneurial agent is needed, visible in previous literature on competence blocks (Dahmén 1989) and innovation systems (Carlsson et al. 2001).

More specifically, we argue here that the ecosystem can best flourish when private entrepreneurial activity, and public policy activities continuously co-evolve. In doing so, we propose that one specific type of entrepreneurship is needed, to combine relevant knowledge into innovations and business competitiveness. Knowledge-intensive entrepreneurship is defined as the process through which 'new learning organizations [i.e. firms] use and transform existing knowledge and generate new knowledge in order to innovate within innovation systems.' (Malerba and McKelvey 2020, 6). They do not propose an ecosystem approach, but do draw upon innovation systems literature.

Thus, in relation to market forces, we assume that entrepreneurs act in response to market signals, and test different inventions as innovations on the market. The reason is that one key component of theoretical work on knowledge-intensive entrepreneurship is of the creation and later exploitation of innovative opportunities (Holmén et al. 2007), which are a combination of market, technological, and productive opportunities. This combination may occur in a KIE firm through the firm drawing on different experiences and skills of its founders and employees (Gifford et al. 2020). Thus, for our conceptual framework, one key component is the creation and exploitation of innovative opportunities based upon science and technology to solve societal problems.

For renewing traditional industries, literature also suggests both entrepreneurship and public policy are relevant, as well as the relatedness of industries and technologies over time (Neffke, Henning, and Boschma 2011; Delgado, Porter, and Stern 2014; McCann and Ortega-Argilés 2015). Smart specialisation is a theoretical concept that has recently found acceptance as a brand of mission-oriented policy, the so-called smart specialisation strategies (S3). Mission-oriented policies per se have seen prior use as tools by national and regional governments (see Bonvillian (2018) for an excellent example from the US defence programme DARPA and its 'clones' of the post-war period). Smart specialisation falls into a new category of mission-oriented policies (Kattel and Mazzucato 2018) that, rather than prioritising a sector for investment and innovation through policy means, focuses on activities that are intended to transform the sector into something new and competitive (Foray 2019). The underlying idea is that nations, and regions, need to identify and augment their already existing industrial assets (Foray, David, and Hall 2011; Foray 2019). The goal is to discover ways to utilise assets to recapture or recreate competitive advantage in more traditional industries, by adding in new relevant technological advancements in both related and un-related industries (Foray 2019). A key component is an entrepreneurial discovery (Foray, David, and Hall 2011). More specifically, smart specialisation argues that entrepreneurs may act as arbitragers of incomplete knowledge in a system, and may through their own motivations and intentionality, accelerate the development and diffusion of innovations and break down barriers (Kirzner 1997; Foray 2019). Literature analysing smart specialisation as a policy tool (Uyarra 2019) argues that the policy tends to in practice be more oriented towards designing strategies which focus on building and strengthening relationships between actors at the regional level, and less oriented towards actual implementation, due to lack of coordination and follow-through. Related literature points to the evidence that within a multilevel governance structure, there can be different responses dependent on where a

policy originates, either at the national or subnational level, or even at the federal or union level (i.e. the EU), and that this may affect its lower level implementation (Lanahan and Feldman 2015). This may be especially problematic for incentivising bottom-up activity and collective action if the subnational level is, in turn, lacking the incentives or ability to carefully adapt national or union level policies (such as S3). Indeed, there have been calls for an expansion of our knowledge about policy learning and how it occurs in practice (Flanagan, Uyarra, and Laranja 2011).

From this, we need more understanding of how policy learning is necessary to identify and solve societal problems, by stimulating others to act. McKelvey and Saemundsson (2018) characterise innovation governance as a policy learning process, where evolutionary elements of learning influence the trajectories and efficacy of policymaking, from both a top-down (policy) and bottom-up (society) perspective. They offer a conceptualisation of the policy alternative, defined, i.e., 'a set of ideas and beliefs about action, which includes the performance of a series of interdependent tasks by a number of actors, expected to be useful for solving policy problems.' Their conceptualisation of policy includes 'a certain class of procedures, interactions, and resources intended to solve a particular policy problem, whose performance is based on the specific procedures, interactions, and resources being instantiated at a certain point in space and time to solve a particular policy problem.' (McKelvey and Saemundsson 2018, 855). McKelvey and Saemundsson (2018) also conceptualise the subsequent evolution of policy fields through experimentation and selection: More specifically, this evolution 'is manifested by emergence of new policy alternatives for solving an existing policy problem or a new sub-problem and by the relative frequencies of policy alternatives across policy organisations (ibid. 2018, 857).' We adapt these definitions of policy alternatives and fields, defined in relation to the type of problem to be solved.

Hence, for this article, our starting notion is an evolutionary one, without a centralised decision-maker able to optimise policy. Our view is that entrepreneurial activity and policy alternatives in an ecosystem must evolve continuously to meet new needs, here specifically in relation to developing science, technology and innovation for sustainability in a traditional industry.

2.3. Collective action and innovation governance – initial conceptual framework

Based upon literature reviewed above, we here enrich and modify an existing conceptual framework of how the collective action problem for innovation governance associates with sustainability, in order to delineate a knowledge-intensive innovation ecosystem. This is in turn used to frame data collection and data analysis in our case study.

Firstly, we argue that the collective action problem for innovation governance must be conceptualised as the need to develop new science, technology and innovation (McKelvey, Saemundsson, and Zaring 2018; McKelvey, Zaring, and Szucs 2019) for sustainable development (Gifford and McKelvey 2019). This use of the collective action concept is in line with recent literature on knowledge commons (Hess and Ostrom 2007); innovation commons during idea development (Potts 2019); and open source community interaction with market actors (Dahlander and Wallin 2006). From the ecosystems and innovation governance perspective, we have identified that a wide variety of heterogeneous actors are involved, and thus not dedicated communities to achieve specific

goals such as water rights. Our interpretation is that sustainable development goals (as those developed by the UN) are generally seen as collective (or public) goods, which rely upon collective action across many different actors. Because these are public goods, the market per se will not supply a solution, unless augmented by innovative opportunities for KIE entrepreneurs and stimulated by public policy.

