

# REGIONAL ECONOMIC AND SOCIAL RESILIENCE:

An Exploratory In-Depth Study  
in the Nordic Countries

By Alberto Giacometti and Jukka Teräs

NORDREGIO REPORT 2019:2





# **REGIONAL ECONOMIC AND SOCIAL RESILIENCE:**

An Exploratory In-Depth Study  
in the Nordic Countries

By Alberto Giacometti and Jukka Teräs

NORDREGIO REPORT 2019:2

*Prepared on behalf of the Nordic Thematic Group for Innovative and Resilient Regions 2017–2020,  
under the Nordic Council of Ministers Committee of Civil Servants for Regional Affairs.*

**Regional Economic and Social Resilience:  
An Exploratory In-Depth Study in the Nordic Countries**

Nordregio Report 2019:2

ISBN 978-91-87295-66-9

ISSN 1403-2503

DOI: [doi.org/10.30689/R2019:2.1403-2503](https://doi.org/10.30689/R2019:2.1403-2503)

© Nordregio 2019

Nordregio  
P.O. Box 1658  
SE-111 86 Stockholm, Sweden  
[nordregio@nordregio.org](mailto:nordregio@nordregio.org)  
[www.nordregio.org](http://www.nordregio.org)  
[www.norden.org](http://www.norden.org)

**Analyses and text:** Alberto Giacometti and Jukka Teräs

**Contributors:** Eeva Turunen, Mari Wøien, Hjördís Rut Sigurjónsdóttir,  
Lise Smed Olsen (Oxford Research), Liisa Perjo, Giuseppe Innocente,  
Viktor Salenius, Laura Fagerlund

## **Nordregio**

is a leading Nordic and European research centre for regional development and planning, established by the Nordic Council of Ministers in 1997. We conduct solution-oriented and applied research, addressing current issues from both a research perspective and the viewpoint of policymakers and practitioners. Operating at the international, national, regional and local levels, Nordregio's research covers a wide geographic scope, with an emphasis on the Nordic and Baltic Sea Regions, Europe and the Arctic.

## **The Nordic co-operation**

*Nordic co-operation* is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, and the Faroe Islands, Greenland, and Åland. *Nordic co-operation* has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe. *Nordic co-operation* seeks to safeguard Nordic and regional interests and principles in the global community. Common Nordic values help the region solidify its position as one of the world's most innovative and competitive.

## **The Nordic Council of Ministers**

is a forum of co-operation between the Nordic governments. The Nordic Council of Ministers implements Nordic co-operation. The prime ministers have the overall responsibility. Its activities are co-ordinated by the Nordic ministers for co-operation, the Nordic Committee for co-operation and portfolio ministers. Founded in 1971.

## **The Nordic Council**

is a forum for co-operation between the Nordic parliaments and governments. The Council consists of 87 parliamentarians from the Nordic countries. The Nordic Council takes policy initiatives and monitors Nordic co-operation. Founded in 1952.

Stockholm, Sweden, 2019

# Table of contents

<b>Foreword</b>	6
<b>Executive summary</b>	7
<b>1. Introduction</b>	9
<b>2. Understanding resilience: theoretical considerations</b>	11
<b>3. Methodology</b>	19
<b>4. Case studies</b>	25
4.1 NORTHERN OSTROBOTHNIA, FINLAND	26
4.2 VESTMANNAEYJAR (WESTMAN ISLANDS), ICELAND	36
4.3 ROGALAND, NORWAY	45
4.4 NORRBOTTEN, SWEDEN	56
4.5 VEJLE, DENMARK	64
<b>5. Findings</b>	75
<b>6. Recommendations</b>	83
<b>References</b>	85



# Foreword

---

Nordregio, on behalf of the *Nordic Council of Ministers Committee of Civil Servants for Regional Affairs*, is the secretariat for the *Nordic thematic group for innovative and resilient regions 2017–2020*. During this programme, the Nordic thematic group has focused on expanding knowledge and identifying policy-relevant solutions to the challenges that the Nordic regions face when it comes to resilience, smart specialisation and digitalisation. This report summarises the work and results achieved within one of the studies conducted by the thematic group between 2017 and 2018, namely 'Regional economic and social resilient regions'.

The study takes a holistic perspective to explore the implications of uncertainty for the Nordic regions and to deepen the understanding on how regional authorities, companies and the society at large are able to react and respond to shocks and disturbances. The aim is also to identify what measures are regional authorities taking to prepare for shocks and unwanted developments, either to repel them as to facilitate structural change. More specifically, this study provides answers to the following research questions:

- What risks/shocks are the Nordic regions vulnerable to?
- What are the drivers of regional resilience?

- What is the role of regions (and their different actors) in anticipating and reacting to shocks?
- How can strong and weak signals of changing regional resilience be recognised?

To achieve these objectives this study was divided into four parts or steps: First, an overview of the conceptual and academic debate on regional economic and social resilience. Second, a methodology design for empirical research in the Nordic regions. Third, field research on the five distinct regions. And finally, a cross-case comparison. This report follows the four steps to present the work in addition to the key findings and recommendations identified.

The key question relevant to the policy makers is: can resilience be built in advance? In other words, how do we plan ahead for possible risks and shocks (and slow burn) in such a way, that our societies and regions are better prepared to carry on and find ways to survive. This work provides plenty of case-based ideas for strengthening resilience planning.



Mikko Huuskonen

Chair of the Nordic thematic group for Innovative and Resilient Regions 2017–2018

# Executive summary

---

How capable are local and regional economies of recovering from exogenous and endogenous (global and local) shocks and threats and ensure resilient long-term development paths? Answering this question was the challenge of **the Nordic Thematic Group on Innovative and Resilient regions, set by the Nordic Council of Ministers. Thus, from 2017 to 2018, an exploratory in-depth study was conducted on economic and social resilience in the Nordic regions. The empirical research included a close examination of a variety of threats as well as factors driving resilience in regions in all five Nordic Countries.**

The growing concern over natural disasters, the 2008–2010 global financial crisis and the shifting geopolitical order, are some of the recent events and developments that have provoked policy-makers to consider the way in which local and regional populations are able to recover from exogenous and endogenous shocks and emergencies. In other words, policy-makers are grappling with ascertaining how resilient local economies are. Despite of the global character of today's developments, their asymmetric effect across territories calls for increased attention on measures taken at local and regional levels. Such debates represent a shifting discourse from 'planning optimism' towards preparing for the unexpected and uncertain. This notion of resilience is relevant in the Nordic regions not only because of their susceptibility to global crises, but also in handling local events and day-to-day challenges that have implications for the long-term development of regional economies and societies.

The concept of resilience offers a lens through which to examine and deepen our understanding on a region's ability to cope with uncertainty. This study makes a case for the need to explore a broader account of conditions and features (capacities) that can make regions more resilient. The logic is that looking at outcomes alone – GDP and employment – does not provide meaningful information about why some regions were able to resist and recover from a shock and others were not, or indeed whether those regions would be able to withstand future shocks. This kind of analysis requires a more comprehensive examination of

the unique context and adaptive capacity of each region, and a detailed understanding of the different types of shocks that a region might suffer. Additionally, research has been increasingly emphasised the role of actors, social norms, conflicts and processes, which highlight the role of human agency in resilience.

Far from providing a full autopsy of the regions' risk landscape, this research project represents a first attempt to map the various types of risks and stress factors that threaten the wellbeing of society and economic performance in different Nordic regions. For instance, the case-study regions revealed risk types such as technology driven risks, financial, policy induced, environment related, and those resulting from sudden changes in demand or geopolitical shifts. After delineating the 'risk landscape' of the studied regions, a distinction was made between risks and stress or stress-factors. The difference is that risks indicate the probability of a shock, whereas stress factors are not necessarily unexpected nor abrupt, but instead are factors and trends that weaken the potential of a region in the long-term.

This study has revealed many interesting findings. Whilst some risks and capacities can be comparable across regions, this study suggests that many capacities are context-specific and place-based. Moreover, the regions studied reveal that risks never exist in isolation but are part of a broader context and interlinked with other risks. In every case, shocks are the result of a combination of different exogenous and endogenous developments and conditions. A relevant example is the economic downturn suffered in Rogaland, Norway after the collapse of the oil price in 2013–2014. While the shock itself was triggered by exogenous conditions (i.e. a technological shock and geopolitics), the impact was aggravated by endogenous conditions (i.e. over-dependency on a single industry and unsustainable costs).

Furthermore, a broad range of stress factors were identified, such as the over-dependence on single industries, ageing population, demographic decline, skills shortages, centralisation of services, unreliable transportation and weather conditions.

In contrast to risks, stressors may not produce abrupt consequences, but they often lead to major challenges to the long-term development of the regions. The case studies shown, for instance, that the unreliability of transportation, and deficiencies in the labour market weaken the regions' competitiveness and its potential of industrial diversification. Moreover, the accumulation of stress can make shocks more likely and more damaging.

