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One coast, two systems: Regional innovation systems and entrepreneurial discovery in Western Norway

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Abstract

This paper introduces an analytical framework for understanding how specialized and diversified regional innovation system (RIS) differ in the way an entrepreneurial discovery process (EDP) is likely to unfold. To analytically explore the proposed framework, we deploy a sequential explanatory design approach, using quantitative data to analyze the regional industry structure of the city regions of Bergen and Stavanger in Western Norway, followed by a qualitative analysis of interviews with key stakeholders in both regions. We find that the city regions face unique challenges that align with an understanding of their respective RIS categorization, providing evidence that the framework proposed serves as a useful guide in understanding the development of an EDP.

1 | INTRODUCTION

According to Foray (2015, pp. 23–24), regional industry development starts with an entrepreneurial discovery. The notion of entrepreneurial discovery can be considered an "essential phase, the decisive link that allows the system to re-orient and renew itself" (Foray, 2014, p. 495). While

regions restructure their economy in different ways, in line with Foray (2015), we regard an entrepreneurial discovery to be *one* first step in the growth or restructuring of a regional economy. However, different preconditions, challenges, and opportunities are present in diverse regions and impact how regions undergo renewal and reorientation processes. Regional industrial restructuring can also be initiated by highly resourceful actors, such as in the case of large industry lead development, state lead development, and development led by external investors. However, this paper aims for a theoretical and empirical contribution of how entrepreneurial discovery process (EDP) will most likely unfold in regions with different regional innovation system (RIS) characteristics.

Recently, there has been an upsurge in policy focusing on Smart Specialization in general and, more pertinent to this paper, the EDP (Lopes et al., 2019). This focus on place-based policies which prioritize a bottom-up approach inclusive of several unique stakeholders can be considered to constitute a renewed focus on the constituent parts of a region's regional economic profile (Mieszkowski & Kardas, 2015; Rodríguez-Pose & Wilkie, 2016; Santini et al., 2016). At the same time, this focus must remain cognizant of multiple stakeholders' diverse interests within a region. This dual-challenge, which many regions face, leads some to question whether there is a need for "differentiated regional entrepreneurial discovery processes" (Isaksen et al., 2018) to be more cognizant of these particularities different regions possess. From this point of departure, this research explores whether one can incorporate an understanding of RIS in how EDP can best be operationalized and contextualized within a given region. To explore whether RIS can be used to inform how EDP will manifest in different regions, we develop an analytical framework which provides an insight into the challenges which different RISs will face through an EDP, and through a sequential explanatory design (SED), bring together quantitative and qualitative insights on two city regions (Bergen and Stavanger) in Western Norway, to explore the proposed analytical framework empirically.

The framework (Table 1) distinguishes between specialized and diversified RISs (Isaksen & Trippl, 2016). In specialized RISs the regions' industry structure is dominated by one or a few industries and the knowledge infrastructure and the policy support system are strongly adapted to the region's specialized industrial base. Diversified RISs, on the other hand, have an industrial structure consisting of many different, and relatively large industries, and these RISs also have several knowledge and supporting organizations that promote innovation activity in a wide range of economic and technological fields.

The analytical framework also considers where RIS actors find their main collaborators and knowledge sources in innovation processes and distinguishes then between regionally networked and regionalized national RISs (Asheim et al., 2019). Important innovation partners for firms in networked RISs are local universities, R&D institutes and technology transfer agencies. In regionalized national RISs, firms cooperate primarily with actors outside the region in innovation processes, and often with science partners.

On this basis, our research question is; *How are regions with specialized and diversified regional innovation systems likely to differ in their engagement with an entrepreneurial discovery process*?

It is through this that we investigate two core assumptions that underpin our research question, namely that;

(i) The development of an EDP is likely to differ between regions, characterized by specialized versus diversified RISs.

TABLE 1 Analytical framework—Expected strategy and regional innovation system (RIS) changes resulting from entrepreneurial discovery processes (EDPs) in two types of RISs

Type of RIS	Type of strategy from EDP	Changes in the knowledge application subsystem of RIS	Changes in the knowledge creation subsystem	Typical barriers for EDP
Specialized	Develop new, related industries/clusters from one/few existing regional industries	Increase collaboration between related firms regarding the use of new technology and business models, and stimulate "related spinoffs"	Establish test facilities, provide new education opportunities, etc. in new technology	Strong networks between a fixed set of local actors, hampering alternative ideas and competence
Diversified	Strengthen knowledge exchange between and diversification into emerging industries from existing regional industries	Increase collaboration between related and unrelated firms and stimulate "related/unrelated" spinoffs	Establish commercialization units and R&D- facilities targeting emerging industries	A fragmented innovation system, hindering knowledge exchange between actors of RISs

(ii) The connectiveness of RIS, regionally networked versus regionalized national, will also influence on the EDP.

(iii) The narratives surrounding entrepreneurial discovery and regional development strategies differ between stakeholders in specialized and diversified RISs.

The paper demonstrates differences between the two city regions under study. We find the Stavanger region to share several similarities with a specialized and regionalized national RIS. In contrast, the Bergen region more closely resembles a diversified and regionally networked RIS. The paper provides further evidence that the analytical framework proposed therein can provide strategies of EDPs that are more cognizant of the differences between RISs present in different regions.

2 | ENTREPRENEURIAL DISCOVERY PROCESS

Entrepreneurial discovery is a key aspect of the Smart Specialization strategy. At its core, entrepreneurial discovery assumes human agency, for example, individuals who initiate and carry out an innovation process. These individuals include entrepreneurs that start new firms and persons that perform innovation activities in existing firms. However, discoveries are also made by other actors such as organizations that provide complementary assets or deliver innovation support (e.g., research institutes and cluster organizations) to many different clients and customers (Garud & Karnøe, 2003). Herein, following Foray (2015, p. 2) EDP's include both those processes which are organized, managed, and institutionalized and those which are more continuous, occur spontaneously and constitute a less formalized EDP. It is here also that we seek to take account of how the formalized structure of the clusters within the Bergen RIS are likely to engage differently in an EDP, than that which we observe in the case of Stavanger where, given the specialized industrial structure, dominant players act outside organized regional policy processes and, in this sense, we rely on both conceptualizations of EDP in our analysis. The case of Stavanger, as discussed further below may also come to rely on the notion of "temporary or pop-up" innovation systems stemming from the work of Frenken (2017) to support the development of unrelated diversification in their EDP given the allure to current stakeholders to instead support further path dependence. This paper relies on both interviews with key stakeholders in the Stavanger and Bergen regions such as with firms, universities, intermediates, financial institutions, alongside conducting a quantitative analysis to provide a clearer picture as to how an EDP process is likely to develop given the latent differences which exists in both city regions.

The discovery itself, for example, an innovation, is the very beginning of the regional development process when seen through the lenses of EDP (Foray, 2015). The next step includes the demonstration by an entrepreneur or a firm that, for example, a new production process, is possible and potentially profitable. Demonstration supports the spillovers of the entrepreneurial knowledge to more economic actors, the entry and agglomeration of similar and complementary firms, and as a result, some form of industrial and innovation system changes that can stimulate regional development can take place, possibly making the EDP process more managed and institutionalized. In sum, an entrepreneurial discovery may result in the creation of new, or reuse of existing, knowledge for a region, which can initiate completely new economic activities, upgrade existing ones, and change parts of the RIS.

2.1 | Two types of RISs

An EDP is likely to occur differently in specific regions, such as regions dominated by different types of RIS. This reflects the fact that "in general, entrepreneurial discoveries relate to existing structures and local knowledge" (Foray, 2014, p. 498). A RIS is typically seen to consist of two subsystems underpinned by an institutional infrastructure (Asheim et al., 2019). The subsystems contain

(i) A region's industry (firms, entrepreneurs, clusters, value chains) and
(ii) The knowledge infrastructure of universities, R&D institutes, incubators, etc.

The institutional infrastructure includes formal regulations, legislation, and informal societal norms that may stimulate or hamper entrepreneurship, knowledge flow, and innovation cooperation between actors in the subsystems.