Secondly, in order to understand the emergence of a knowledge-intensive innovation ecosystem, we initiated our understanding of the processes between public policy and entrepreneurial action from the proposed conceptual framework by McKelvey, Zaring, and Szucs (2019). McKelvey, Zaring, and Szucs (2019) propose to expand our understanding of innovation governance into a dynamic perspective through their discussion of evolutionary governance routines for science, technology and innovation, and how these routines influence entrepreneurship. '[E]volutionary governance routines involve routines that (1) stimulate the creation and diffusion of scientific and technological knowledge while (2) allowing entrepreneurial action to privatise returns by transforming collective knowledge into private knowledge and while also (3) preserving the incentives for heterogeneous actors to continue to participate in the development and application of further advances of scientific and technological knowledge (McKelvey, Zaring, and Szucs 2019, 10).' Gifford and McKelvey (2019) proposed a specific aspect of this type of governance for sustainable development goals.

Taken these points into consideration, our initial conceptual framework as visualised in Figure 1.

The conceptual framework found in Figure 1 characterises the process of collective action for the innovation governance system related to developing science and technology. The figure also visualises how these activities span both public and private sector activities, specifically in the context of sustainable development.

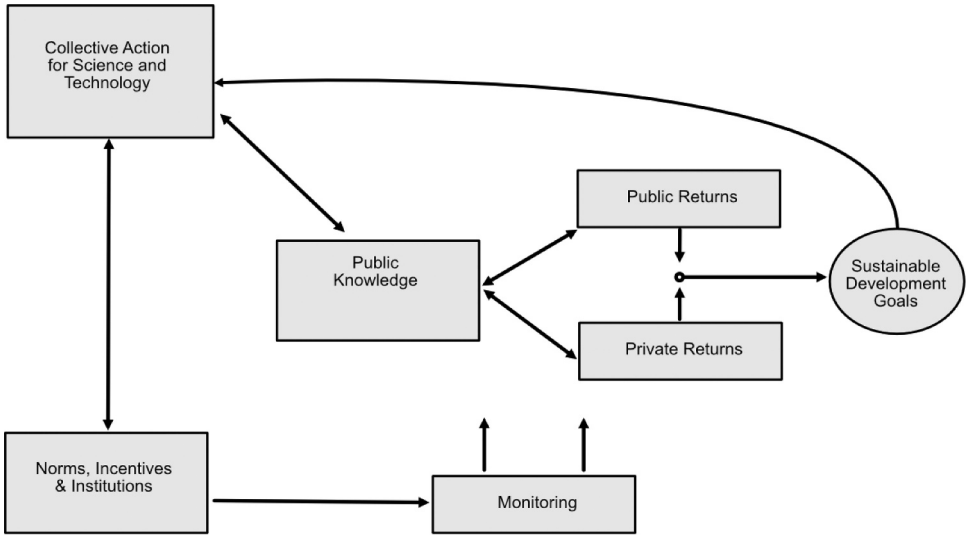

Figure 1. Evolutionary policy making in the context of innovation ecosystems. Framework adapted from McKelvey, Zaring, and Szucs (2019), and Gifford and McKelvey (2019)

On the left hand side, collective action influences, but also requires, sets of norms, incentives and institutions, which enable heterogeneous actors to have a common goal of developing new public knowledge. Examples of new public knowledge can be a published research result, or a new technology, which later diffuses across an industry to improve products. Inherent to their nature, the processes underlying science, technology and innovation may also lead to new public returns and private returns. A public return could be reducing environmental degradation, and a private return is generally seen as monetary returns from commercialisation. Moreover, Figure 1 indicates that the process of interaction is not static, but has continuing changes over time. Based on this, we would expect that the presence of different types of incentives provided by sustainability-oriented policy initiatives will affect the process of collective action as well as affect later norms, incentives and incentives.

3. Research design and methodology

3.1. Contribution and motivation

Following Eisenhardt (1989), and Goffin et al. (2019), we have chosen a theoretically relevant topic to explore and elaborate upon through our qualitative research. In our selection of the case, we have chosen a system that is directed towards new science, technology and business innovation for sustainability and the transformation of a traditional industrial landscape.

The reason for selecting a case study methodology is as follows: We view this research as theory-elaboration (Ketokivi and Choi 2014) in that we are attempting to conceptualise a novel type of ecosystem, and the case is an attempt to inform and shape our conceptualisation of the knowledge-intensive innovation ecosystem. Theory elaboration, as opposed to a theory generation or theory testing approach, strives to elaborate on the underlying logic of a general or generalised theory. This may be done through an in-depth investigation of how a set of concepts relate to one another, or through examining the boundary conditions of a theory. While the empirical context greatly influences theory generation, and generalised theory greatly influences theory testing, both play a large role in influencing the direction of theory elaboration (ibid.). We argue that this is a suitable strategy since the aim of this research is to explore emergent economic processes about which much is in flux, or has yet to be discovered.

3.2. Data collection and method of analysis

The case study is longitudinal, and was conducted through analysis of archival data spanning roughly 2004–2019. Collected during late 2018 and the entirety of 2019, our source material stemmed from the over 1900 pages across roughly three dozen public documents from. (1) Swedish national and regional policy documents concerning maritime industries and systems; (2) External reviews of the efficacy of these policies and (3) Publications by regional maritime interest groups and non-profit organisations. Though some material is available in English, it was primarily in Swedish. All three authors are fluent speakers of Swedish so translations were handled by the authors.

Table 1a. Stage 1 – informal meetings, etc.