In terms of resilience drivers, this work identified several factors that appear important for strengthening regions' ability to prevent major shocks and to respond and shape along inevitable developments. Some of these drivers can be distinguished as preconditions for regions' businesses and society to thrive as well as to provide a solid basis to prevent shocks taking place. Such examples include, solid and efficient institutions, building a financial buffer, spreading the risk through diversity of economic activities and markets. When it comes to responding to shocks, however, this study has revealed a different account of drivers. Trust amongst regional actors, self-organisation and reorganisation, adaptability and flexibility, welcoming change and even stimulating disruption are essential for coping with threatening developments.

This study highlights, that all regions, without exception, are under permanent presence of risks

and stress. Therefore, on the long-run, resilience is not as dependent on regions ability to repel shocks, but rather on their flexibility and adaptability to changing conditions. Moreover, adaptability is closely determined by the trust levels amongst regional actors, social cohesion and the human capital available. These elements were essential in all the cases studied in leading change by shaping the working and collaborative cultures, redirecting resources, and effectively coordinating collective and individual actions. Not least relevant, positive shocks, or the improvements resulting from economic turmoil, can be extremely beneficial for long-term resilience. meaning that, economic difficulties often the reorganisation of institutional structures and industrial composition, tackling unsustainable practices and establishing new working cultures, strengthening social bonds and/or open business opportunities, paving the way for a more forward-looking societies and businesses.

Finally, as a result of the two-year in-depth study, this report presents a list of recommendations which are targeted towards policy-makers and professionals working with regional planning and territorial development, risk management, business development and innovation at local, regional and national levels. Moreover, this report and recommendations is relevant to anyone interested in regional economic and social resilience.



# 1. Introduction

---

The notion of resilience has recently become an imperative in policy-makers' vocabulary at all levels of governance and has featured in a great number of studies and policy papers. The policy attention given to resilience might be a response to the general sense of uncertainty and insecurity growing in many societies across the world.

The recent succession of major natural and environmental disasters has provoked questions regarding the ability of local and regional populations to recover quickly from shocks and emergencies. Similarly, the deep financial and economic crisis that affected most regions across the globe in 2008–2010, along with the austerity policies that followed, have directed attention towards the ability of local and regional economies to respond to these events (Martin, 2012). Additionally, the EU Commission has pointed out that profound transformations in existing social and economic systems are emerging due to globalisation, decarbonisation and the rise of digital technologies (EU Commission, 2017). These transforming trends can be expected to have an enormous impact on employment structures, industrial sectors, business models, the economy and society at large. Therefore, the Commission has emphasised the need to help citizens, organisations and regions to adapt to these transformations (EU Commission, 2017).

Searching for new paths to strengthen social, economic and environmental resilience becomes increasingly important in a world consistently facing unanticipated risk, which is shaking the very core of global contemporary societies.

Anticipating potential crises has clear consequences for policy and planning. Bonß (2016) notes that because modern societies are confronted by risks, societal planning also needs to change in order to become better at rearranging and adapting, so as to absorb and prevent risks. Whereas planning in the 1960s and 1970s was characterised by 'planning optimism' and expectations of scientific progress eliminating future problems, resilience thinking sees the future as unexpected and uncertain (Bonß, 2016).

Regions are affected by global, national and local developments. Economic turmoil at national

and regional levels might originate from either major global happenings or local occurrences. The 2008 financial crisis, for instance, emerged locally in the US as a result of a housing bubble and sub-prime mortgages, and spread internationally due to truly interdependent global financial institutions. Additional shocks that affect local (sub-national) economies are related to internal decision-making processes, for instance in the closure or relocation of key employers (Sensier et al., 2016). However, economic shocks at the local level can be symptomatic of long-term struggles in sustaining an economic path that perhaps was doomed to decline eventually. It is in this light that is worth distinguishing between **'slow burns' and shocks**. Regions or systems where conditions have long been deteriorating, and where established institutions struggle to cope with transformation and restructuring, can be categorised as undergoing a **slow burn** (Pendall et al., 2010). In contrast, **shocks** are events that are abrupt, disruptive and discrete, and may come as singular occurrences or as a series of shocks to the system (ibid.). Moreover, **slow burns tend to make regions more vulnerable to shocks as the long-term trends, or stress, weaken regions' potential and deepen the vulnerability of their actors** (OECD, 2014).

**The Nordic regions**, outside of the bigger cities, appear to be notably affected by slow burns. These may have major consequences for the regions' long-term social and economic development, due, for instance, to shrinking populations caused by low birth rates and urbanisation. However, regions that are overly dependent on a single industry or development path may also suffer from shocks, due to the emergence of new technologies and changes in consumer demand, for example. The Nordic regions are particularly susceptible to the closure of major industries, which can lead to a rapid increase in unemployment and outmigration.

**The Nordic welfare state and governance system, with its strong public institutions and broad participation model with different actors involved in decision-making processes, can be argued to be the Nordic model towards achieving increased resilience.** This model is often praised for its gains in

societal trust, which may have key implications for resilience. On the one hand, the Nordic perspective on resilient regions can therefore bring about new insights into how to tackle risks and shocks, by building on the strengths of the Nordic societies. On the other hand, the **increasingly deepened, globalised Nordic economy has made the Nordic region particularly vulnerable to external developments** (Gylfason et al., 2010). The 2008 financial crisis is the most recent example of Nordic vulnerability, with Iceland being the prime example of its devastating effects. However, at the same time, Iceland's quick recovery from its deep economic crisis is often highlighted as a Nordic success story (ibid.). Gylfason et al. (2010) note that the growing housing bubbles are worrying developments, as countries both outside and within the Nordic region have been allowing them to grow for several years. Yet, the authors note that the strong state of financial institutions in the Nordic countries 'allow automatic stabilisers to operate in a recession, thereby softening the blow for households and firms and the economy as a whole' (ibid.). Arguably, this could also be said for similar issues in **preparing for carbon-neutrality, and the automation of the**

**labour market.** The strength of the Nordic states and the trust they place in these public institutions plays to their advantage.

This study further investigates the sub-national levels to gain in-depth understanding of what regions can do to become successful in meeting and anticipating shocks, caused by endogenous and exogenous events. Current research on regional resilience emphasises the need for place-based and context-sensitive approaches to measuring resilience, which cannot be reached without in-depth understanding of the studied region, its preconditions, context and processes. To do this, it is necessary to use both qualitative methods and quantitative indicators that, based on a qualitative understanding, have been deemed relevant from the region's unique perspective. This paper represents a first step towards that aim by providing a knowledge base and an overview of existing regional resilience examples. Within the Nordic context specifically, the aim during the next phases of the project is to shed new light on regions' inherent adaptive capacities, which can then help them build up stronger resilience.

## 2. Understanding resilience: theoretical considerations\*

---

### Conceptualising resilience

Resilience thinking has been widely used in ecology, physics, medicine and psychology, and has only recently been adopted within social sciences. The Latin root *resilire*, to leap back or to rebound, refers to the ability of an entity or system to recover form and position elastically, following a disturbance or disruption (Martin, 2012). Thus, be it an individual person, a specific ecosystem (e.g. a forest), a city or an economy, resilience refers to **the capacity to cope with change and continue to develop**. Resilience thinking has offered a new lens through which to consider some of the most pressing societal, economic and environmental issues of today, for instance, the ability of a local or regional community to recover from natural disasters, or to anticipate global trends that may present risks to local industries, jobs and communities. This may include the automation and decarbonisation of the energy sector or, from a local perspective, trends such as an ageing population and demographic decline.

There is no consensus on a single definition of resilience. For instance, in engineering the resilience concept emphasises the resistance of a system to disturbances and the speed of return to its pre-shock state. In ecological resilience studies, the focus is on measuring the scale of disturbance that a system can absorb before getting destabilised (Martin, 2012). The social scientific regional resilience perspective involves both engineering and ecological meanings, and refers to a complex set of economic, social and institutional traits that characterise the ability of regions to respond to a shock. This carries a clear purpose of maintaining system stability and durability, as well as adapting to structural changes and moving to new development paths (Di Caro, 2014; Hu & Hassink, 2016).

### *Bouncing back or bouncing forward?*

Resilience literature identifies two possible ways of recovering from a shock or disturbance: by **'bouncing back'** or by **'bouncing forward'**. Bouncing back implies returning to the pre-shock or normal position by reconstructing earlier parameters. Bouncing forward requires finding a new normal by replacing certain parameters with new ones (Bonß 2016; Muštra et al., 2016). The former would occur, for instance, when a region is able to absorb a shock without changing its core industrial base and organisation (and return to business as usual). The latter would occur when the underlying conditions have fundamentally changed, making it impossible to return to business as usual (Bonß, 2016; Muštra et al., 2016). In such a scenario, the removal of unproductive activities can open up new sectors and a new phase of growth, thereby establishing a new normal. To better explain this phenomenon, Martin (2012) borrows the concept of 'hysteresis' from the natural sciences to compare the magnetic and elastic properties of materials with the elasticity of economies. With this notion, the possibility of multiple equilibria is recognised and that economies can move from one state of 'equilibrium or domain to another as a result of a shock or disturbance' (Martin, 2012).