Regional innovation systems differ in many respects, and the literature contends that different types of RISs have different potentials to support entrepreneurship, innovation, and industrial growth and restructuring (Isaksen & Trippl, 2016; Njøs & Jakobsen, 2018). We distinguish between RISs based on the geography of innovation collaboration and on the state of the two subsystems, which also impacts the institutional framework's working. Regarding innovation collaboration, one type of RIS, the regionally networked ones, finds their important innovation partners mostly within the region (Asheim et al., 2019). Interactive learning among local actors characterizes innovation processes in networked RISs. Another type of RISs, the regionalized national, represents a more science driven innovation model. Parts of the industry are functionally integrated in national and international innovation systems and finds innovation partners outside the region.

We also distinguish two types of RISs based on structural characteristics of the two subsystems. The first type is *specialized* RIS. This type is dominated by one or a few industries and may have some large clusters that include the dominant industries. The knowledge and support organizations in regions characterized by a specialized RIS are, first, tailored to the regions' narrow industrial base. The institutional framework also supports the dominant industries; policies may be tuned to support the development of these industries, and the industrial culture (informal institutions) forms together with the growth of the large regional industries and become adapted to these. It is often stated that specialized RIS may experience lock-in situations (Grabher, 1993). This includes close and stable ties between regional firms, groupthink interpretation stemming from long-standing personal ties, and policy support focused on already strong industries, all of which may hamper the inflow of new ideas and knowledge and hamper industrial restructuring.

The second type is diversified RISs. These have a heterogeneous industrial structure, for example, with clusters in different types of industries. The knowledge and support organizations are also varied, including, among others, education facilities, and R&D institutes that can facilitate innovation in different economic and technological fields. The institutional framework may include a more diverse range of policy tools and a regional industrial culture that stimulates entrepreneurship and regional industrial restructuring to a more considerable extent than is the case in specialized RISs. This reflects the more extensive and more diverse exchange of ideas and knowledge in diversified compared to specialized RISs.

2.2 | Entrepreneurial discoveries in different RISs

We argue that the type of RIS, specialized versus diversified, that characterizes a region will influence various stakeholders' ideas to support future industrial development. More precisely, we contend that the proposal for EDP will differ between stakeholders in the two types of RISs. We propose in the analytical framework in Table 1 that entrepreneurial discovery type of policy in specialized RIS will aim to diversify the industrial structure by developing new but related industries; This resembles the structural transformation logic of "transition" and "diversification" in the words of (Foray, 2015, p. 25). Both logics include the growth of new activities and industries from existing but related activities and competence. These capture "both the present limits of and potential for innovation and transformation of the existing structures" (Foray, 2015, p. 26). The EDP in diversified RISs can strengthen collaboration and knowledge flows between firms in different industries and support emerging industries that employ competence from existing related and unrelated industries. Such strategies are also similar to transition and diversification but also include "radical foundation" in the words of Foray (2015, p. 26). The last logic includes the creation of new activities with no direct link to existing structures, for example, those which are unrelated to the regions industrial profile. We further contextualize this table through a case study of two different RISs in Western Norway, the city region of Bergen and Stavanger.

The analytical framework in Table 1 outlines what changes need to occur in the two subsystems of RISs to lower barriers and contribute to growth and renewal in specialized and diversified RISs. Specialized RISs that are in danger of lock-in, followed by stagnation and decline, need to increase the exchange of ideas, information, and knowledge. The framework proposes more collaboration between existing firms within the regions' few strong industries and clusters, extra-regional collaborations, and new knowledge organizations or new activities in existing knowledge organizations. In addition, some changes in the institutional infrastructure, such as policy tools to support emerging firms and industries. Diversified RISs often have several opportunities due to the flurry of research activity and entrepreneurship, which is present across several industries. A possible hampering factor can be a lack of support for new initiatives by a possibly fragmented RIS. Therefore, the analytical framework proposes stimulating collaboration and knowledge flow between several existing industries and clusters and supports diversification from new related and unrelated industries.

2.3 | Barriers as systemic and transformational failures

Entrepreneurial discovery processes should aim to lower barriers to future industrial development. Barriers to EDP in the two types of RISs proposed above can be discussed using the concepts of innovation system failures and transformational failures. The identification of systemic failures to innovation opened up a new rationale for justifying policy interventions in the economy besides focusing on market failures (Weber & Truffer, 2017). Three distinct types of innovation system failures of relevance are identified (Woolthuis et al., 2005). The first is capability failures, which involve innovation system actors such as firms and knowledge and support organizations lacking appropriate competence to carry out or support innovation activity. Such failures are likely to be found in both specialized and diversified RISs. The second is coordination failures. These include in specialized RISs, the risk of too much information, and knowledge exchange between a fixed set of actors only, which hinder the inflow of complementary and alternative ideas and competence. In diversified RISs, a lack of interactions and knowledge exchange

between actors in the RIS can occur due to a fragmented and "chaotic" innovation system. Third, institutional failures occur when formal institutions (laws, regulations, etc.) and informal institutions (norms and implicit "rules of the game") hinder innovation. This may represent an innovation barrier in both types of RIS but can probably be the most severe in specialized RISs that rely much more on one or a few industries only and potential innovation failures in these can be significantly more damaging.

These system failures hinder RISs to efficiently support innovation activity in *existing* regional industries, while they do not necessarily stimulate the development of new regional industries. Therefore, "the rather static concept of system failures' (Weber & Truffer, 2017, p. 113) could be expanded to include transformational system failures understood as the failures of innovation systems to support new industries" emergence. These failures can potentially be more severe in specialized than in diversified RISs. Diversified RISs include more various economic actors and thus more related and unrelated knowledge flow than specialized RISs of similar size, which *could* hamper EDPs more in the specialized RISs. One way in which this can be overcome is proposed by Frenken (2017), wherein the author refers to a notion of a "temporary or pop-up innovation system" being useful to enable niche experimentation, which the author refers to as particularly useful in the context of sustainable transition processes. The use of such a temporary or pop-up innovation systems can help to support the development of unrelated diversification, a particular challenge which specialized RISs can face as the potential for lock-in to emerge is particularly strong in the case of a specialized industrial structure.

3 | DATA AND METHODS

3.1 | SED

This paper uses a SED approach, which allows for insights into the quantitative environment, as expressed through the regional industrial profile, to provide a richer analysis of the qualitative data into how regional stakeholders understand the future development of their region, as expressed through in-depth interviews. This paper builds on an understanding of qualitative data existing within a frame of the quantitative environment or put simply, the interviewed stakeholders (of which a full description of the interviewed stakeholders can be found in Appendix A) view the current status and future potential of the regional economy through the prism of observable regional economic structures. These structures can be expressed by quantitative data in line with an understanding of SED as expressed by Bowen et al. (2017, p. 10) namely that "The reason for collecting sequential quantitative and qualitative data into one study brings together two types of information providing greater understanding and insight into the research topics that may not have been obtained analyzing and evaluating data separately." In this sense, the analysis is focused on the integration of the quantitative environment, with the insights provided using the qualitative stakeholders' interviews to provide a clearer picture of the differences likely to emerge in the case of an EDP in different RISs.

3.2 | Case selection

The two city regions analyzed are Bergen and Stavanger, located on the western coast of Norway, located approximately 200 kilometers from one another (see Map 1).

MAP 1 Locations of Bergen (red) and Stavanger (blue)

3.3 | Bergen case study

The Bergen region includes the municipalities of Bergen and Bjørnafjorden, Samnanger, Austevoll, Sund, Fjell, Askøy, Vaksdal, Modalen, Osterøy, Meland, Øygarden, Radøy, Lindås, Austrheim, Fedje, and Masfjorden and the total number of inhabitants is 401,999 (Statistics Norway, 2020). The region differs from the Stavanger region, most notably in the prominence of its *manufacturing, construction, and wholesale and retail trade* sectors. The region's primary industries are the petroleum sector, the seafood sector, and the maritime sector. The petroleum sector is dominated by a large supplier industry, including several multinational companies. The seafood sector includes both fisheries and processing industry, but more recently, this sector has been dominated by the salmon farming industry. Several of the largest salmon farming companies in the world have their headquarters in the Bergen region. The maritime industry consists of both shipping companies, shipyards, and suppliers. Other important industries in the region are the media, financial, and tourism sectors. A key point of departure in the Bergen region is that given the varied nature of its industrial structure, as compared to Stavanger, there exists several distinct cluster projects in the Bergen region (Njøs et al., 2016).