Source	Date	Duration
Discussion/interview with Sweden-based Professor in Environmental Law	2019-08-23	90 minutes
Lecture by a lead strategist of regional development, VGR	2019–10–22	90 minutes
Maritime Cluster – Marine Biotechnology Conference 2019 – 'Marine products for health'. Gothenburg, Sweden.	2019–09-19	420 minutes

The first stage of data collection was composed of gathering basic information about the system and a number of policy documents outlining the main strategies of the region in building and maintaining the system. In addition, we conducted informal meetings with the head of relevant centres with the higher education system, attended lectures by involved policymakers, as well as took part in regional conferences and events focusing on the maritime system, in order to increase our empirical understanding of the phenomenon (see Table 1a). The second stage (Table 1b) was composed of reviewing the archival material systematically, in order to cover influence of policy initiatives at the supra-national level on local and regional Sweden innovation policy. Lastly, both the internal and external evaluations of these policies were collected online and critically reviewed, in relation to the concepts of policy learning and entrepreneurial action (Table 1c). We have analysed promotional documents as well as policy documents and public decisions by VGR and other Swedish authorities, public interviews with prominent entrepreneurs and business owners within the ecosystem, and project reports by various arms of the S3 project initiative in different areas of the region.

The following limitations apply. This article is limited to analysis of secondary data, with the goal of theory elaboration. Our analysis of public policy has been explicitly based upon a vast amount of publicly available documentation, but this also means we are limited to the views expressed in this material. We do not analyse performance, and acknowledge that the efficacy of mission-oriented policy may vary considerably depending on the context, e.g. the country, region, industry.

Table 1b. Stage 2: analysed documents following systematic archival review.

Source	Year	Total # of pages
EU – Strategy to protect and conserve	2002	64
EU – Parliament decision, community action program	2002	15
EC – EU Marine Strategy – The story behind the strategy	2006	32
EC – Green Paper and Green Paper Summary	2006	54
EC – Marine knowledge 2020	2013	40
OECD – Reviews of innovation policy: Sweden	2012	286
Vinnova – The Swedish Maritime Sector	2013	74
Vinnova – Swedish maritime research and innovation agenda	2013	15
Vinnova – OECD's Review of Sweden's innnovation policy: A summary	2013	32
Statsitics Sweden – Development of statistics around the maritime cluster	2016	35
Tillväxtanalys (the Swedish agency for growth policy analysis) – Sweden's Maritime sector	2010	132
Havs- och vatten myndigheten (the Swedish agency for marine and water management) – Marine tourism and recreation in Sweden	2012	111
ÖGP (Delegation for the organisation of marine resources) – Swedish maritime activity	1989	150
VGR – Maritme strategy for Västra Götaland	2008, 2012, 2015	32, 48, 9,
VGR – Västra Götaland 2020 – Strategy for growth and development 2014–2020	2013	37
VGR – Region report 2018 – Sustainable development in Västra Götaland	2018	36

Table 1c. Stage 3: analysed internal and external evaluation reviews.

Source	Year	Total # of pages
SDSN – Ocean solutions report	2017	64
Kontigo (VGR) – Launching a cluster initiative: An evaluation of the Maritime Cluster in Västra Götaland	2016	82
VGR – Working program for sustainable maritime business	2016	18
Maritime Cluster – Prospects for a growing biomarine industry in Sweden	2019	20
Maritime Cluster – Account of activities 2018	2018	28
Offshore Väst – Wind energy at sea	2019	15
Stenseke and Hansen – From rhetoric to knowledge-based actions- challenges for outdoor recreation management in Sweden	2014	9

4. Entrepreneurial activity and innovation policy in the West Swedish maritime system

Maritime activities in Sweden as a whole, as well as specifically in West Sweden, play a substantial role in the Swedish economy (Hanning 2011; Statistiska Centralbyrå [Statistics Sweden] 2017). In 2014, Sweden employed at the national level about 33 thousand people within maritime activities (Statistiska Centralbyrå [Statistics Sweden] 2017) up from 30 thousand in 2006. Roughly 45% of those employed in 2014 may be attributable to the county of Västra Götaland (Hanning 2011), which is the second largest county in Sweden with roughly 1.6 million inhabitants and 49 municipalities. In most groups of the national maritime system, Västra Götaland is the leading region in terms of R&D intensity (ibid.). In 2014, the number of firms involved in maritime activities in Sweden as a whole to be just over 7000 (Statistiska Centralbyrå [Statistics Sweden] 2017) producing a net turnover of 80 billion SEK with a positive trade balance (export – import) of about 628 million SEK (ibid.). In this paper, we focus expressly on the situation in Västra Götaland. Since around 2012–2013, the main actor in this area from a policy perspective has been the West Swedish Maritime Cluster (*Maritima klustret* in Swedish). The Cluster manages and facilitates several different groups of maritime activities spanning both the public and private sector; operations and logistics; biotechnology; energy; food and aquaculture; and, tourism and recreation.

We will begin our account by discussing the situation of the present day for the entrepreneurs taking part in the system. Based on our discussion of the concepts of innovative opportunities consisting of market, technology and productive opportunities and as relevant for knowledge-intensive entrepreneurship in Section 2.3, we identify KIE entrepreneurs in the maritime system. We analyse these entrepreneurs in relation to their statements about their innovative opportunities, which we have categorised into market-based, technology-based and productive-based. This is done based on gathered data about KIE entrepreneurs within only one subgroup of the system (Marine Foods), but there are indications that other groups experience similar challenges, which we reflect upon at the end of the next section.

5. The present-day entrepreneur's perspective: bottom-up activities

Despite the policy actions of the Maritime Cluster as an official organising body in West Sweden since 2013, difficulties persist from the perspective of entrepreneurs within the maritime system today. Many of these have been identified by the entrepreneurs and

innovators working within the system. Recently, entrepreneurs, business owners, and related experts in the marine foods and aquaculture group voiced their perspectives on what needs to happen in the cluster in order for it to overcome its current challenges (Maritime Cluster 2019).