### *The evolutionary approach*

Critics challenge the notion of bouncing back to the full extent, however. Even when a region could preserve its main function, structure, identity and feedbacks, the 'ability to absorb' a shock requires a certain degree of reorganisation and change (Muštra et al., 2016). Recent literature describes regional economic resilience as highly complex and multi-dimensional (Sensier et al., 2016; Martin & Sunley, 2015). Contrary to the engineering-rooted notion that implies returning to a state of equilibrium, economic geographers advocate for an evolutionary and dynamic understanding of resilience (Sensier et al., 2016). **The evolutionary approach rejects the idea that regional economies can be in**

---

\*Note: Chapters 2 and 3 are an adaptation of a discussion paper published in Giacometti et al. (2018).

a state of equilibrium, and instead envisions economic trajectories as being complex, non-linear and dynamic. Market and economic conditions are in a state of continuous change, where unexpected events and even shocks are commonplace. Yet, it is only when shocks reach a 'certain magnitude, or occur in a particular context, that the effects become observable' (ibid.).

Evolutionary economic geographers also emphasise the place-based and path-dependent aspects of regional economies. They argue that **specific contextual features of regions play a role in their economic performance, while at the same time decisions made in the past will continue to influence regional development in the future** (Sensier et al., 2016).

### Adaptive resilience

Assuming an evolutionary approach to resilience, a new concept has been introduced: '**adaptive resilience**'. This considers a system's ability to withstand market or environmental shocks without losing the capacity to allocate resources efficiently (Muštra et al., 2016). From this viewpoint, adaptive changes to regional economic structures and social and institutional arrangements are imperative in order to maintain or restore a region's 'previous developmental path, or transit to a new sustainable path' (Muštra et al., 2016). Adaptive resilience is understood as a multifaceted process by Martin

et al. (2016), which comprises four key conditions: **risk, resistance, reorientation and recoverability** (see the next section).

### Deconstructing resilience: a multifaceted process

Martin et al., (2016) provide a categorisation that recognises resilience as a multifaceted process rather than a 'singular, static state of affairs or fixed characteristic of a regional or local economy' (see Figure 1). This conceptualisation of regional resilience comprises four sequential steps: 1) the risk of shocks to a region's key economic players (firms, industries, workers and institutions); 2) the resistance of those actors to the impact of economic shocks; 3) the ability of regional actors to conduct the necessary adjustments (to re-orient and adapt) to resume their main activities; and 4) the degree of recoverability of the shock (Martin et al., 2016).

These four conditions – risk, resistance, reorientation and recoverability – are dependent on the scale, nature and duration of the economic shock (Martin et al., 2016). Likewise, the path dependence or the existing economic path of a region, and many other variables, play a role in the process of enduring a shock. These include regional economic structures, resources, capabilities and competences, as well as business cultures and any supportive measures implemented by different institutions at national and sub-national levels (e.g. welfare sup-

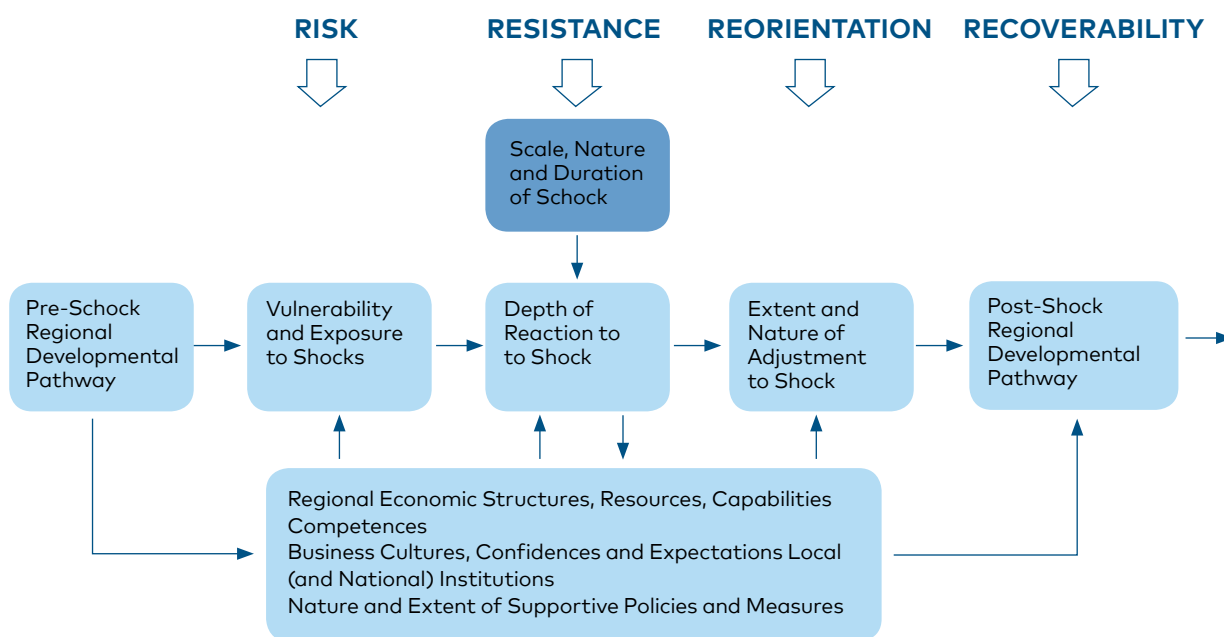


Figure 1: Regional resilience from recessions. Source: Martin et al. (2016)

portive policies and programmes). Similarly, the OECD (2014) connects a comprehensive combination of factors to a region's abilities to endure shocks, in this case assets or capital, including: financial, human, natural, physical, political and social capital (see more in the methodology section).

These wide sets of factors determine the degree of resistance of a regional economy to recessions, but also the adjustments made to economic structures in response to shocks (Martin et al., 2016). Thus, Martin et al. (2016) conclude that regional economic resilience depends on the capacity of the region's firms, industries, workers and institutions to firstly, resist shocks; and secondly, to undertake the necessary adjustments to boost economic performances, including profitability, employment and investment.

## Regional economic resilience

The concept of *economic resilience* has been used to understand and monitor how economies react to different types of recessionary shock, as well as to determine how to build capacity to anticipate economic disturbances. Such a view of resilience is related to the Keynesian theory of business cycles, which implies that periods of recession occur regularly as the economy goes through cycles of economic growth (Martin, 2012). This notion characterises long-running regional economic growth as a sequence of phases with contractions and expansions, '*with turning points defined as "peaks" and "troughs" in activity*' (Martin et al., 2016). However, there is no consensus on how to analyse the reaction of regions to economic cycles.

Martin et al. (2016) review the key perspectives found in literature to analyse economic cycles. What all these perspectives have in common is the element of surprise or the unpredictability of the shock that shakes the regular performance of the economy. The authors note that recessions are different in nature but generally involve the contraction of the economy, closure of firms and loss of employment. However, depending on the intensity of the shock, there is a difference in the depth of the economic impact. For instance, a region that experiences a severe economic shock is likely neither to recover nor return to the pre-shock growth path but instead be redirected onto a different path, which is likely to be an inferior one. It is in this context that the notion of resilience becomes relevant, to scrutinise how a system – a region in this context – reacts to recessionary downturns.

According to Sensier et al. (2016), the notion of regional economic resilience offers local economies the possibility of identifying their own capabilities to cope with economic shocks and act upon this to influence the development path. This suggests that although regions have different capabilities and capacities to react to shocks, they can also actively redirect their development path towards stronger resilience. A deep understanding of a region's adaptive capacities as well as its weaknesses and vulnerability to external developments is necessary for building capacity to anticipate shocks, either by preventing them or by minimising their negative impact.

## Local communities and regional resilience

Regional resilience demands local responses to global challenges; therefore, it is logical to envision a key role for the local community in making regions resilient. During the last decade, there has been an increased focus on social resilience in research (Keck & Sakdapolrak, 2013), often with an explicit focus on communities (see e.g. Keck & Sakdapolrak, 2013; Huggins & Thompson, 2015; Mulligan et al., 2016). For example, the OECD (2016) emphasises **the role of inclusive and cohesive societies as an important driver of resilience, together with active citizens' networks, safe neighbourhoods and healthy lives.**

Criticism towards the depoliticising and ignoring of the role of human agency in resilience research has led to an increased focus on actors, conflicts and processes (see e.g. Martin & Sunley, 2015; Brassett et al., 2013; Bristow & Healy, 2014). Brassett et al. (2013) suggest that future research questions on resilience focusing on actors and expert knowledge relevant to the performance of resilience policy and practice, should look at 'who benefits, and what and/or whom is excluded' (Brassett, 2013, p.225). Similarly, Martin and Sunley (2015, p.12) propose that resilience studies should always specify the 'resilience of what, to what by what means, and with what outcome?'

Studying agency in local communities places further attention on how social agents are organised in complex and interconnected networks, which in turn composes the regional social structures and economies (Bristow & Healy, 2014, p.928). In this light, Bristow and Healy (2014) recognise that strengthening resilience can be possible by public, social and commercial actors working together, and by utilising all available resources.

Local generators of resilience are often narrowed down to local economy and entrepreneurship. Simultaneously, local communities are considered to contribute to resilience by promoting entrepreneurship. Huggins and Thompson (2015) identify the following **local generators of resilience: 1) social cohesion; 2) embracement of education; 3) social values and rules.** In many cases these three aspects of community culture determine the bonding processes within the community, which may be linked to local entrepreneurship through social trust. Similarly, societies that embrace education as a way of transmitting values between generations are more likely to develop institutions that create prerequisites for regional resilience (Huggins & Thompson, 2015).