This diversified RIS does manifest itself in a few important areas, most notably in education, where the region has a well-functioning and comprehensive knowledge-creating subsystem consisting of higher education institutions (HEIs) and various research institutions. This includes the University of Bergen, Western Norway University of Applied Sciences (HVL), Norwegian School of Economics (NHH), The Institute of Marine Research, and Norwegian Research Centre

(NORCE). Much of the activity within this knowledge-creating subsystem is directed toward supporting the region's leading industry sectors.

Moreover, the existence of a well-functioning RIS in the region is manifested through a complex set of linkages between the knowledge-creating subsystem and the regional industry. As discussed above, many of these linkages are managed through formally organized industry cluster projects. There are publicly funded industry cluster organizations for several of the industry sectors in the region, including the three main sectors (petroleum, maritime, and seafood). For a long-time, they have stimulated networking and collaboration both between industry actors and between industry actors and HEIs. Norwegian Centres of Expertise (NCE) Subsea (now GCE Ocean Technology) was set up in 2006 to stimulate innovations within the subsea segment of the oil and gas sector but have now a much wider target group focusing on different types of ocean technology. NCE Maritime Clean Tech was established in 2014 to promote green solutions within the maritime sector, while NCE Seafood was set up in 2015 to encourage sustainable development within the seafood sector. One of the main aims for these cluster organizations is to ensure the development of research-based innovation through close collaboration with HEIs and R&D institutions (Njøs & Jakobsen, 2016, 2018). Several of the HEIs in the region are also members of these industry clusters. In addition, there are also cluster organizations in the region initiated by the largest HEI. The University of Bergen has developed "knowledge clusters" to promote knowledge sharing and collaboration with regional industry actors, public administration, and cultural and societal entities. This includes a healthcare cluster, a marine research cluster, and an energy and technology cluster, but also other constellations (University of Bergen, 2019). There is also the NCE Media Cluster, set up in 2014, in close collaboration between the University of Bergen and the key media firms in the region. The media cluster represents a hybrid between a knowledge cluster promoted by an HEI and a public-funded industry cluster. Given that Bergen has a number of industries and several HEIs in which an EDP could prioritize, it serves as a pertinent example of how a diversified RIS can engage with a bottom-up approach, and this development of formally organized cluster projects in the case of Bergen constitutes an important difference between the two city regions, and could help to explain the differences which have emerged in recent decades between the two city regions as the development of such clusters is not such a feature in the case of Stavanger.

3.4 | Stavanger case study

The Stavanger region includes the municipalities of Stavanger, Sandnes, Sola, Klepp, Hå, Time, Strand, Gjesdal, Randaberg, Rennesøy, Finnøy, Forsand, and Kvitsøy, with a total number of inhabitants of 348,990 (Statistics Norway, 2020). The Stavanger region has traditionally focused on one industry—which was similar in many respects to the case of Bergen. In Stavanger, in a historical sense much of the focus has been on the herring and related canning industry, however in recent decades the focus shifted to becoming the "oil capital" in Norway which refers to the dominance of the oil and gas sector within the regional economy and the presence of national headquarters of several large oil and gas firms. The change to a clearer focus on oil and gas came into existence with the establishment of offshore petroleum activity in the late 1960s and "has since evolved through an interplay between petroleum firms, suppliers, large R&D institutes and universities, and supportive policies" (Andersen & Gulbrandsen, 2020, p. 5). Stavanger has increasingly specialized in its industrial structure on the oil and gas sector, whereas Bergen's

diversified industrial structure has provided the impetus for the formation of distinct cluster projects centered around the different industries present in Bergen.

Several institutions were established in the Stavanger region following the discovery of oil and gas deposits in the North Sea, which was made official in 1969. These institutions were created specifically to develop this industry within the regional economy. Andrews and Playfoot (2014) observe that relatively quickly, the region and at the national level in general, there was a drive to establish the skills, demands, and industry requirements necessary to build an internally stable workforce (Andrews & Playfoot, 2014, pp. 1–15). The supportive policies that emphasized "positive discrimination" toward Norwegian companies during the industry's build-up further fueled the development of the region's industrial structure (see Solheim & Tveterås, 2017, pp. 906–907). It led to a situation whereby the region was primarily focused on the extraction of oil and gas from the North Sea, and much of the regional industrial structure coalesced around this industry, and a process of specialization developed (see Figure 4). For this reason, Stavanger provides a useful example of a specialized RIS in operation and given its national character with regard to policy support and knowledge infrastructure and self-propelling growth, a clear rationale for the creation of formally organized regional-oriented clusters did not exist, as we can see in the case of Bergen and as such the creation and management of clusters is less so a feature in Stavanger as in Bergen. The national character produces a situation that leads Stavanger to rely to a greater extent than Bergen on externally produced knowledge and in the sense of knowledge production Stavanger could be considered more a case of a regionalized national innovation system, while Bergen more closely resembles a regional networked innovation system (Asheim & Isaksen, 2002, p. 84). We can see that while the upgrading of the former University College in Stavanger (Høgskolen i Stavanger (HiS)) to University status in 2005 has led to a greater role being played by the University in the local RIS, it is focused largely on oil and gas research has however led to continued reliance on the more national and international level HEI's to play a large role in industry-HEI interactions within Stavanger. As such the conceptualization of Stavanger as regionalized national RIS is understood as one with a regional concentration at the industry level but still relies to a large extent on interactions with HEIs at the national and international level. Stavanger as such, has, as said, traits that resemble a regionalized national RIS (Asheim & Isaksen, 2002). This entails "regional clusters where the knowledge providers stimulating firms' innovation activity mainly are found outside the region" (Asheim & Isaksen, 2002, p. 84). Given that there exists an advanced and specialized HEI focus in Stavanger with the oil and gas industry (see Figure 3), we see that there is a strong degree of engagement from HEI in Stavanger with the wider regional industrial actors as discussed further within Ahoba-Sam (2019). Ahoba-Sam (2019) highlights that the linkages between researchers and local actors proliferate due in part to conditions in the region, namely that "The region seems to provide relevance for their research areas and provided a platform to engage in problem-solving efforts with regional industries" (Ahoba-Sam, 2019, p. 261). However, in the case of knowledge linkages, specifically so in the oil and gas industry within the Stavanger region one must conceptualize the early and ongoing linkages as those which have been to a large degree extra-regional, namely to other parts of Norway such as with both Norwegian University of Science and Technology and its applied research arm, SINTEF.

3.5 | Quantitative approach

Two data sets were constructed for both Stavanger and Bergen, respectively, to allow exploratory analyses to be undertaken. The Stavanger region data set was constructed based on 461

industry-level unique observations, and the data set for the Bergen region contains 313 industry-level unique observations for the year 2016, with the difference stemming from differing representation across industry subgroups, a full list of industry subgroups can be found at Statistics Norway (2008). Occupations are categorized by Statistics Norway's general industry classification (SN2007), which allows for comparability between the two regions.

The primary variables used in this exploratory analysis of the differing regional economic structures are the concepts of ***relatedness***, ***location quotient***, and ***complexity*** and using these variables it becomes possible to more manifestly outline how the EDP in the differing RISs is likely to unfold.

Our measure of ***relatedness*** is computed in line with Hidalgo et al. (2007) approach to understanding relatedness. In this paper, relatedness is understood as two activities, such as products, industries, or research areas that require similar knowledge or inputs (Hidalgo et al., 2018, p. 452). Relatedness can be understood as a form of a risk assessment, where a high degree of relatedness in a region can be understood as containing a high likelihood of success in entering new activities, be that technology, products or industries, and vice versa, a low degree of relatedness indicating a higher likelihood of failure in entering new activities.

The Computation of ***location quotients*** (***LQ***) for both regions is constructed to capture the specialization within a given region in relation to the national context. LQ is used to compare the share of a sector in the local economy in relation to the average employment observed in the broader national economy. A value above one indicates a revealed comparative advantage within the region. The use of relatedness and LQ allows for a broad analysis of the potential for prioritized activities within an EDP to take root and be successful, given the industry's linkages to the regional industrial profile.

We also compute ***complexity*** values (as per Balland et al., 2018; Balland & Rigby, 2017; Deegan et al., 2021) within each industry as organized according to Statistics Norway's general industry classification (SN2007). In order to better understand the potential of industries within both city regions, we constructed a variable called *indregmeancomplexity*, which calculated the mean complexity within each given region based on occupational skill complexity in line with Caines et al. (2017) and Neffke et al. (2017). A complex occupation can be considered to be those which are based on ones "ability to abstract, solve problems, make decisions, or communicate effectively" (Caines et al., 2017, p. 1), and is considered an important dimension to use in tandem with the concept of relatedness (Balland et al., 2018).