The main issues outlined in the report focusing on Marine Foods – *Prospects for a growing biomarine industry in Sweden* (Maritime Cluster 2019) – are that this group has huge commercial potential but faces some serious challenges; the need for stronger political commitment, increased investment, and adaptation of the legal framework surrounding the group in terms of laws and regulations. The entrepreneurs in this study argued for numerous difficulties with running their business effectively, which we will expand upon below and illustrative quotes found in Table 2.

If we further analyse, specific to the marine foods group, mussel farming is seen as being the only economic activity that is viewed as important by policymakers (ibid.). The entrepreneurs point out in various ways that the innovations being produced in the group are rapidly changing the nature of the activities within it, but that the regulations and investment have been slow to follow. One instance of this has been the development of new cultivation methods based on Biofloc technology and Recycled Aquaculture Systems (RAS), which have led to a more circular aquaculture production system that minimise the amount of nutrient leakage (ibid.). The entrepreneurs within this group have also expressed a lack of funds available for what they deem necessary to develop the cluster further. Growth funds and grants (national and regional), EU-funds, and increased access to private venture capital have been identified as being even more crucial than getting even more support through the current cluster activities facilitated largely through VGR. The entrepreneurs have called for a reduction in bureaucracy, and a modernisation of legislation and regulations surrounding their activities. They also suggest new incentives to stimulate companies to reduce their emission output by providing compensation for 'blue catch crops', in order to both attract investors, and to stimulate a positive growth environment in the future.

Other groups in the cluster experience similar challenges. In the marine energy group, commercialising new technology has proved difficult, particularly when transitioning from the research and development phase, to prototyping, to demonstration and pre-commercial applications (SDSN Northern Europe 2017). This is viewed as a difficulty in technological acceptance and understanding by the rest of the ecosystem, which results in reluctance on the part of key investors. Regulations and financial shortcomings in terms of licencing, planning, and monitoring where also identified as being out of date and in need of modernisation (SDSN Northern Europe 2017). Many of these challenges can be extended to other groups in the cluster like tourism and recreation (Stenseke and Hansen 2014) and marine energy (SDSN Northern Europe 2017).

5.1. EU policy on maritime activities . . .

Around 2005/2006, it became a major priority within the EU to align and strengthen policy activities with regards to its ocean and sea-connected regions. This came as a result of a fairly disconnected set of marine environment protection measures and policies at the EU level that to a large degree had their roots in the early 1970s (European Commission 2006a). In the early 2000s, most regions of the EU were managing their marine environments separately, and each concentrated mainly on natural resource

Table 2. Challenges with entrepreneurship and innovation as seen by entrepreneurs in the maritime group marine food.

Entrepreneur/Company within marine foods	Challenge or situation identified needing resolution:	Type of opportunity
Matilda Olstorpe, CEO of Vegafish	'[There is a need to] integrate aquaculture into the municipal comprehensive plans'	Market
Anders Granhed, CEO of Scanfjord Mollösund	'The government is subsidising the agricultural sector in many ways but nothing goes to aquaculture. Our industry needs to be legally accepted and equated to agriculture. By introducing economic incentives and compensations for the positive environmental impact from mussel farming, the interest for investments in the farming industry may increase. This could for example be a compensation per tonne of nitrogen removed from the sea by aquaculture. … Sustainable and long-term governance with clear rules and regulations and a reasonable measure of supervision and control would make the industry more predictable and also more attractive for capital investments.'	Market and business
Tore Sveälv, at Business Developer GU Ventures	'To enable the aquaculture business to grow in Sweden, the sector must receive a higher status with public authorities and be considered equal to agriculture and forestry. Furthermore, the entrepreneurs in the aquaculture industry must continue to work on how to develop sustainable and profitable business models.'	Market and business
Elisabet Brock, President of Koster Algae	'The government needs to take a more unified and offensive approach … [by] modernization of laws and regulations, simplification of the licensing processes and increased national co-financing.'	Market and business
Bengt Gunnarsson – Cofounder of Smögenlax Aquaculture	'[W]e are definitely in the front of developing the [Recycling Aquaculture Systems] RAS technology [and] have the potential to be self-sufficient in salmon within 10 years … We need to construct a full-scale plant on the west coast where we can bring the researchers into the development work. Then we can showcase the importance of research for start-up companies and increased profitability for the industry. Sweden needs more entrepreneurs and more educated staff who have the skills to run production facilities.'	Market, business, and technology
Sofia Kocher, CEO of Musselfeed	'A joint test facility in Sweden [for aquaculture], where knowledge is built through operational testing, would be valuable and contribute to stimulating the industry's development.'	Business and technology

Source of interviews and quotes: Maritime Cluster (2019)

economics-related issues and conservation (fisheries, pollution, etc.). Though different conventions for sea and ocean protection of different bodies of water acted as regional 'protectors', all of these conventions on average lacked ability to enforce or control their particular policy area (ibid. 2006a).[5] As challenges to the sustainability of the marine environment became more severe, involving climate change, overfishing, and pollution, a more coordinated effort from the EU was called for. Signs of this become stronger in the mid-2000s, catalysed through the 6th Environmental Action Programme, which identified areas of policy attention that should, but did not at the time, incorporate a holistic strategy for maritime activities (European Commission 2002). Around 2005, the

[5]This phenomenon points to another type of tragedy of the commons regarding natural resource management and international and intergovernmental responsibility which often calls for specific types of collective action which we do not address in this paper. Our discussion of collective action is focused on the emergence of new science and technology in an ecosystem.

European Commission recommending and designing Blue Growth strategies to bolster the lagging competitiveness of the region's maritime system. This was signified by the emergence of the 'Green Paper', which outlined a more holistic strategy for the EU moving from 2005 to 2009. The document stressed that 'policies on maritime transport, industry, coastal regions, offshore energy, fisheries, the marine environment and other relevant areas [had] been developed separately' (European Commission 2006b, 4). This is argued needed to give way to a new vision of extended integration and interaction between these related but so-far separate areas. The report outlined future areas in need of attention from policy, including: competitiveness of MNEs and SMEs in maritime sectors, sustainable development of maritime industry, deepening and expanding new knowledge and technology for translation into income and employment, needed constellations of stakeholders, and the overall promotion of synergies of related marine sectors, among others. All in all, it constituted the first step towards an 'all embracing EU Maritime Policy' (European Commission 2006b).