However, the **ways in which communities contribute to resilience are complex.** For example, **even if social cohesion can contribute to resilience, homogenous cohesive groups can also be exclusive and reject ideas coming from the outside, which may have a negative effect on local resilience** (Huggins & Thompson, 2015). Similarly, it is not confirmed whether individualistic or collectivistic rules and values are better for resilience, since individualistic values may promote entrepreneurial spirit while more collectivistic values may enable, for example, the pooling of resources, and thereby contribute towards stronger resilience to economic shocks (Huggins & Thompson, 2015).

## Governance as a driver for regional resilience

To study resilience, governance bodies and their roles can be of further interest, as they function as connectors between the different actors and as facilitators of communication between, for example, firms, labour force, consumers and interest groups (Bristow & Healy, 2014; Brooks et al., 2015).

In studying resilience, it is not sufficient to study traditional economic factors, and there is a need for studies in governance and leadership to understand what makes certain regions resilient (Brooks et al., 2015). According to the OECD, which identifies governance as one of the four areas that drive resilience, resilience is promoted by clear leadership and management, strategic and integrated approaches, public sector skills, and open and transparent governments (OECD, 2016).

Although resilience is highly dependent on several actors, and no one actor has the capacity to influence or control the overall development, the

state and public-sector actors in general are likely to play a key role (Bristow & Healy, 2014). In the Nordic context, where the role of the public sector is traditionally strong, it can be expected that different public-sector actors, alongside policies, play a key role in promoting regional resilience.

## Socio-economic impact of environmental and ecological resilience

Environmental resilience itself is beyond the scope of this study; however, social and economic systems cannot exist in isolation from ecological systems. Ecosystems are not only a physical recreational space, but also an essential source of economic wealth through primary economic sectors such as forestry, agriculture, fisheries and aquaculture, and ultimately, ecosystems are the arena in which all human activity takes place (Adger et al., 2005). Communities are an integral part of such systems, actively affecting each of its components and conditions, being simultaneously influenced by human and non-human driven eco-systemic factors. Cutter et al. (2008) argue that a community can be resilient without being environmentally resilient. This may be partially true if such a community has a sufficiently diversified source of income and is unaffected by major environmental phenomena. However, this view may lack a holistic perspective on resilience, ignoring the global interdependence of ecosystems and the indirect effects of natural disasters or ecosystem disturbance elsewhere. What can be distinguished is the degree of socio-economic dependence of different communities on ecosystems services and their degree of vulnerability to natural conditions. Depending on this, the socio-economic consequences of environmental stress may vary significantly between communities.

Vulnerability to major storms and floods, as well as volcanic activity in the case of Iceland, are some of the most obvious and large-scale threats to different Nordic regions, potentially affecting every aspect of society and economy. In general terms, however, low eco-systemic resilience may amplify the impact on bioresources' security, therefore undermining food production, water availability, and biomaterials extraction and processing, as well as the jobs dependent on their utilisation (Wiens, 2015). Chemical, thermal and physical pollutants directly compromise human health and wellbeing, increasing the social costs of healthcare and leading to higher mortality levels (Kampa & Castanas, 2008; Patz et al., 2005). Furthermore,



altering landscapes could affect their cultural, recreational and tourism value. Finally, the indirect effects of environmental stress may have significant consequences for societies and economies, namely the scarcity of resources such as water and biore-sources. Major natural disasters can also trigger further conflict and migratory waves from other parts of the world towards Europe and the Nordic countries (World Bank, 2016).

## Types of risks/shocks and stressors

In addition to the context-specific capacities of regions and the wide range of factors involved, regional recoverability and overall resilience also depends significantly on the types of shock, their nature and their intensity.

Resilience thinking is about anticipating and reacting to risks, shocks and stress. In this case, 'risks' and 'shocks' refer to the same negative events and their consequences. The difference is that risk implies probability, and shock implies the event itself (OECD, 2014). Stressors, rather, refer to long-term trends that have weakened the potential of a region and deepened the vulnerability of its actors (ibid.). However, the type, nature and intensity of such

disturbances can vary significantly, and so can their impact. The OECD (2014) categorises three types of risks and shocks: **1) covariate shocks**, infrequent events with an impact on almost everyone; **2) idiosyncratic shocks**, events that specifically affect individuals and families; and **3) seasonal shocks**, recurring events such as annual floods, displacement of people or market fluctuations. Within these major categories, numerous types of shocks and risks may be identified, both from a macro-economic perspective and at local level, as well as from social, political (and geopolitical) and natural (and environmental) perspectives. Table 1 provides a non-exhaustive list of different types of shocks/risks and stressors that have been identified as relevant when studying regional resilience.

Some of the risks and hazard types presented in Table 1 are expanded on here.

### ■ Financial risks/shocks

In a deeply globalised economy and society, the consequences of financial bubbles are devastating. 'A really large bank collapse could be way worse than the global eruption that started with the US

**Table 1: Types of risks/shocks and stressors**

Types of shocks/risks	Hazard type	Description
<b>Covariate shocks</b>	Financial shock	Sudden change in exchange rate or collapse of a credit institution
	Technological shock	Introduction of new disruptive technologies
	Commodity price shock	Sudden change of price of a specific good/service
	Demand-driven shock	Variance in aggregate demand, e.g. due to collapse of consumer confidence leading to drop in spending
	Policy-induced and regulatory shock	Changing the 'rules of the game', e.g. interest rate, tax regimes, increasing the money supply abruptly, trade deals, new prohibitions, regulations and laws
	Geopolitical shock	Resulting from relations between states, tensions, increasing protectionism or liberalisation of markets, or conflicts that disrupt production and consumption
	Environmental shock	Human and non-human driven, e.g. storms, floods, droughts, volcanic activity, fires, collapsing ecosystems, pandemics
<b>Idiosyncratic shocks</b>	Loss of income-generating activity, e.g. closure/relocation of a large industry	
<b>Seasonal shocks</b>	Recurring events, e.g. annual floods or recurrent displacement of people or market fluctuations	
<b>Stressors</b>	Unemployment, market instability, weak institutions, ageing population, mistrust among regional actors, isolation, lack of infrastructure, changing climatic conditions, etc.	

housing loan crash in 2009' (Rosling et al., 2018). It is important to highlight that this event came as a complete surprise. As Rosling et al. (2018) sums up, 'even the best economists in the world failed to predict the last crash and fail year on year to predict the recovery from it'. The global financial crisis has concretely reminded both researchers and practitioners of the complexity of market forces and the difficulty of making accurate predictions. On the one hand, global discourse today recognises much better than in the previous decade that financial markets are inherently unstable due to their dependence on intersubjective communication between individuals who make decision under uncertain conditions and with imperfect information (the Keynesian view). On the other hand, coordinated efforts to improve financial regulation have fallen short of the ambitious goals set out during the latest shock (Lall, 2012). There is reason to expect similar and even more wide-reaching financial crises in the future

#### ■ Technological risks/shocks

Technological shocks result from a process known as 'creative destruction', which implies a transformation of the economic structure because of the mutation or evolution of its industrial base through the emergence of new technologies. The intensity and impact of technological innovations depends, among other factors, on 1) where the technology is pioneered, and 2) whether it is a radical or an incremental innovation. Regarding the first point, technological innovation is geographically unbalanced and generally leads to gains and losses to different industries and their host regions. As for the second point, whether the innovation is incremental or radical can have different consequences on the stake of industries and their supply chains in the market, as well as on the labour market in terms of amount of labour and skills needed. Incremental innovations are the most dominant, and normally represent small leaps forward, whereas radical or disruptive innovations imply major transformation, fundamentally shaking the market and rendering old technologies obsolete.

#### ■ Commodity price fluctuations

Natural resources and basic products are traded as commodities, which means that there is little or no value differentiation attributed to their place of origin (as long as they meet the general stand-

ards). Thus, their prices are determined primarily by the supply and demand in global exchange markets. Despite the efforts made to predict production and consumption rates, there are numerous global factors and events that can significantly divert the price mechanism, such as wars and import tariffs. It is therefore impossible to predict or control commodity prices significantly at regional and local levels.

#### ■ Demand-driven risks/shocks

Variation in the aggregate demand for any product or service can relate with the collapse of consumers' confidence, a decrease in purchasing power, or technological advancements and other trends that may make a product less desirable. Demand can be obstructed at any point of the supply chain.

#### ■ Policy-induced and regulatory risks/shocks

Political risk in the economy and society arises from decisions made at any political level, from local to national and supranational (e.g. the EU), which can have an impact on individuals, business or the economy at large. Political decisions can vary significantly in relation to, for example, interest rates, tax regimes, spending (increasing the money supply abruptly), new prohibitions, trade deals and tariffs, labour laws and environmental regulations. Geopolitical considerations are an additional dimension of political risk (see below). The potential impact on the economy can differ in terms of size and nature, and includes phenomena such as decreases in the purchasing power of households, lowered investment returns, capital flight and a standstill in the volume of new investments, loss of competitiveness, and loss of confidence both of financial markets and political decision-makers. Losing trust in public institutions at the local level can disrupt networks, collaborative culture and business opportunities.