Alongside relatedness and complexity, and with the aim being to capture those activities which are both large and potentially influential in a region, we also compute a value which we call ***shareregemp***. We use *shareregemp* to capture the share of regional employment, which a given industry consists of within both city regions. At the same time, this value can be used to better contextualize the given size of employment in both regions and point us toward the dominant employers within the regions.

3.6 | The qualitative approach

Based on previous studies by the authors, key stakeholders in Bergen and Stavanger have been identified with the intention to select stakeholders from the private and public sectors and in positions to be well-informed on regional industry development challenges. In total, 22 stakeholders were selected (11 in each region). The interviews with these stakeholders were conducted in 2018, using a semi-structured interview guide that emphasized regional restructuring, explored

the stakeholders' perception of ideas for future specialization, and identified opportunities and obstacles for future growth areas.

The Bergen case comprises six industry actors, two representatives for higher education institutions (HEIs), one intermediate organization, and two policy actors. The Stavanger case consists of eight industry actors, two intermediates, and one policy actor (see Appendix A).

The interviews lasted between 45 min—one and a half hours and were recorded and transcribed. Inductive constructivist thematic analysis (as per Braun & Clarke, 2006) was conducted on the transcribed interview material. This enabled us to extract and construct patterns of meaning from the data material (as per Solheim & Moss, 2021; see Staller, 2015). Herein the data were categorized based on extracting meaning concerned with the key stakeholders' perception of future regional industrial development.

3.7 | The usefulness of the analytical framework

In line with the discussion above on the development of an analytical framework, which culminates in Table 1, what follows below is a discussion rooted within the SED methodological approach into how Table 1 provides an insight into how these concepts interact through a case study of two city regions. With descriptive statistics, based on the computations of the variables discussed above, we first explore the empirical situation in which both regions exist and provide further evidence into the respective classifications of Bergen and Stavanger. Following the contextualization, we then explore how stakeholders across the differing dimensions, as contained within Table 1, are likely to engage with a bottom-up approach and how this engagement could be understood and operationalized in different RISs. It is here which we provide a richer insight into how EDPs are likely to interact differently with different RISs as expressed through the cases selected.

4 | RESULTS

4.1 | The empirical situation

The Stavanger and Bergen city regions differ markedly across several of the key variables we outlined above, and here we provide an insight into how these differences manifest. Across all the plots, different industrial subgroups are contained within the broader industry classifications, leading to different variables within the same broad industry classification. As we can see in Figure 1 below, Bergen has a number of industries wherein it has an ***LQ*** which is above one (and in many cases significantly above 1) and, as such, could be considered a region which is uniquely concentrated in a number of industries when compared to the national average, thus indicating a potential revealed comparative advantage across several industries. In contrast, for Stavanger, the specialized nature of its RIS can be observed by the high degree of employment contained within the uniquely concentrated industry of mining and quarrying (constituting the oil and gas sectors) and much smaller industries (as measured by their share of employment) which appear to have a revealed comparative advantage. Through the analysis of the LQ in both regions we are more clearly able to identify and express the differences which exist in both regions, and are better positioned to identify the different industrial structures, not least in how the different structures influence the motivation for cluster formation. We can also use the LQ to more clearly support

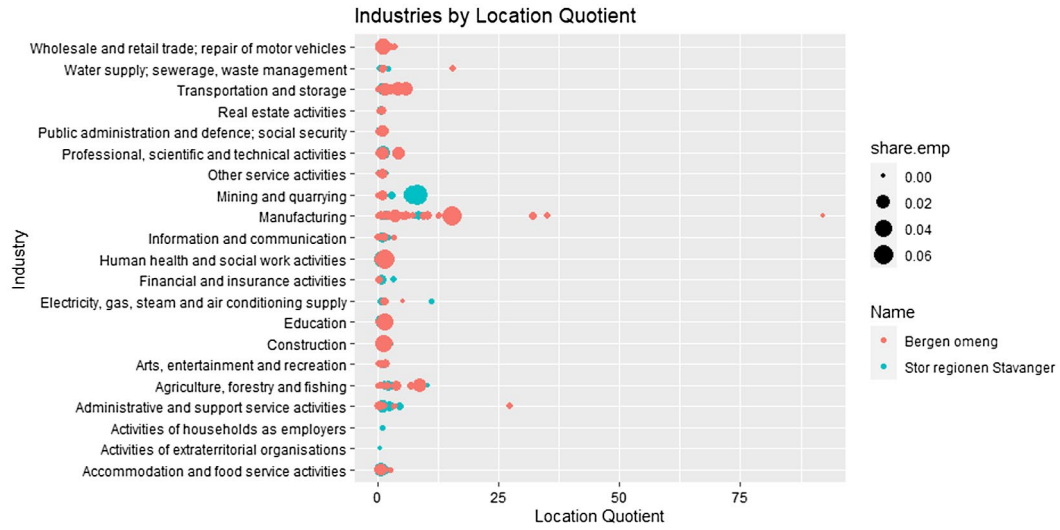

FIGURE 1 Industries by location quotient

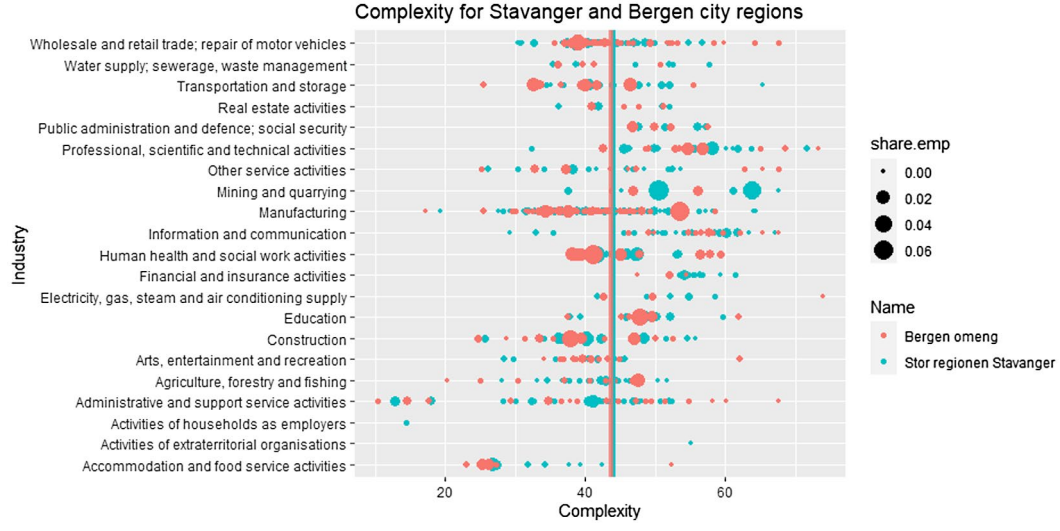

FIGURE 2 Industry regional mean complexity by industry

the argument that the difference in the respective regions is likely to produce divergent outcomes with regards to the EDP of both regions. An important point here is that the use of the LQ helps to identify the starting position of the regions in engaging with the EDP more generally, but given both the ongoing nature of the EDP and it is the recency of the process in both regions, it is not yet possible to identify the outcome of the EDP on the region's economic and industrial structures.

We can similarly see a trend emerge regarding the ***complexity*** of the industries within both city regions (expressed in Figure 2), where industries are represented by their level of complexity, with the vertical axis outlining the average complexity within both city regions. We observe that complex industries largely dominate in the Stavanger city region, with a high share of employment industries of *mining and quarrying*, with support industries such as *Professional,*

scientific and technical activities, and *information and communication* being sizable with regards to their share of employment and being quite complex industries. This pattern is apparent across all the variables we used to explore the differing regional economic systems. However, looking at Bergen, we can observe a different dispersion of complex industries from the case of Stavanger. We see that while the level of complexity differs across relatively large industries, such as; within *construction, human health, and social work activities, and manufacturing*, the picture is much less clear with regards to being overly dominated by a single large and complex industry such as is apparent in Stavanger with regards to mining and quarrying. The complex industries' dispersion is quite close on average, with Stavanger's average complexity value standing at 44.00 versus the average complexity of Bergen's industry standing at 43.68 out of a possible 100, with 100 representing the maximum level of complexity and 0 the minimum.