5.2. . . . and subsequent Swedish policy adoption: top-down activities

While Sweden had been active in maritime politics for many years, and during recent decades there have been some attempts by policymakers to enact a coherent and inclusive strategy for maritime activities broadly (ÖGP 1989). However, it is clear that in the early years of the 2000s, the country began adapting more policies from larger intergovernmental organisations, particularly the European Union. In the case of Sweden, these EU recommended Blue Growth strategies were translated into national cluster initiatives, which came to resemble more designated strategies incorporating tourism, industry, research, and sustainability (environmental conservation, etc.) together in a single holistic policy alternative that varies from region to region in implementation and effectiveness.

During the 1990s and early 2000s, university-industry-related policy was focused more on directly applicable advancements in science and technology, and how these could be commercialised (Jacob and Orsenigo 2007). This focus upon high-tech industries left many traditional industries, like those linked to maritime activities, out in the cold when it concerned the potential to apply for the same type of programmes offered by Swedish research grant distributing organisations like Vinnova, MISTRA, and Formas. In the early 2000s, implementation of EU-influenced maritime policy coupled with a growing emphasis on promoting and enacting smart specialisation (holistic and more mission-oriented efforts), in the end resulted in a more decisive role for regional governmental organisations (VGR), who took larger responsibility in funding and project activities in this area.

In 2008, Sweden's region Västra Götaland, through the regional government office, Region Västra Götaland (VGR), issued their own maritime strategy. This was inspired by the EU's Green Book report and tried to encompass the same holistic approach to maritime policy set out by that document which were 'in agreement with West Sweden's priorities' (VGR 2008, 12). VGR subsequently outlined their own goals with regionally holistic maritime policy:

- Maximising of sustainable use of ocean and sea.

- Building up of a knowledge and innovation base for maritime policy.
- Delivering the maximum quality of life for the Swedish west coast.
- Contributing towards European (Swedish) leadership in the international maritime sector.
- Improving visibility of Europe's (Swedish) maritime activities and regions.

VGR, in tandem with Chalmers University of Technology and the University of Gothenburg (GU), prepared an assessment of the 2008 implementation of maritime policy in 2011–2012. This report recommended the official formation of a temporary organisational form to manage the 'cluster'. This became the above-mentioned West Swedish Maritime Cluster. This meant that different groups of maritime activities were bound together in a more holistic strategy. The aim was to build up collaboration and cooperation between the different knowledge producers (in the groups) spanning both public and private sector, with the end goal of innovation for future sustainable growth (VGR 2012). This constituted a critical policy-level integration of less related fields, based on their competitive dependence upon, and proximity to, the ocean and the surrounding marine environment. The Chalmers/GU report resonated with discussions of creating long-term interaction between different knowledge producers, who were argued to be crucial to the knowledge-driven development that the cluster could potentially achieve.

These viewpoints voiced by Chalmers/GU about the maritime political agenda were integrated into VGR's longer-term strategy Västra Götaland 2020, an extension of the above-mentioned Good Life strategy. Moreover, the 2012 report outlined the following priorities for the regional effort: (i). the need for an administrative body overarching authority; (ii). Divided leadership between public and private sector knowledge producers; (iii). Strategic goal alignment between both academia, the private sector, and other beneficiaries of the cluster; iv. Building an innovation group to link new suggestions and ideas to the innovation system; v. benchmarking and business environment strategic awareness. All of this led to an expansion of activities during the years ahead, including involving more private and public sector stakeholders in the new 'cluster' (VGR 2015).

Relatedly, in 2011 the EU began to implement smart specialisation programs in their member states, and by 2014 its core principles had been integrated into EU Cohesion Policy and into other different related growth strategies (RIS3, for instance). In West Sweden, the maritime system was identified as a key area for implementation of this principle, and many of the concepts that this program relies on, industrial renewal, entrepreneurial discovery, and reliance on previous underlying infrastructure and competitive advantage, were already a focus of VGRs development strategy in the period of 2010–2015 (VGR 2020).

In 2016, VGR employed the consultancy company Kontigo to perform an evaluation of the effectiveness of the Maritime Cluster effort thus far (about 4 years after the GU/Chalmers report referenced above) (VGR 2017). One of the clear questions this evaluation raised was how different tasks could be prioritised in order to develop the cluster based on actual policy documents focusing on the cluster, as well as national-level policy initiatives (VGR 2017). The report also discussed the need to work more closely with industry actors involved in or near the cluster in order to identify new challenges and new projects, and the need for further cross-group and cross-disciplinary collaboration in

order to find synergies that can ensure that the cluster is more than the sum of its parts (ibid.). Overall, key dimensions of Kontigo's recommendations included areas like:

- Improving regional marketing. The evaluation showed that many companies were not even aware of the cluster's activities or that they were even 'members'.
- Implementing a more effective and transparent division of rolls within the cluster.
- Formulating assessable goals for the cluster (See Table 2 below)
- Prioritising communication.
- Conducting a deeper analysis of the socio-economic value created by the cluster.
- Working towards giving coordinating and financing actors a clearer mandate to work with business environment analysis and benchmarking.

In the years since, VGR and the Maritime Cluster have strived to fulfil these recommendations. Table 3 below is taken from a recent publication by the Maritime Cluster in Västra Götaland (Maritime Cluster 2018), meant to give an overview of the extent of its activities in the few years since the cluster was formalised. Many of the reported actions are in alignment with the proposed areas for improvement of the Kontigo report (e.g. VGR 2017).