#### ■ Geopolitical risks/shocks

Geopolitical risks result from souring relations between states, political tensions, increasing protectionism or liberalisation of markets, tariffs and sanctions, and conflicts that disrupt production and consumption (supply and demand). The impact of such events can spill over into other risks such as commodity price variations and financial crises. Geopolitics can also have a negative impact on the outlook and competitiveness of specific in-

dustries, on political interstate and interregional cooperation and on other forms of cooperation, such as research partnerships.

### ■ Environmental risks/shocks

Risks related to the environment are normally associated either with natural disasters or with the adverse effects of human activity on ecosystems. When discussing environmental risks in the present context, the primary focus is not on the integrity and survival of ecosystems as an end in itself but rather on the existing and potential consequences of any human- and non-human-driven threat to society and the economy that in some way involves the natural environment. Natural disasters, such as floods, storms, wildfires and volcanic eruptions can potentially affect every aspect of society. Likewise, human-driven actions such as overfishing, pollution and the alteration of landscapes may result in the collapse of an economic resource (e.g. fish stocks, tourist attractions, arable land) or even damage public health. Major shocks may undermine food production and potable water availability and cause increased consumer prices and decreased supply, which may even lead to widespread displacement, migration or armed conflict.

### ■ Stress factors

Stress factors differ from risks/shocks in the sense that they are not abrupt or unpredictable events but rather long-term trends that weaken the potential of a region and its actors to thrive. Accumulated stress often results in a vicious circle where the effects of one stressor reinforces another, in a series of negative feedback loops. As an example, unreliable transportation, the lack of accessibility to higher education, limited labour opportunities and insufficient cultural amenities may lead to outmigration and brain-drain. The shortage of skilled labour, in turn, reduces competitiveness and hinders the development of new economic opportunities. The lack of new job opportunities leads to more outmigration. And as more people leave, the population level drops below the critical mass needed to provide basic services such as specialised healthcare, schooling, financial services and public transportation. If the vicious circle of deteriorating living quality is not interrupted, for example by improving transportation, the risk of major shocks increases. The decision of a key employer in the region to close or relocate due to the shortage

of labour or an inadequate labour force further worsens the unfavourable business environment and the low incentives to invest in infrastructure. Moreover, stress factors not only threaten existing economic activities – they also hinder the emergence of new ones.

At the **macroeconomic level** various kinds of economic shocks, albeit mostly covariate shocks, can be identified, including: 'financial shocks; fiscal shocks; exchange rate shocks; commodity price shocks; productivity/technology shocks; regulatory shocks [policy induced], and, through disasters, shocks to capital stocks' (Sensier et al., 2016; c.f. Table 1). Events occurring at a macroeconomic level also have significant impact at the **regional and local level**. More specifically, shocks that have critical impact locally respond to decisions made at that level or elsewhere, always depending on the prevailing economic and industrial context (ibid.). One example is the closure, downscaling or relocation of major employers or industries (ibid.). The dominance of a single firm or industry in a region represents a major risk, as its employment and economic base relies on the success of one or few actors. Another example is the implementation of a regulation that requires a profound transformation of industries, which could lead to the closure of firms in a region. This is particularly evident in the normative nature of policy efforts to decarbonise the energy sector.

Unless there is one dominant player, regional resilience does not depend on all firms surviving shocks. It is normal for new firms to emerge and others to disappear, even in larger numbers. More important for regional resilience is the net 'population' of firms and industries, to maintain stability, or a net increase, in economic activity. The same is true for the resilience of a specific sector or industry. Resilience is determined not by the survival of all firms within an industry after a shock but rather by the capacity of the industry as a whole to adapt to new conditions. This may happen, for example, by introducing innovative products, services, organisation and technology (Holm and Østergaard, 2015). Such an evolution can generate new spin-offs and attract new jobs and opportunities.

In most cases, such events exhibit a combination of different types of shocks and stressors that are interrelated. The categorisation made here helps an understanding of the causes of economic turmoil. However, in practice, risks that eventually materialise

into shocks are interrelated with other risks and stress factors, as well as global and local trends that impact technologies, consumers demand, production, and so on. To understand a specific event, therefore, it requires a holistic view of all the factors that contribute to economic turmoil, even if it may appear that a single reason triggered the shock. Additionally, shocks can be considered to be either temporary, for example when economic activity returns quickly back to normal (e.g. prices, employment levels) or permanent, when the shocks alter the market/society so drastically that there is no easy return to the status quo. A sudden collapse in the price of oil, for instance, may have permanent consequences. Likewise, shocks can either be

**symmetric**, affecting all regions or industries in the same way, or **asymmetric**, affecting a specific region or industry more than others. For instance, fluctuations in the value of the British pound may have a different impact in different Nordic regions, as was evident in the wake of the unrest in currency markets that followed the Brexit vote in the summer of 2016; and technological innovations could have caused the fall of Nokia, with major economic implications for regions where Nokia was an important employer but causing no harm to other regions. This exemplifies the importance of understanding the context and distinguishing the global and local factors that may generate societal and economic disturbance.

# 3. Methodology\*

---

There are various approaches to studying and measuring resilience. Resilience research has mostly centred on ecological resilience; thus, indicators have been developed mainly around environmental issues (OECD, 2016). As interest in measuring regional resilience from other perspectives has increased, so has the need to identify new indicators. The aim of this chapter is to identify indicators to measure economic resilience at the sub-national level and, to a certain extent, indicators that could specifically benefit the study of resilient local communities.

Resilience can be measured by focusing either on mapping the region's ability to address shocks (by means of the region's own adaptive capacities) or on the specific outcomes of these efforts (OECD, 2016). **The confusion between outputs and capacities is the main challenge for measuring resilience; that a region demonstrates positive economic outcomes (e.g. increased employment) may not necessarily mean that the region is resilient to further shocks** (Sensier et al., 2016). A region that coped well with a shock at a given time may lack capacity-building efforts and thereby have a weakened ability to address future shocks (OECD, 2016). In other words, measuring outputs alone – such as GDP or employment levels and the speed of recovery of these – does not provide meaningful insight about why one region is more resilient than another or whether a region would be resilient to future disturbances (Sensier et al., 2016). This would require more detailed understanding of the inherent adaptive capacities of the region, which can help it resist, respond and recover from a shock (ibid.).

Measuring regional resilience takes both of these dimensions into account; it considers both the revealed resilience (outcomes) and the resilient

capacities. Outcomes can be measured either in relation to a region's own reference indicators or in comparison with other regions (Sensier et al., 2016). Measuring the adaptive capacity, in turn, is more challenging. The indicators used for adaptive capacity do not reveal resilience directly but instead provide an understanding of those capacities and adaptive mechanisms that give a region the means to be resilient (ibid.).

Moreover, useful indicators will often differ from region to region. Although indicative lists of interesting indicators can be made, suitable indicators for studying a specific city or region should be chosen based on local knowledge about the local pre-conditions. As the OECD emphasises, resilience is context-specific and place-based, and thus regions need to identify their own indicators and analyse the results in a context- and place-based manner. The OECD (2014) 'Guidelines for Resilience System Analysis' suggest an overview of the regional assets as different kinds of capital, including financial, human, natural, physical, political and social capital (see also the Methodology section). According to the OECD (2014), these kinds of capital should be contrasted with the identified stressors and risks when designing appropriate counter-measures and policy responses.

In a general overview of the different approaches to measuring regional economic resilience, Martin & Sunley (2015) show the benefit of conducting case-study research in addition to various indices and models (Table 2, next page).

The common feature of the different approaches to studying regional resilience is the emphasis on taking into consideration the time- and place-specific nature of resilience. Resilience cannot be measured with the same indicators in every case, and there are no one-size-fits-all solutions where high results on certain indicators would always imply more resilient regions. The highly complex nature of shocks, responses and actors involved makes it relevant to approach regional resilience from a place-based case-study

---

**\*Note:** Chapters 2 and 3 are an adaptation of a discussion paper published in Giacometti et al. (2018).

**Table 2: Alternative approaches to measuring regional economic resilience (Martin & Sunley, 2015)**

Method	Focus	Examples
<b>1. Case-study based</b>	Mainly narrative based, may involve simple descriptive data and interviews with key actors, interrogation of policies.	Munich (Evans and Karecha, 2014); Cambridge and Swansea (Simmie and Martin, 2010); Buffalo and Cleveland (Cowell, 2013)
<b>2. Resilience indices</b>	Singular or composite, comparative, measures of (relative) resistance and recovery, using key system variables of interest.	UK regions (Martin, 2012); US cities and counties (Augustine et al., 2013; Han and Goetz, 2013)
<b>3. Resilience indices Statistical time series models</b>	Impulse response models; error correction models. These estimate how long it takes for impact of shock to dissipate (how much of the impact is subsequently eliminated per unit time period).	US regions (Blanchard and Katz, 1992); UK regions (Fingleton et al., 2012)
<b>4. Causal structural models</b>	Embedding resilience in regional economic models to generate counterfactual positions of where system would have been in the absence of shock.	US regions (Blanchard and Katz, 1992); UK regions (Fingleton et al., 2012) US metropolitan areas (Doran and Fingleton, 2013); EU regions (Fingleton et al., 2014)

perspective. In order to identify the right indicators to study a region's resilience, it is important to gain an in-depth understanding of the regional context. Subsequently, **in order to study the process whereby regional actors build resilience, a more qualitative, case-study-focused approach is needed (Bristow & Healy, 2014) as a complement to general economic and demographic indicators.** To understand social resilience and how communities and governance bodies adapt to and respond to change, there needs to be a focus on the specific place and context, and this is best achieved by way of case-study research (Bristow & Healy, 2014).