We observe the differing structures of both city regions regarding the share of employment within different industries (Figure 3). The presence of differing dominant sectors points toward a need for further analysis within the qualitative stage of this paper into how the different industrial structures impact a region's EDP. Of particular note is the *mining and quarrying* sector within Stavanger, and the *manufacturing* (including several different branches), respectively within Bergen, which further expresses the difference which one can observe across the different RISs of Stavanger and Bergen.

A similar story also emerges when looking at the differences between the two city regions with regards to the ***relatedness*** of the regions' industries. Stavanger is dominated by industrial subgroups, which are contained within the *mining and quarrying* industry, alongside those subgroups which are contained in ancillary industries such as *professional, scientific, and technical activities* alongside *construction* (Figure 4). The relatedness of industries within Stavanger is on average higher than observed in the Bergen region (27.16 vs. 25.05 in Bergen), which supports Bergen's classification as a more diversified region. However, notable exceptions exist within *transportation and storage, manufacturing*, in addition to *agriculture, forestry, and fishing*, and within *construction*, as we likewise can see within Stavanger. This finding with regards to the relatedness with other domains in Stavanger conforms to what we see discussed within Herstad and Sandven (2017), that the challenge for the region stemming from this "is to ensure that ideas, information, and knowledge generated within

FIGURE 3 Industries by share of employment

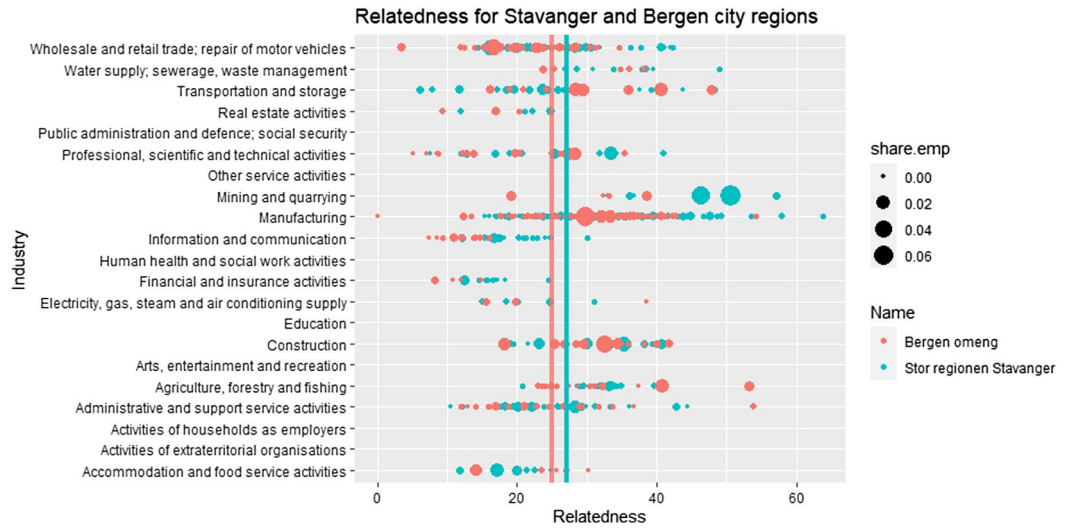

FIGURE 4 Industry relatedness by city region

the oil & gas sector spill over into the broader economy and benefits activities beyond those directly associated with oil & gas extraction. This points to the importance of active intervention through RIS construction" (Herstad & Sandven, 2017, p. 123) and furthermore conforms to a notion of Frenken's "temporary or pop-up innovation systems" which we argue could be particularly useful in the case of Stavanger to support niche experimentation (Frenken, 2017).

4.2 | Two different narratives

While in the empirical situation as discussed above, we have sought to add further context in which the qualitative data can be understood, what follows here is an analysis of the usefulness of the analytical framework based upon the qualitative data. We interpret the interviews' results in line with the analytical framework, as outlined in Table 1 above. Furthermore, we compare the results between the different regions to better answer the research question.

4.3 | Changes in the knowledge application subsystem

4.3.1 | Bergen

The stakeholders we interviewed in Bergen expressed considerable consistency regarding the vision for the regions' future. Most of the stakeholders argue that diversification is the right way forward. In other words, in Bergen, firms should look for new markets that are not very different from their existing market, which is in alignment with Table 1.

As an example, a representative for the petroleum sector provides this insight into the thinking around the use of enabling technologies which serve as a conduit between different sectors: "*We introduce our companies to new markets. Particularly related industries, according to the theories. And then there is aquaculture, renewable energy, and deep-sea mining. We use subsea technology as an enabling technology to get it done.*" (BE5).

A representative from the maritime sector further echoes this: "*I think the broader value chain is something we will live from in the future, and there are many firms that are entering new markets gradually, for instance, aquaculture and fisheries. Our firms are very adaptable*" (BE6). Moreover, a representative from the regional authorities states the following: "*So it is in a sense in our 'smart specialization thinking' that we are going to adapt and develop the interfaces of fisheries, salmon farming, the energy sector, the oil and gas sector, shipping, but also agriculture and tourism. We are so lucky in our region that we have several legs to stand on. When one industry has a tough market situation, others can have a rise. Working on interfaces between industries has become such an important part of our regional policy*" (BE9). Building on this, we echo that diversified regions have many legs to stand on and as such can move relatively more fluidly between industries to identify areas for prioritization in the region; however, of particular concern to regional authorities is precisely this increased collaboration between several stakeholders, in line with Table 1 above.

Among the stakeholders, less focus is placed on developing industries that are new to the region. The argument for more radical diversification mainly exists among representatives for higher education institutions. One of which states: "*I think it is crucial that the region also develops other legs to stand on when it comes to business. Not least, smart technologies, disruptive technologies, and ICT are central. It is important that we take as a starting point the fantastic industry structure we have in our region, but existing industry structure should not restrict our ambitions and how we need to develop*" (BE11).

4.3.2 | Stavanger

Differing considerably from the structure in Bergen is the understanding of the dominance of the oil and gas industry in Stavanger and its considerable importance to the regional economy. This understanding conforms considerably with that which one would expect to exist in a region with a specialized industrial structure. One of the stakeholder's states that, "*I think that the oil and gas industry will be the most important industry in a long, long, long time. I think so. That is going to be our main thing. But what I believe is that new technology will come. We have always been able to readjust our technology. We have a supplier sector that no one else has that is incredibly creative. I think that we will work like crazy to make the oil and gas industry greener, less emissions, make products that make it more viable*" (SV5).

As emphasized in the quote above, several of Stavanger's stakeholders emphasize a belief that the oil and gas industry will remain the largest component of the regional economy into the future. The use of technology developed specifically within the oil and gas industry being applied to other industries has also been highlighted, as well as the "greening" of the industry, which is similarly a concern echoed within Bergen. However, in the context of the specialized RIS which exists within Stavanger, stakeholders have also argued in favor of "green restructuring" within the already existing oil and gas industry, such as when the same stakeholder as above emphasizes that; "*We have a social responsibility to continue to deliver green oil. We can say it like that, green oil and gas*" (SV5). Along similar lines, the downturn of the oil price, as well as increased emphasis on a "green shift" (Njøs et al., 2020) has led to a subsequent "rebranding" attempt of Stavanger from the "Oil capital" to the "Energy capital" of Norway which can be considered an attempt to emphasize this shift.

A number of stakeholders interviewed express concern for the future of Stavanger; given the broader change which we can see within the oil and gas sector, one such stakeholder expresses doubts over the viability of the aforementioned "rebranding" attempt and the broader issues

facing Stavanger: "*I don't know what it will look like, but I hope we have found our new identity. Because we are in mind, heart, and soul, an oil and gas region, and that is what we are known for. But we now talk about the energy region. We don't own that as wholeheartedly as we did with oil and gas*" (SV1). This concern over the potential decline of the dominant industry within a specialized RIS and the region's prospects following the transition away from this industry sheds some light on the unique issues that specialized regions will likely face in an EDP and shows that some stakeholders in Stavanger are skeptical of whether increased collaboration, in line with Table 1, can be achieved to re-orient the regional industrial profile.