Table 3 shows how much of each activity has been performed within the entire cluster, with the rightmost column depicting how much a single group within the cluster accounts for. The minimum is always 0, which means that no activity was performed across every group. This table reveals that while numerous indicators are being used and summarised across all groups, a single group may account at times for all measured outcomes. While some activities may have very specific connections to certain groups,

Table 3. Metrics: maritime cluster in Sweden in 2018.

Indicators	Total within cluster	Within group minimum-maximum
Individuals in entrepreneurship development efforts (themed days, workshops)	1096	0–383
Firms receiving advice or consultation	130	0–96
Firms performing product development	56	0–25
Amount SEK in R&D activities	3 million	0–3 million
Number of completed seminars and workshops per group	28	0–12
Number of government agencies, municipalities or other organisations that have been involved in cluster activities	104	0–43
Number of co-arranged events between groups	6	0–2
Number of co-arranged events with other non-cluster organisations nationally	13	0–5
Number of co-arranged events with other non-cluster organisastions internationally	8	0–4
Firms that have participated in cluster activities	410	0–164
Firms that have been contacted for evaluation following a cluster event	20	0–10
Firms that have had products in the pipeline in the innovation system broadly	31	0–30
Number of collaborative projects with firms, academi, and the public sector where ideas or needs are stemming from the cluster with a budget less than 1 million SEK	5	0–2
Number of collaborative projects with firms, academi, and the public sector where ideas or needs are stemming from the cluster with a budget more than 1 million SEK	7	0–3
Number of research applications in which ideas or needs come from the cluster	10	0–4
Number of educational programs and/or courses that have been initiated due to cluster needs	3	0-2

Source: Maritime Cluster (2018).

overall this may have direct implications for the balance of support activities being received by the cluster at large.

6. Proposed conceptual framework of a knowledge-intensive innovation ecosystem

In the above case study, we explore the dynamics between the role of public policy in providing collective goods relevant for science, technology and innovation, with the role of entrepreneurial activity in generating private goods through the commercialisation of science and technology. The case study is of the renewal of a traditional industry, namely the Maritime Cluster in West Sweden. We have not investigated the extent of actual policy learning, success nor the overarching vision and implementation of smart specialisation strategies, which is a general problem, as discussed extensively in Uyarra (2019).[6] Instead, we have documented how the collective action for science, technology and innovation occurs through the efforts of a variety of different actors, including entrepreneurs, policymakers, universities and researchers, and other members of the maritime system.

Concerning entrepreneurial action, we find that entrepreneurs in this system face many choices in deciding which products and processes to develop for a more sustainable future. Their choices for commercialising science and technology include building and/or creating markets for innovations, as well as challenges in terms of different conflicting needs, wants, and willingness of different actors and participate in the collaborative action problems needed to achieve sustainability goals. We first identified how the KIE entrepreneurs also faced certain sets of systemic challenges, specifically a lack of political commitment, a lack of direct investment, technology acceptance issues within their market, and the non-adaptive nature of the laws and regulations surrounding their activities.

For the policy initiatives, we examined the events that led to the formation of West Sweden's Maritime Cluster. We concentrated on how this policy organisation has approached problem-solving since its inception, ultimately resulting in the Maritime Cluster in West Sweden. Through this a historical perspective we have shown how the EU agenda for growth in blue sectors seems to have prompted an industrial renewal of the maritime system in West Sweden. At the start of the 21st century, Sweden focused largely on natural resource management and environmental degradation areas, in which more regulatory policy was in effect to manage these resources.[7] However, the EU's focus areas began shifting towards revitalising traditional industries through smart specialisation, along with a strategic focus on ocean and marine resource management, both of which were critically important to the economy of West Sweden. Our interpretation is that a shift in Swedish maritime policy followed. We argue that this also led to the intertwining of S3 policy with Blue Growth policy in West Sweden to the point where the two often became indistinguishable, due to the overlap

[6]We do note that the case study seems to suggest a multi-level policy situation that appears in the literature wherein union level policy is implemented at the subnational level (Lanahan and Feldman 2015).

[7]Predating 2005/6, the last attempt at a holistic maritime policy seems to have been in the 1980s (Swedish Government 1983; ÖGP 1989), but it is unclear at this point to what extent its implementation occurred or had any long-lasting effect on regional policy

of objectives, and the fact that the same organisation, VGR, was often responsible for both types of initiatives. The current status of the Maritime Cluster, and its resultant strategic direction and method of solving challenges, is the result of these factors.

Hence, our interpretation of the case study of the West Sweden maritime system is that public policy-makers did use set policy alternatives at the regional level, which primarily evolved from the more holistic and extensive policy efforts at the EU level (Blue growth strategy and Smart Specialisation Strategy). This we see as a process of exaptation (Gould and Vrba 1982; McKelvey and Saemundsson 2018), i.e. when problems from a broader policy field generate new policy alternatives that are then selected for use in solving more narrow or specific problems at the regional level. By this, we mean that policy makers used a combination of policy alternatives from Smart Specialisation Strategy as well as Blue Growth strategy. They developed new varieties of these policy alternatives from the more holistic EU strategies, and combining this with local policy initiatives (VGR 2020, etc.). Through this, they try to ensure that there exists some means for collective action to occur: by stimulating collaboration, meeting places, grant funding, university-industry networking and partnerships, and organising activities in order to further integrate the actors involved. However, as Table 3 showed, the distribution of these efforts may be in some cases quite uneven, with some groups within the cluster receiving the most or even all attention in terms of key indicators.

Hence, we have shown a selection process of relevant policy alternatives designed to stimulate this ecosystem. We propose this has to be understood in combination with bottom-up entrepreneurial activities, in a co-evolutionary manner, fraught with uncertainties of innovation processes. This means that policy-makers must act in a coordinating, incentive-generating role, while entrepreneurial action generates innovations through a process of regional collaboration. The actions of each of these types of actors are dependent on the other. One example where collaborations between scientists and business-minded entrepreneurs have led to innovations in the marine foods group is referenced in more detail above (OffshoreVäst 2019).