## A methodology for studying regional resilience in the Nordic regions

The context-dependent nature of both resilience studies and regional resilience poses a challenge to the transferability of good-practice cases between different regions. Studying resilient regions requires cross-disciplinary expertise and a thorough understanding of current trends. This encompasses all kinds of industries, technologies, politics and the environment, as well as their respective impact on different levels of governance. The intention of this project is to maintain a wide scope and study a rich sample of regions with different characteristics, industrial bases, social structures and economic paths, to determine the different risk typologies that exist in the Nordic Region. By doing so,

this study will gain insight into the different types of risks that threaten Nordic regions, and into the different types of assets and measures related to those risks that may be important for boosting resilience. However, a comprehensive mapping of the risk landscape in the Nordic regions is beyond the scope of this study.

### Methodology: resilience systems analysis

The methodology designed for the empirical research and case studies in this project (also applicable beyond the Nordic regions) is based on the 'Guidelines for Resilience Systems Analysis' (RSA) developed by the OECD (2014). The RSA methodology was originally designed to support public administration in programming and providing input into policies and strategies. It does so by: 1) analysing the context; 2) exploring scenarios for future changes; and 3) assessing evidence for future change (OECD, 2014). In this case, the approach has been adapted for research purposes, and therefore the length and scope of the study has been restricted. However, the general logic prevails.

The OECD's resilience systems analysis builds on risk management approaches. This approach involves a much wider perspective than single-case analyses as it focuses on the system as a whole, instead of one risk alone or a single event. The added value of applying systems thinking is its



complex approach, which makes it possible to gain a more comprehensive picture of the interlinkages between different risks; for instance, how disasters can trigger economic shocks. It also makes a connection between long-term trends (stressors) spanning economic, social, environmental and physical perspectives, as well as the nature and impact of future trends (OECD, 2014).

Figure 2 (below) visualises the conceptual framework of the RSA. The RSA aims to:

- understand the risk landscape in a specific context
- consider how risks will affect society
- gather information about what elements makes those systems resilient, and what actions are employed to cope with the highlighted risks
- identify possible measures for boosting resilience, the levels of shock absorption and adaption and/ or preventative measures through systems transformation

\*In identifying measures, it is essential to determine the level of administration or societal collaboration from which risks are best managed

- gain a better understanding of how the overall context and risk landscape of the system will change after the measures implemented to boost resilience are put in place.

### The empirical study

In line with the RSA, the following steps have been designed to provide information that is comparable between case-study regions in order to permit comparative analysis about 'the system' in a specific region, its actors, its risks, the historical context and future trends (Figure 3).



Figure 3: Dimensions of the scoping question for a resilience systems analysis. Source: OECD, 2014

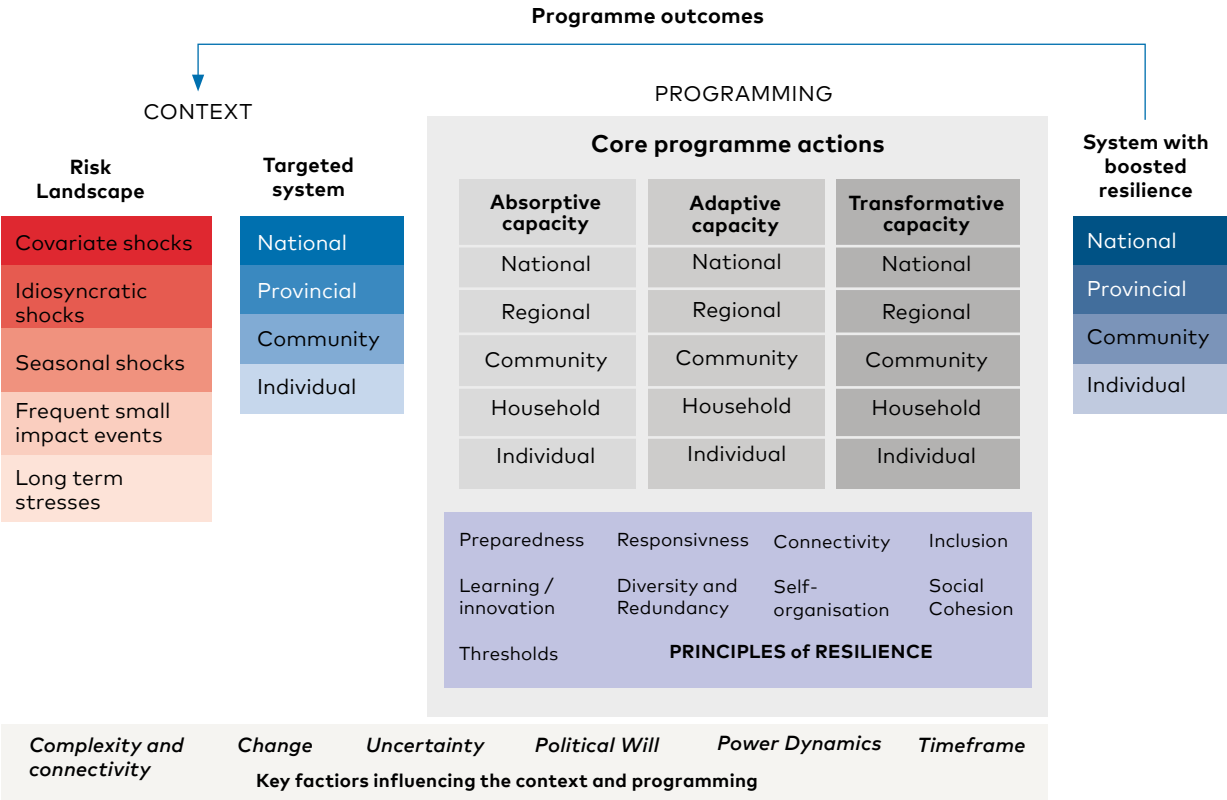


Figure 2: Conceptual framework for the resilience systems analysis. Source: OECD, 2014

## Understanding the system (the region)

The overall wellbeing of a community, in this case a region's economy and society, depends on a combination of different assets, comprising of six main kinds of capital: financial, human, natural, physical, political and social. These may vary significantly in different regions and contexts. Having an overview of the different kinds of capital is useful for studying resilience. This will help develop a more detailed understanding of the specific strengths and weaknesses of the overall system in a given region.

→ Informants will be asked to provide input on:

■ the assets that are essential for an economic and social resilience analysis, and that are present or lacking in their region.

Furthermore, regional resilience is not static; it strengthens or weakens over time depending on numerous variables, both internally and externally. Changing conditions may affect only parts of the system (e.g. one firm and its employees) or fundamentally change it (e.g. remove an entire economic activity), depending on the nature and intensity of the disturbances and the characteristics of the region. Resilience depends on three 'capacities' (Figure

4): the region's **1) absorptive capacity**, which signifies its ability to resist the negative impact of shocks; **2) adaptive capacity**, which signifies its ability to adapt to new conditions; and **3) transformative capacity**, which signifies its ability to change fundamental structures and alter impacts (OECD, 2014). The mere existence of regional assets does not guarantee their effective use in managing risks or enhancing wellbeing, yet their absence may tell us something about the region's vulnerability (ODI, 2016). Therefore, these capacities may be related to what measures are in place, and how regional actors react to shocks and disturbances.

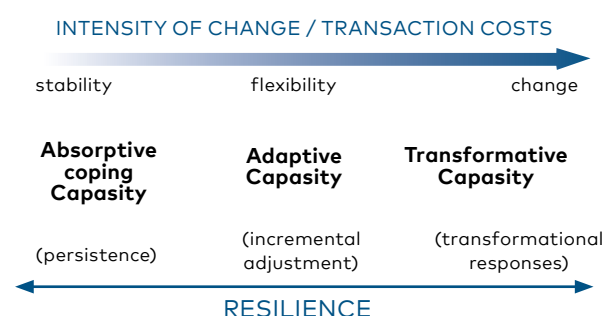


Figure 4: The relationship between absorptive, adaptive and transformative capacities for strengthening regional resilience. Source: OECD, 2014

Table 3: Questionnaire designed to collect existing and lacking assets/capital that are relevant for the regional resilience analysis

Capital	Existing capabilities/assets	Lacking capabilities/assets
<b>Financial</b>	e.g. functioning/stable markets, emergency funds, savings, credit, banking facilities	
<b>Human</b>	e.g. vocational skills, attainment of education, knowledge, practices	
<b>Natural</b>	e.g. forest, agricultural land, livestock, minerals, water resources	
<b>Physical</b>	e.g. commodities, electricity, transport infrastructure, telecommunication infrastructures, productive land/capital, social infrastructure	
<b>Political</b>	e.g. functioning institutions, trust in institutions, participatory processes, political participation in community gatherings, community organisations influencing local power structures	
<b>Social</b>	e.g. community organisations and their capacity to get organised, informal/formal conflict management mechanisms, engaged citizens, minorities participation and integration, trust among actors, security	

→ Informants will be asked to provide input on:

- **what makes their region able to: 1) resist shocks; 2) adapt to new conditions; and/or 3) fundamentally change to strengthen its resilience.**

Finally, to paint a holistic picture of a system's (or region's) key components, it is necessary to identify the regional key actors and their role in impacting on regional resilience. Additionally, this will help determine what their respective risks are. The objective is to interview regional and national actors (per case study region) from the following categories:

- Regional authorities
- City/local authority
- Industry/cluster/private sector informant
- National expert
- Research expert
- Cross-border expert (if applicable)
- Other if appropriate.