An issue that is made apparent in the interviews, concerning diversification is that "*the systems are weighted incorrectly to the advantage of established structures*" (SV3) and that "*In the past, we have seen that it is hard to keep up the restructuring-agenda if it is going too well in a region*" (SV6), this is a particularity which is likely to afflict those RIS which are more specialized, as there may exist less room for maneuver among stakeholders. The high wages that exist in the oil and gas sector within the specialized RIS of Stavanger could serve as a poisoned chalice to the region and have long-lasting consequences on recruitment and the labor market more generally (Fitjar & Timmermans, 2017). We can similarly see this challenge expressed by a stakeholder who states that "*the worst that can happen now is an upturn in the oil price. Then people are vacuumed back, and restructuring processes in Statoil, Aker, Aibel, and others will be reversed*" (SV5), within this quote we can see the crux of the issue for a specialized RIS in the knowledge application subsystem, namely that the dominant actors within the system may siphon off much of the potential for a gradual transition within the region, due in part to their ability to "vacuum" off much of the impetus for such a change to occur.

4.4 | Changes in the knowledge creation subsystem

4.4.1 | Bergen

We can observe that a number of the stakeholders argue for a "regional fit" between the knowledge creation and knowledge application subsystem: "*There is the need to link business restructuring and changes in businesses, closer to changes in the education system. So, transition in business is also transition in universities*" (BE9); this observation aligns closely with the analytical framework in Table 1, to focus more on commercialization. Similarly, other stakeholders build on this need for change within the knowledge creation subsystem, wherein they state that "*We need to make changes in our education programs to adapt them to the changes ongoing in our region. So as a higher education institution, we are keen to be close to the region that we serve*." (BE10).

Still, one of the main challenges seems to be to establish a better link between the two subsystems, which could be considered one of the main requirements for a well-functioning RIS. One of the stakeholders, representing an intermediate organization, says: "*It is clear that we have a strong academic environment on one side and a strong business environment on the other side. But there should be a bridge between them, between the production of knowledge and the use of knowledge. We are strong on both sides and must work on how we can achieve the best possible exchange*" (BE4). One of the industry representatives has a more specific focus on making the ongoing research activities in HEIs more relevant for the industry: "*What we work for here is, after all, is to promote industry-driven research. We try to work towards academia and to get research projects in academia that the industry really needs*" (BE5). This observation of greater collaboration between

the knowledge-creating subsystem and industry closely aligns with that which we propose in the analytical framework in Table 1.

Different initiatives and strategies have been launched in the region to strengthen the collaboration between academic institutions and the industry. As put forward by one of the HEIs in the region: "*When it comes to education, research and innovation, the knowledge clusters that we work with are perhaps the most important in terms of interaction. Media City is a brilliant example of how we try to interact with local, regional, and international industry actors. Some of the success criteria are that we see much more collaboration between our students, researchers, and industry actors manifested through joint projects, joint applications, increased revenues, and so on and so forth*." (BE11).

A characteristic of Bergen is a strong presence of cluster organizations. As illustrated in the presentation of our cases, there are public-funded cluster organizations mobilizing for R&D and innovation within all the region's main sectors (petroleum, seafood, maritime, and media,). Most of them have been initiated by the industry, while HEI's has been pivotal in the development of others (such as the NCE Media Cluster). Thus, the ideas of cluster formation are actively used to promote sound and sustainable economic development of the region (Njøs et al., 2020). The advantage of this is that these formally organized units give a potential for developing a coherence strategy and common vision for each of the clusters. However, a potential drawback is that you get several organizations promoting regional industry development, and it can be difficult to coordinate their effort and avoid duplication and inefficiency, as outlined in table 1. There is also the need for coordinating regional and national initiatives (Njøs et al., 2020). A representative from the subsea industry argues: "*It is clear that the system here and the system nationally suffers from being, I almost called it, the chaos of many small benefactors. Very often, each of them is too small to really make the big difference and take on the big responsibilities. I have made myself a strong advocate for these superclusters to optimize the system and get better profit*" (BE5).

There is a need for enhanced coordination within the region to overcome a potential challenge faced by diversified regions, namely poor coordination of actors. To overcome this coordination problem that diversified RISs face, one representative for the regional authorities' states: "*We want to have broad ownership around the strategic direction. We cannot sit here and decide, and then nobody cares. That is why we must work very closely in partnership with universities and the industry, and we also need to mobilize the inhabitants*" (BE9). Within this understanding of the regional authorities' role, we can see the integration of an EDP logic, in which diversified RISs are likely to focus on knowledge exchange among different types of stakeholders.

4.4.2 | Stavanger

As the HEI and research institutes in Stavanger were developed to provide teaching and training primarily for the oil and gas industry, the tension of future development and establishment of new courses is mentioned and captured by one of the stakeholders: "*It quickly turns into a chicken and egg discussion concerning if one should offer an education on jobs that do not exist today. Or is so that when one educates people within new areas, then something new is created because one has new knowledge that is being distributed that makes that one creates new dynamics. Bergen, for example, has not experienced the oil crisis the same way as us because they are more diversified, they have broader industry and industry basis. That is why they were not hit as hard by the crisis as we were*" (SV6): It is, in fact, the case that the knowledge creation subsystem within Bergen is much more developed and offers more education opportunities when compared to Stavanger,

whether this is because of the diversified nature of the RIS present there, or instead, whether the presence of this knowledge creation subsystem instead spurred the development of a diversified RIS is outside the remit of this paper, however it does pose some pertinent questions pertaining to the potential shortfalls of the knowledge creation subsystem within the more specialized RIS of Stavanger, and open up a discussion on what this may in fact signal to the potential areas for which the region can prioritize in a likely EDP.

The importance of local knowledge-creating institutions, however, is expressed by one stakeholder, who signals toward the importance of the university and technology transfer office (TTO) "*If the idea does not come from University of Stavanger, or Validé (TTO), they struggle a lot. Not invented here syndrome*" (SV8). This importance of particular nodes within the knowledge creation subsystem (in this case, the primary university within the region and a TTO) may signal the broader issue of resistance to external pressures and influences on the knowledge creation subsystem within the RIS of Stavanger and point toward a real need to establish test facilities, provide new education opportunities, etc. in new technology in line with that which is proposed in Table 1, to overcome these shortfalls. Similarly, and as mentioned above, this focus on internal sources of innovation being privileged does provide a particular paradox, given that much of the knowledge linkages within the dominant sectors of oil and gas, are indeed extra-regional, largely toward SINTEF and NTNU which are in Trondheim.

4.5 | Barriers to change

4.5.1 | Bergen

Several barriers to future change and upgrading of the RIS were reported throughout the stakeholder interviews. For instance, it has been argued that there is a specific resistance toward change; the focus on traditions is referred to as a potential blind spot: "*Our well-established companies in the region, they are struggling a little to somehow see that here are major changes going on. I must say, I might be a little worried because their emphasis on traditions and can blind them.*" (BE2). A HEI argues that the region needs to focus more on upgrading its industrial competence: "*It is a concern that the business sector in Norway to a much lesser extent than Germany, France, and Italy hire people with PhDs. It worries me that we may not have what it takes to drive a knowledge-based change in the industry. We need to succeed in a transition from a resource-based to a knowledge-based economy*" (BE11).

In addition, several stakeholders point toward the lack of venture capital as one of the main barriers to future change; "*Our biggest challenge to succeed in restructuring is a lack of capital. The oil will come to an end, and that the level of investment in other and newer sector has a challenge in matching the oil companies' large investment budgets. So, the gap there is important to be aware of.*" (BE3). A specific focus on the need to promote further growth among newly established firms with international potential was also highlighted, and a lack of capital constituting a primary challenge for these firms: "*We need to develop the ecosystem to become a growth-based ecosystem that can truly develop and scale up new international export-oriented companies. So how do we develop the ecosystem to be that scalable? I feel we here have a missing component.*" (BE7). These challenges contribute to a particular barrier to change which can exist within diversified RISs, namely that of a disjointed or fragmented innovation system hindering knowledge exchange and leading to persistent and debilitating coordination problems in the RIS (Mueller-Using et al., 2020).