Our interpretation of the role of these knowledge-intensive entrepreneurial firms is largely one of pushing development into new adjacent areas through new applications of novel scientific and technological advancements, which ideally go on to become market verified innovations. However, we would also like to stress that our case study also shows the market for these technologies often remains uncertain well after the innovations have been developed, and also that existing funding and investment practices, along with rules and regulations surrounding given industries, can be slow to change along with the evolution of new technologies driven by entrepreneurial initiatives, even with the help of policy.

Another interpretation from the case study is that the KIE entrepreneurs are beginning to ask for more sophisticated public policy initiatives moving forward, which can be seen as an ecosystem perspective. In their opinion, the next step for public policy – after what they already do in facilitating connections, creating meeting places, and maximising input potential to the cluster in terms of active members and awareness – should be to work in a more strategic way together with entrepreneurs and other larger organisations. Here, these collaborations to solve collective action problems would include assisting in creating markets for new technologies, as well as better and updated evolving regulations to complement evolving technologies. Such collaborations have the potential to reinforce

the bottom up perspective of innovation governance, which comes from the regional/local level and the role of entrepreneurial action in generating innovations. Successful implementation of this could lead to better opportunity exploitation in terms of markets, business practice, and new technologies (see Table 2).

Based upon our analysis of the case study, Figure 2 visualises our modified conceptual framework, which more clearly defines the separate, but overlapping areas for bottom-up entrepreneurial action and top-down policy initiatives.

Figure 2 represents our interpretation of the coevolution of these two sets of activities, within an emerging ecosystem. In particular, we indicate that entrepreneurial activity takes place across the collective action, draws on public knowledge, and affects or is incentivised by the existence of potential private returns. Policy activity happens throughout the lower-left dimension of the figure, by providing and enforcing the norms, institutions and incentives required for the system to operate, as well as conducting different types of monitoring activities. What we propose is that the effective governance of the knowledge-intensive innovation ecosystem occurs when there is an interface between top-down and bottom-up activities spanning the available public knowledge, the collective action for science and technology that links to this knowledge, and the norms, institutions, and especially incentives that drive this action. This is a space, we argue, where top-down policy activity must assist with both the regulation- and stimulation-based needs of bottom-up entrepreneurial activity in order to solve specific challenges on both the micro- and macro- levels. Doing so can increase the likelihood of ensuring both public returns to society, and private returns to the

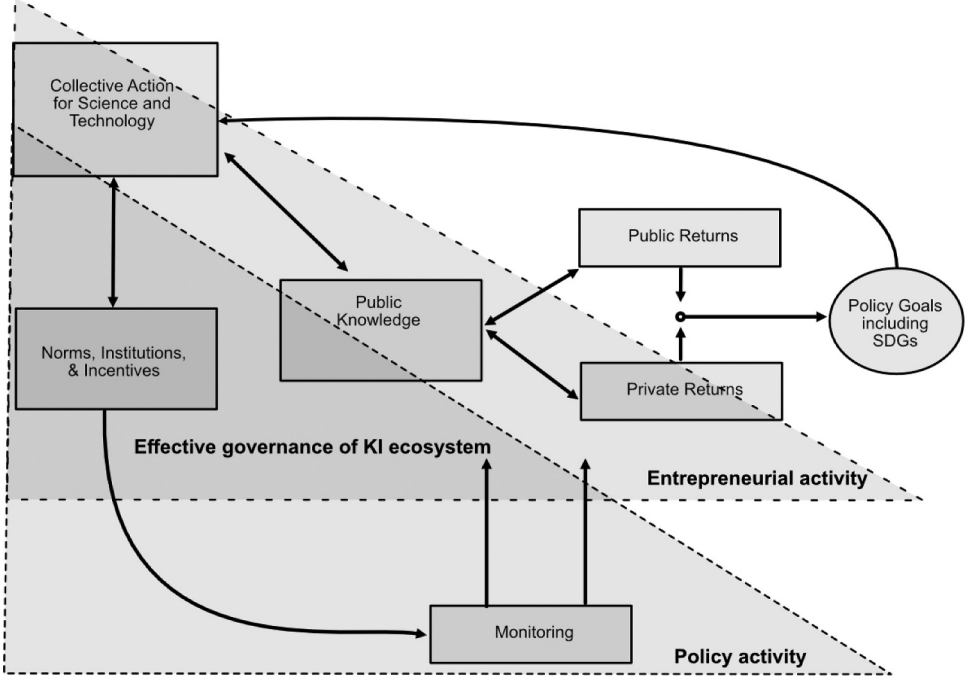

Figure 2. Effective governance in the context of knowledge-intensive innovation ecosystems.

entrepreneurs, which leads in turn to increased likelihood of SDG fulfilment as argued above.

7. Conclusions

Our conclusions are related to the above revised conceptual framework based on theory elaboration through analysis of our case study. These conclusions are informed by the conceptual model of McKelvey and Saemundsson (2018), which outlined that new policy alternatives are a result of experimentation, which may be used to aid the selection process of possible alternatives. Each conclusion is followed by propositions. As Figure 2 has shown, many different propositions might be derivable from this exercise in theory elaboration. We have chosen to focus on a few which relate to specific observed phenomena.

Firstly: Sustained incentives for existing start-ups and new entrants to the Cluster need to be present to create bottom-up progress. By progress we mean the continuous generation of useful product and service innovations that push the ecosystem forward, both in terms of SDGs, as well as economically and commercially. This is especially critical in smart specialisation areas or traditional industry-focused ecosystems undergoing change, where commercialising innovation is continuously uncertain, because markets may not yet exist. Hence, innovative opportunities for business remain important also in areas of collective action problems such as sustainability. This to some extent can reflect the market failure, or 'transition failure' (Weber and Rohracher 2012) related tension of innovating for socially desirable outcomes that are also perceived as 'grand challenges' such as sustainable development (Schott and Steinmueller 2018).