→ All informants from all categories will be asked to provide their view on the role of different actors and their potential risks.

## Identifying the risks

In line with OECD guidelines, this project takes a multi-hazard approach to uncovering the risk landscape of the regions studied. This includes a combination of geopolitical, economic, and natural and environmental risks. Depending on the case-study region, the analysis may focus on a narrower set of risks.

In addition to risks, this research will attempt to identify what long-term trends or stressors are present in the regions that may potentially have damaging effects. For example, this could include trends that are weakening the potential of the regional actors to react to shocks, and subsequently their ability to employ counter-measures. The cumulative effects of stressors may also turn into shocks.

→ Informants will be asked to provide input on risks and stressors, both existing and expected. A list of different types of risks and stressors will be shared with informants to stimulate a more detailed discussion in relation to each region's respective contexts.

## Time-span and historical context

Understanding the system requires a historical overview of the regional economy, its industries and institutions, how these have behaved throughout different stages of the economic cycle, and how they coped/responded to previous shocks or threats. This includes taking into account what measures were taken and how other actors reacted to these situations.

→ Informants will be asked to elaborate on the historical development of the region, or simply to relate their answers to their specific historical context.

## Analytical approach

Following from OECD guidelines, the analysis will draw on the collected information to create profiles for the identified risks, including:

**Table 4: Questionnaire designed for collecting information about regions' 'capacities'**

What makes a region able to resist or prevent negative impact of shocks and stress?	What makes a region able to adjust or modify its characteristics and actions without major structural changes (adapt to new conditions)?	What makes a region able to change fundamental structures so that a shock will no longer have any impact?
e.g. diversity of industrial base, contingency plans, savings, safety, reliable infrastructures, long-term vision, sustainable urban development	e.g. R&D, innovation profile, diverse human resources, inclusive society, active community, good leadership	e.g. R&D, innovation profile, diverse human resources, inclusive society, active community, good leadership e.g. entrepreneurship, R&D, close collaboration among regional actors, citizen participation, financial resources available for structural change, smooth vertical coordination (national and regional level institutions)

- type of risk (idiosyncratic or covariate)
- hazard type (natural, geopolitical, economic, etc.)
- related stresses (long-term trends, aggravating factors)
- risk description (summary of what is known about the characteristics of this risk)
- past shocks and scenarios (examples of past events and shocks, and their impact)
- possible impact (description of possible impact on different system components derived from past impacts and scenario exercises).

This study will not measure the probability that identified risks may actually occur. It is thus beyond

this study to determine with absolute certainty the causal relationship between risk and circumstantial events as this would require an extensive, comprehensive study of the risk landscape at large. However, this study aims to contribute to the field of research with a snapshot of the interlinkages and dominant factors that may cause shocks, as well as a sketch of appropriate counter-measures. The analysis will highlight some of these connections between specific risks and specific assets, regional capacities and types of capital. By connecting specific risks with the presence or absence of certain capacities, the analysis will provide insights into how resilience can be proactively strengthened.

## 4. Case studies

Figure 5 presents the five case-study regions selected for this study. The selection process was made in collaboration with the Nordic thematic group for innovative and resilient regions 2017–2020. The selection criteria included: 1) regions from the five Nordic countries; 2) both urban and rural areas;

3) a variety of risks and types of shock. In addition, cases were chosen where a qualitative approach was seen as a complement to economic and demographic indicators to understand how communities adapt to and respond to change.

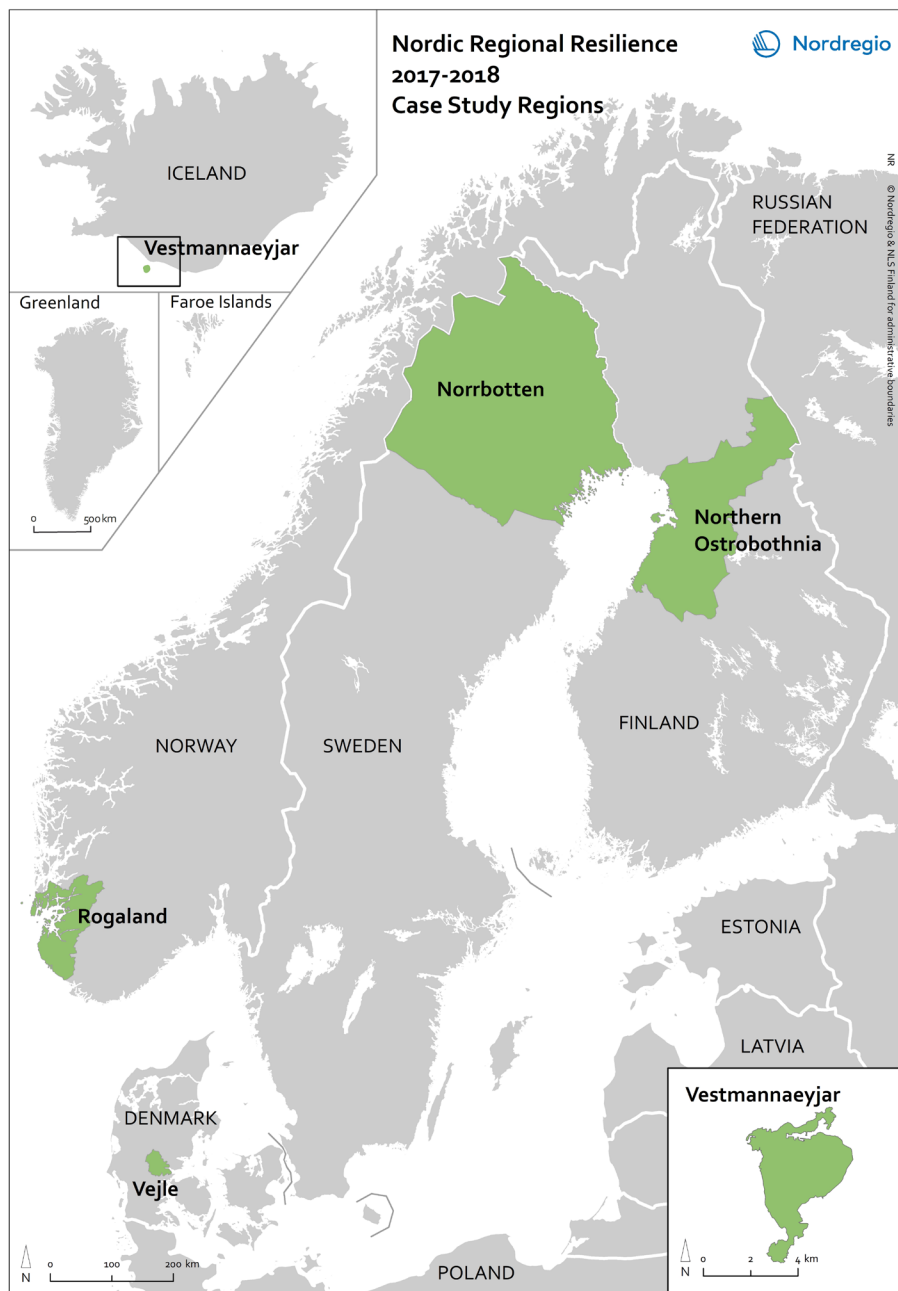


Figure 5: Case-study regions selected for field research

## 4.1 NORTHERN OSTROBOTHNIA, FINLAND

by Eeva Turunen & Alberto Giacometti

### Introduction

The area around the region's capital city, Oulu, was highly-dependent on a single company, Nokia, and a single product, the mobile phone. This proved to be highly risky. A 'technological shock' at the beginning of the 2010s, resulting from a combination of global competition and technological innovation, effectively 'snatched out' the mobile phone industry, one of Northern Ostrobothnia's most profitable businesses, in a short space of time. However, the rapid response of the regional actors, their deeply rooted triple-helix model and the exceptional work force, drove the region's key ICT industry to 'bounce forward' towards a path

of renewed, more resilient regional development. Today, Oulu's ICT sector has spread the risk between numerous SMEs and start-ups with a much broader offer of products and services. The ambition now is to establish better connections between the ICT sector and traditional industries so that the productivity of these industries (e.g. metals, forestry, mining and, most importantly, e-health) is improved by digital technologies. The collapse and subsequent re-bounce of the ICT sector in the region is an excellent example of regional resilience. However, a holistic understanding of resilience in the region cannot be limited to one sector alone without considering the sum of all other economic activities, which together account for the largest share of employment and turnover in the region. It is essential to take a close look at global and local developments in other sectors, such as mining, metals, forestry and agriculture, in order

to gain a more complete picture of how prepared Northern Ostrobothnia is for abrupt changing conditions. No less importantly, global politics (such as souring trade relations with Russia, Brexit, US tariffs on EU exports and social unrest in the Middle East) has direct consequences for regional resilience.