4.5.2 | Stavanger

The case study highlights several barriers to change that are concerning what could be considered "conformity-seeking"-behavior (Isaksen et al., 2018). This conformity-seeking behavior was exemplified by what one stakeholder refers to regarding risky investments and access to capital for start-ups, that the institutions are "*not doing it at all. The structures are security-seeking*" (SV3). This risk-aversion strategy flows logically from a specialized RIS, wherein a dominant player constitutes a safe investment; this is expressed by one stakeholder who states that "*We are not good at taking risk on new technologies in new areas besides oil and gas. It costs a lot, a lot more than the old, safe*." *(SV5)*.

The issue of risk-aversion and conformity-seeking behavior is not necessarily a novel insight. However, the focus within a specialized RIS on those safe issues constitutes a considerable risk for the region, is in becoming overly dependent, and hampering alternative ideas and competence. The issue in the region, as stated by one stakeholder, is "*capital. Capital to dare to take risks on things that one does not know. One is good at taking risk on oil and gas companies because one knows that, one understands that market, one has earned money in that market in the past. But to dare to take risks in foreign areas…*." (SV5). The importance of personal networks also becomes apparent in the identification of opportunities for investment, given the dearth of other options for investors and for new firms "*It is hard to find an optimal match between investors and start-ups. There is no suitable arena where you meet investors, you go to neighbours and friends*" (SV3). This point further underscores the role of informal networks, and speaks to a typical trait of specialized RIS wherein there is increased importance attributed to close and stable ties (Grabher, 1993). This focus on close ties, which in certain situations may be beneficial, the threat in a specialized RIS is that they could lead to an emphasis being placed on path-dependent industrial development and focus too much on already existing knowledge and industries, this focus on those activities which are already existing and seek to further develop rather than build on from is expressed by one stakeholder who states that "*The closer to the dock you are, the lower our risk. We are terrified of Forus,*[1] *they are far from the dock, and are primarily concerned with administration, that might as well be located in Houston*." (SV10). Building on from this focus on prioritizing what one knows to the detriment of what one does not, a representative from a financial institution state that "*If it is a family we have known for several years (…), they fix it, and we are in. But if it is an Olsen that we do not know, we say no. That is probably the case for other banks as well*" (SV10). This focus on prioritizing what one knows, while on the surface may appear logical and consistent, poses a risk to the specialized RIS of Stavanger moving out from over-reliance on a dominant sector, which, although dominant now, very much has limitations (in both a physical sense, but also in line with trends toward a green transition). We can also see an over-concentration being referred to by one of the stakeholders, and hints toward a "pile-in" effect occurring, where those sectors which are dominant are receiving the lion's share of the investment within an area, thus leading to further and further concentration to the detriment of those areas where capital and investment is much scarcer "*We cannot be with everyone. That is why we choose our known ones. The ones that have much, receive even more*" (SV10).

5 | CONCLUSION

This paper utilizes a SED approach deployed on two city regions located on the western coast of Norway. The design allowed us to carefully examine how differing RISs are likely to engage

with an EDP to address future regional industrial development. The research was motivated by the twin aims of answering whether: (i) the development of an EDP is likely to differ between regions, characterized by a specialized and regionalized national RIS versus a diversified and regionally networked RIS and (ii) the narratives surrounding entrepreneurial discovery and regional development strategies differ between stakeholders in these specialized and diversified RISs.

The paper analyses data gathered on the quantitative regional economic profiles along the dimensions of industrial relatedness, the share of regional employment, skill complexity, and location quotient. We then combine this quantitative data with interviews with key stakeholders based on an analytical framework (as outlined in Table 1) for incorporating how differing RISs interact with EDP targeted at regional industrial development.

By applying the analytical framework with empirical data as outlined using the SED methodological approach, we found that in the case of specialized and regionalized national RISs, stakeholders remain cognizant of the dominant role of the dominant sector within the regional economy. However, there are notable differences among stakeholders' narratives about this dominance's merits or demerits. While some identify development stemming from this dominant sector as the direction the regional economy should seek to develop, others see a greater need to focus on new industry development to mitigate the potential risk of overreliance. Juxtaposed against this in what can be considered a more diversified and regionally networked RIS, such as that which we observe in Bergen, we can see a greater focus being placed on improving the linkages among the differing stakeholders and a focus on how best to build relationships within the RIS, alongside an understanding of the merits as expressed by policy actors that a diversified RIS has "a number of legs to stand on." The differing narratives between stakeholders within different RISs conform to an understanding of not just how the stakeholders assume change will take place but more broadly inform the policy options pragmatically available to the policy actors within the RIS, given these narratives are rooted in an understanding which we have explored with quantitative data on the regional economic profile of the different RISs.

With regards to the policy changes that one would assume are likely to take place within the different RISs, the clarity on the differing narratives aids in understanding which policy options are both likely to be pursued in an EDP. Within the specialized RIS of Stavanger, we are likely to see a push for change in the institutional infrastructure, which is focused on building clusters in related, emerging regional industries, as this provides the impetus for the RIS to mitigate the overreliance on a dominant sector, while at the same time, mitigate another serious risk, of moving too far from established industries and potentially stretching too far from its current activities. While in the more diversified RIS, we are likely to see this diversity in the regional economic profile be further embraced and centralized by the relevant policy actors, wherein the logical extension would be to focus policy on strengthening the diversification of a regions industry mix through seizing upon opportunities of developing new industries and markets at the intersection between existing industries.

With regards to the limitations of this study, one notable limitation is the use of Norwegian data, which, while rich in it is depth, may face limitations with regards to the generalizability of the study. However, by contextualizing Norwegian data in the broader context of the RIS literature, we have sought to mitigate this limitation, as while the scale of the differences in RISs may be apparent between more disparate regions, the degree to which this difference is likely to exist between two regions within the categorizations of specialized and diversified RISs is unlikely to impede further studies. While the limitation does serve to restrain this study, it also provides ample space for further research to test the analytical framework in different contexts

and to empirically explore the framework in the context of different methodological approaches and across different regions. Another limitation and opportunity for future research which this paper provides is for a fuller analysis as to the outcomes of the EDP in the respective regions. While the authors note that this is an emerging practice, which is hampered by the recency of many regional EDPs, it does provide scope for further research on how the different RISs produce different outcomes from their EDP.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the authors.

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ENDNOTE

[1] Forus is an industrial park located approximately 10 km south of Stavanger and is one of the main locations of administration and hosts the headquarters of several multinational firms.

REFERENCES

Ahoba-Sam, R. (2019). Why do academics engage locally? Insights from the University of Stavanger. *Regional Studies, Regional Science*, *6*(1), 250–264. https://doi.org/10.1080/21681376.2019.1583600

Andersen, A. D., & Gulbrandsen, M. (2020). The innovation and industry dynamics of technology phase-out in sustainability transitions: Insights from diversifying petroleum technology suppliers in Norway. *Energy Research and Social Science*, *64*(February), 101447. https://doi.org/10.1016/j.erss.2020.101447

Andrews, P., & Playfoot, J. (2014). *Education and training for the oil and gas industry: Building a technically competent workforce*. Elsevier Science.

Asheim, B. T., & Isaksen, A. (2002). Regional innovation systems: The integration of local "sticky" and global "ubiquitous" knowledge. *Journal of Technology Transfer*, *27*(1), 77–86. https://doi.org/10.1023/A:1013100704794

Asheim, B. T., Isaksen, A., & Trippl, M. (2019). *Advanced introduction to regional innovation systems* (1st ed.). Edward Elgar Publishing (Elgar Advanced Introductions).

Balland, P. A., Boschma, R., Crespo, J., & Rigby, D. L. (2018). Smart specialization policy in the European Union: Relatedness, knowledge complexity and regional diversification. *Regional Studies*, *3404*, 1–17. https://doi.org/10.1080/00343404.2018.1437900

Balland, P. A., & Rigby, D. (2017). The geography of complex knowledge. *Economic Geography*, *93*(1), 1–23. https://doi.org/10.1080/00130095.2016.1205947

Bowen, P., Rose, R., & Pilkington, A. (2017). Mixed methods-theory and practice. Sequential, explanatory approach. *International Journal of Quantitative and Qualitative Research Methods*, *5*(2), 10–27.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Caines, C., Hoffman, F., & Kambourov, G. (2017). Complex-task biased technological change and the labor market. *International Finance Discussion Paper*, *1192*, 1–65. https://doi.org/10.17016/ifdp.2017.1192

Deegan, J., Broekel, T., & Fitjar, R. D. (2021). Searching through the Haystack: The relatedness and complexity of priorities in smart specialization strategies. *Economic Geography. Routledge*, *97*(5), 497–520. https://doi.org/10.1080/00130095.2021.1967739

Fitjar, R. D., & Timmermans, B. (2017). Regional skill relatedness: Towards a new measure of regional related diversification. *European Planning Studies*, *25*(3), 516–538. https://doi.org/10.1080/09654313.2016.1244515

Foray, D. (2014). From smart specialisation to smart specialisation policy. *European Journal of Innovation Management*, *17*(4), 492–507. https://doi.org/10.1108/EJIM-09-2014-0096

Foray, D. (2015). *Smart specialisation; Opportunities and challenges for regional innovation policy* (1st ed.). Routledge.