Interactions between public and private actors in a knowledge-intensive innovation ecosystem create new innovative opportunities along with new markets. Thus, to move towards the future, existing actors need to be incentivised to change their business to accommodate sustainable development. Without incentives and opportunities for profit, entrepreneurial activity around new technology in traditional industrial systems like that of the maritime system is unlikely to take form and generate new innovative firms, or be realised by existing firms.

Proposition 1: Within a knowledge intensive innovation ecosystem, there is a positive relationship between the strength of entrepreneurial incentives for innovation, and the likelihood of progress towards sustainable development in that ecosystem.

Secondly: To fulfil the promise of sustainable development in the region – which is not only a major policy priority, but a societal one as well – policymakers need to become even more flexible, and work with others outside their often narrow specialisation in order to enable the continued and long-term competitiveness of the system, both regionally and nationally. We argue this can be achieved through further policy experimentation, including dynamic monitoring practices, adaptation to new problems, and working with adjacent policy fields to solve new challenges. Our case shows that a system often needs to, from the policy perspective, become more efficient at evaluating, and pivoting to dedicate resources to problem areas, to supply entrepreneurial agents with the

needed means, which may shift in character over time from – in one instance described above – network building to regulatory support. Thus, we stress the need for adaptability of policymakers, through continuous learning and collaborating outside their direct field, in order to aid knowledge-intensive entrepreneurial firms in more demanding evolving challenges involving the commercialisation of new technology. Such policy learning should also take into account universities, entrepreneurs and other relevant actors within the system both existing today, and those entering the ecosystem in the future (following Carlsson et al. (2013)).

Proposition 2: The entrepreneurial incentives within a knowledge-intensive innovation ecosystem are strengthened by a higher degree of policy experimentation

While our propositions convey unidirectional relationships, we admit that reality is often more complex. There must be reciprocity between both knowledge-intensive entrepreneurial activity and policy activity in terms of how they are carried out, and evolve over time. I.e. the two ideally need to be co-evolving for the ecosystem to function properly and in this case to work towards diverse policy goals including SDGs. A 'knowledge-intensive innovation ecosystem' has the potential to facilitate long-term growth, competitiveness, and potential transition towards sustainable development. In such an ecosystem, policy needs to not only ensure institutions and norms, provide incentives, and monitor that all these processes are in continuous good standing. Policymakers also need to learn and evolve along with the needs of the system in order to ensure that when entrepreneur-innovators are faced with insurmountable challenges, they have some means of navigating solutions to these.

Knowledge-intensive entrepreneurship that is incentivised and legitimised by policy action is crucial for the successful growth (and sustainable transition) of an ecosystem. Though the Maritime Cluster has exhibited some degree of policy learning in their exaptation of holistic strategies to the local level, we think that more evolutionary policy learning, prompted by further experimentation would be beneficial for the Cluster. We argue, as has been argued elsewhere (Gifford and McKelvey 2019), KIE constitutes a key building block in designing successful smart specialisation strategies (Foray 2019). By combining different types of unique knowledge, including not only how a product or service might be developed, but also how it might be successfully brought to the market, knowledge-intensive entrepreneurial firms constitute the main vehicle for bottom-up development in such an ecosystem. Still, if progress towards the desired goals is to be made, policymakers, along with the policy alternatives they employ, must experiment in order to incentivise and facilitate these knowledge-intensive actors and activities.

8. Implications and future research

Our case study directly addresses UN's sustainable development goals in relation to environmental protection of maritime resources (SDG 14: Life below Water) in this particular maritime system, along with those relating to innovation (SDG 8) and economic growth (SDG 12). The more policy makers understand the importance of entrepreneurship as a vehicle for innovation and growth, and that they may require more than consultation, organisation of activities, and creating common meeting places, the better

these ecosystems can work. Some room must be left in the ecosystem for experimentation by both policymakers as well as the entrepreneurs who act on the innovative opportunities they create.

Regarding our first proposition, we suggest that more detailed qualitative and quantitative studies be directed towards the role of incentives for knowledge-intensive entrepreneurial firms to innovate within other types of knowledge-intensive innovation ecosystems, and the potential effect on related sustainable development goals. One key benefit would be to further identify sectoral conditions regarding how successful these firms are at navigating the system with varying levels of support from policy around key areas.

Regarding our second proposition, policymakers involved in the maritime system should seek to expand the set of policy alternatives they work with by experimenting with how they work with actors from other policy fields. This could include working closely with: the judicial branch of government in order to find solutions to the perceived hindrances of current (and arguably outdated) aquaculture regulation; universities, research facilities, multinational corporations, innovation authorities, and tax authorities in order to align the supply and demand aspects of R&D and new product development and subsequent market adoption; and, larger funding bodies of government and other types of funding agencies in order to set up a better infrastructure of support that meets the needs of the entrepreneurs in the system. A more evolutionary governance structure that takes into account the evolving needs of entrepreneurs, and other actors in the ecosystem, is crucial.

Relatedly, we suggest that within the Maritime cluster, further action by policymakers could be taken in terms of incentivising multinational enterprises to contract services and products from new entrants and existing small firms, as well as ensuring that market conditions are adequate for the successfully commercialisation of new (sustainability focused) innovations. Tools like additional R&D and tax credits might be effective, but we encourage further experimentation on behalf of policy as well. If this is not done, then less-expensive, less-clean products and processes may persist, resulting in a reduced degree of progress towards sustainable development goals.

Future research regarding knowledge-intensive innovation ecosystems should explore in more rich qualitative studies the motivations behind the activities of the entrepreneurs inhabiting this type of ecosystem, and the actual skills and capabilities of policymakers in these types of ecosystems, in order to uncover how to better align them. Moreover, deeper understanding of the process of policy learning through variation and selection among different policy alternatives in the evolution of different regional ecosystems would be beneficial as a comparison, particularly in regard to what types of actors need to be involved in the Cluster from the policy side that currently are not, and how.

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