Frenken, K. (2017). A complexity-theoretic perspective on innovation policy. *Complexity, Governance & Networks*, (1), 35–47. https://doi.org/10.20377/cgn-41

Garud, R., & Karnøe, P. (2003). Bricolage versus breakthrough: Distributed and embedded agency in technology entrepreneurship. *Research Policy*, *32*(2), 277–300. https://doi.org/10.1016/S0048-7333(02)00100-2

Grabher, G. (1993). The weakness of strong ties: The lock-in of regional development in the Ruhr Area. In G. Grabher (Ed.), *The embedded firm* (pp. 255–277). London: Routledge.

Herstad, S., & Sandven, T. (2017). *Towards regional innovation systems in Norway? An explorative empirical analysis*. Nordic Institute for Studies in Innovation, Research and Education (NIFU).

Hidalgo, C. A., Balland, P. A., Boschma, R., Delgado, M., Feldman, M., Frenken, K., Glaeser, E., He, C., Kogler, D. F., Morrison, A., Neffke, F., Rigby, D., Stern, S., Zheng, S., & Zhu, S. (2018). The principle of relatedness. In A. Morales, C. Gershenson, D. Braha, A. Minai, & Y. Bar-Yam (Eds.), In *Unifying themes in complex systems IX. ICCS 2018*. Springer Proceedings in Complexity. Springer. https://doi.org/10.1007/978-3-319-96661-8_46

Hidalgo, C. A., Klinger, B., Barabasi, A.-L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science*, *317*(5837), 482–487. https://doi.org/10.1126/science.1144581

Isaksen, A., Martin, R., & Trippl, M. (2018). New avenues for regional innovation systems and policy. In A. Isaksen, R. Martin, & M. Trippl (Eds.), *New avenues for regional innovation systems - theoretical advances, empirical cases and policy lessons* (pp. 1–19). Cham: Springer. https://doi.org/10.1007/978-3-319-71661-9

Isaksen, A., & Trippl, M. (2016). Path development in different regional innovation systems: A conceptual analysis. In M. D. Parrilli, A. Rodriguez-Pose, & D. F. Rune (Eds.), *Innovation drivers and regional innovation strategies* (1st ed., pp. 82–100). New York, NY: Routledge.

Lopes, J., Ferreira, J. J., & Farinha, L. (2019). Innovation strategies for smart specialisation (RIS3): Past, present and future research. *Growth and Change*, *50*, 38–68. https://doi.org/10.1111/grow.12268

Mieszkowski, K., & Kardas, M. (2015). Facilitating an entrepreneurial discovery process for smart specialisation. The case of Poland. *Journal of the Knowledge Economy*, *6*(2), 357–384. https://doi.org/10.1007/s13132-015-0242-y

Mueller-Using, S., Urban, W., & Wedemeier, J. (2020). Internationalization of SMEs in the Baltic Sea Region: Barriers of cross-national collaboration considering regional innovation strategies for smart specialization. *Growth and Change*, *51*, 1471–1490. https://doi.org/10.1111/grow.12439

Neffke, F., Otto, A., & Weyh, A. (2017). *Skill-relatedness matrices for Germany. Data method and access*. FDZ-Methodenreport, pp. 1–16.

Njøs, R., & Jakobsen, S.-E. (2018). Policy for evolution of regional innovation systems: The role of social capital and regional particularities. *Science and Public Policy*, *45*(2), 257–268. https://doi.org/10.1093/scipol/scx064

Njøs, R., & Jakobsen, S.-E. (2016). Cluster policy and regional development: Scale, scope and renewal. *Regional Studies, Regional Science*, *3*(1), 146–169. https://doi.org/10.1080/21681376.2015.1138094

Njøs, R., Jakobsen, S.-E., Wiig Aslesen, H., & Fløysand, A. (2016). Encounters between cluster theory, policy and practice in Norway: Hubbing, blending and conceptual stretching. *European Urban and Regional Studies*, *24*(3), 274–289. https://doi.org/10.1177/0969776416655860

Njøs, R., Sjøtun, S. G., Jakobsen, S.-E., & Fløysand, A. (2020). Expanding analyses of path creation: Interconnections between territory and technology. *Economic Geography*, *96*(3), 266–288. https://doi.org/10.1080/00130095.2020.1756768

Rodríguez-Pose, A., & Wilkie, C. (2016). Institutions and the entrepreneurial discovery process for smart specialization. In D. Kyriakou, M. Palazuelos Martínez, I. Periáñez-Forte, & A. Rainoldi (Eds.), *Governing smart specialisation* (pp. 34–48). London: Routledge. https://doi.org/10.4324/9781315617374

Santini, C., Marinelli, E., Boden, M., Cavicchi, A., & Haegeman, K. (2016). Reducing the distance between thinkers and doers in the entrepreneurial discovery process: An exploratory study. *Journal of Business Research*, *69*(5), 1840–1844. https://doi.org/10.1016/j.jbusres.2015.10.066

Solheim, M. C. W., & Moss, S. M. (2021). Inter-organizational learning within an organization? Mainstreaming gender policies in the Swedish ministry of foreign affairs. *The Learning Organization*, *28*(2), 181–194. https://doi.org/10.1108/TLO-05-2020-0103

Solheim, M. C. W., & Tveterås, R. (2017). Benefitting from co-location? Evidence from the upstream oil and gas erås, Ragindustry. *The Extractive Industries and Society*, *4*(4), 904–914. https://doi.org/10.1016/j.exis.2017.09.001

Staller, K. M. (2015). Moving beyond description in qualitative analysis: Finding applied advice. *Qualitative Social Work*, *14*(6), 731–740. https://doi.org/10.1177/1473325015612859

Statistics Norway. (2008). *Standard industrial classification*. Retrieved December 2, 2021 from, https://www.ssb.no/a/publikasjoner/pdf/nos_d383/nos_d383.pdf

Statistics Norway. (2020). *Alders- og kjønnsfordeling i kommuner, fylker og hele landets befolkning*. Retrieved November 19, 2020 from, https://www.ssb.no/statbank/table/07459/

University of Bergen. (2019). *Knowledge clusters*. Retrieved December 2, 2021 from, https://www.uib.no/en/strategy/113919/knowledge-clusters

Weber, K. M., & Truffer, B. (2017). Moving innovation systems research to the next level: Towards an integrative agenda. *Oxford Review of Economic Policy*, *33*(1), 101–121. https://doi.org/10.1093/oxrep/grx002

Woolthuis, R. K., Lankhuizen, M., & Gilsing, V. (2005). A system failure framework for innovation policy design. *Technovation*, *25*(6), 609–619. https://doi.org/10.1016/j.technovation.2003.11.002

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APPENDIX A

OVERVIEW OF STAKEHOLDERS

Identification number	Region	Type of stakeholder
BE1	Bergen	Industry actor
BE2	Bergen	Industry actor
BE3	Bergen	Industry actor
BE4	Bergen	Intermediate
BE5	Bergen	Industry Actor
BE6	Bergen	Industry Actor
BE7	Bergen	Industry Actor
BE8	Bergen	Policy actor
BE9	Bergen	Policy actor
BE10	Bergen	Higher Educational Institute
BE11	Bergen	Higher Educational Institute
SV1	Stavanger	Intermediate
SV2	Stavanger	Intermediate

Identification number	Region	Type of stakeholder
SV3	Stavanger	Industry actor
SV4	Stavanger	Industry actor
SV5	Stavanger	Policy actor
SV6	Stavanger	Industry actor
SV7	Stavanger	Industry actor
SV8	Stavanger	Industry actor
SV9	Stavanger	Industry actor
SV10	Stavanger	Industry actor
SV11	Stavanger	Industry actor