### Territorial factors

Northern Ostrobothnia is the second largest region in Finland with 30 municipalities and 7 sub-regions located from the coast of Bothnian Bay to north-east Finland and to the border of Russia. It has 411,856 inhabitants, almost half of them living in Oulu, which is the sixth most populous city in Finland (Statistics Finland, 2018).

Figure 6 gives a rough illustration of Northern Ostrobothnia's key economic sectors and growth potentials. The most diversified industrial structure is focused on the Oulu sub-region. Oulu, the capital of Northern Ostro-

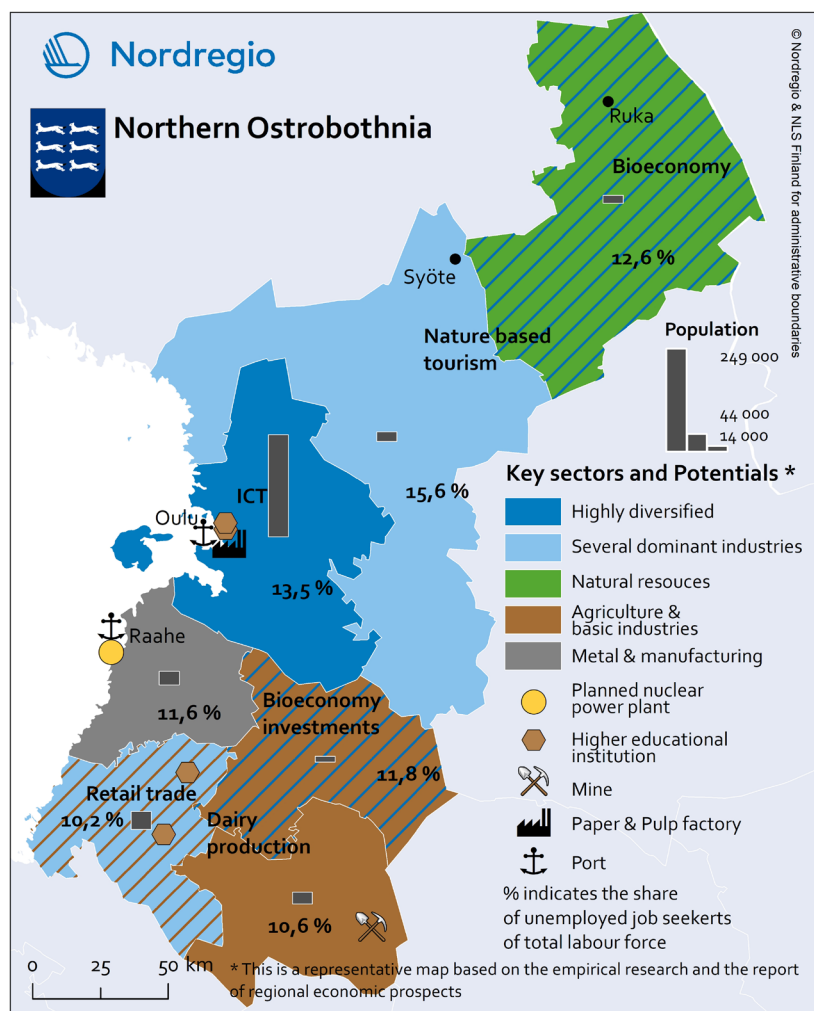


Figure 6: Illustration of industries identified as central for the regional resilience study in Northern Ostrobothnia





*The downturn and rebirth of the ICT sector in Northern Ostrobothnia is an excellent example of regional resilience. The regions' hands-on response and a diverse industrial basis were crucial to withstand the crisis.*

bothnia region, is known as a technology hub and a favourable environment for start-ups, with a strong entrepreneurial culture and many SMEs. In the high-tech industry, in particular, conditions have radically changed since the collapse of mobile phone industry led by Nokia and it has become a much more dynamic and diversified sector. Oulu University and Oulu University of Applied Sciences attract many young people to the city, mostly from other parts of the region. Oulu's potential can especially be seen in the ICT, construction and e-health sectors (Regional Economic Prospects, 2018). New investment in a bioenergy plant and an increasing interest in bio-based products are also seen as potential growth areas for the region.

Outside Oulu the reality is quite different, in terms of both demography and industrial composition. While Oulu has experienced constant population growth over the past few decades, other parts of the region have experienced stagnation or decline. The dominant industries and areas of potential development are mostly based on natural resources, primary production and refining. The metal industry is particularly important in Raase, while forestry and agriculture are the traditional sectors throughout Northern Ostrobothnia. A planned nuclear power plant in Pyhäjoki will also bring new jobs and economic growth, especially to Oulu and neighbouring coastal areas.

The rather young demographic structure, highly skilled labour in technological sectors and strong research and product development capability are acknowledged as current and future strengths for

the region. (Interview 6) Based on their annual turnover, the ICT, metal and construction sectors are the region's top clusters. Increased turnover in the health and cleantech sectors, too, indicate positive development. Construction, ICT and tourism have the highest share of employment by sector (Regional Economic Prospects, 2018). Attractiveness and digitalisation are cross-cutting themes in Northern Ostrobothnia's regional strategic plan (Interview 6). The fast-growing ICT sector is constantly in search of good employees, and the northern region, Oulu and Oulu University are putting a great deal of effort into responding to this challenge by investing in education and attracting international workers and students. However, this remains one of the key challenges. Other important challenges include relatively high youth unemployment in the Nordic context and a mismatch between the skills needed and those available; yet, at the same time, highly skilled labour is available in certain fields such as engineering.

Gross regional product (GRP) and employment rates in Northern Ostrobothnia have matched the rates in Finland as a whole. Specifically, it is worth noting the large drop in GRP in the early 1990s during one of the worst economic crises in Finland. The national crisis also dragged down the economy of the region. However, the exceptional development of Nokia at that time, and its continuing growth, resulted in positive economic growth and employment for the region. A distinct dip in employment can be seen in the early 2000s, partly connected to the first signs of trouble at Nokia. Finally, the

most recent downturn in the years 2008–2010 coincided with the global financial crisis, heightened by the exceptional collapse of the mobile phone industry (Interview 4 & 5).

## **Risk landscape**

This section provides a mapping of different past events (shocks) as well as existing and potential risks to different economic sectors in the region of Northern Ostrobothnia. The aim is to illustrate the different types of situation that can lead to abrupt changes in the social and economic structure of the region or parts of the region.

### **Technological risk**

The 'technological shock' in Oulu results from a process known as 'creative destruction', which essentially implies a transformation of the economic structure because of the 'mutation' or evolution of its industrial base through the emergence of new technologies. In this case, the mobile phone industry, once largely dominated by Nokia, based in Oulu. The sudden collapse of Nokia's mobile phone industry did not come as an isolated event; technology is constantly advancing and companies need to stay up to date, if they are not fore-runners in technological development, if they are to keep their position in the market (Interview 4 & 5). This was precisely one of Nokia's mistakes, when it failed to foresee the potential of touch-screen technology – and later the smartphone – to become the new generation of mobile phones.

The risk materialised as a 'shock' when a new technology (the touchscreen) was introduced to the market by a foreign company, effectively 'snatching away' Nokia's share of the global market. This led to the loss of about 3750 jobs (Ministry of Economic Affairs and Employment of Finland) in high tech companies in Oulu and negative consequences throughout the supply chain (Simonen et al., 2017). In the early 2000s, Nokia started to look outside the region for subcontractors and as a result several service companies had to relocate, close down altogether or adapt to the new situation by broadening their client and innovative capital portfolios (Interview 4 & 5)

The excellent response of the regional actors, their deeply-rooted triple-helix model and the exceptional human capital, drove the ICT industry, a key sector in the region, to 'bounce forward' towards a path of renewed, more resilient regional development. One important factor was that

workers had a strong attachment to the region and did not abandon it during the shock. Instead they had a readiness to change, and many found their way from the electronics industry into high technology services. (Interview 4-6)

Even though the high-tech sector evidences a much healthier situation today, the Council of Oulu Region still considers technological shock to be a major risk to the sector, the regional economy and employment (Council of Oulu Region, 2016). In any potential new shock within the ICT sector, an important difference is now the composition of the industry (Interview 2). The triple-helix model was an effective way to coordinate a response to the structural change resulting from the crash of Nokia. However, it is harder to coordinate a response today, due to the fact that there is now greater diversification in business sectors, with smaller actors and a higher complexity of industries and their interconnectivity, in contrast to a major player (i.e. Nokia) (Interview 4 & 5). An example of this interconnectivity is how ICT technology is being utilised within the health sector (i.e. e-health).

Other important developments connected to the high-tech sector that have an influence on the social structure of the region are, for instance, the gender imbalance and the difficulty of attracting enough young professionals (Interview 6). The high-tech sector, like other key industries, is rather male-dominated. Only one in five employees in software development companies is female, of which a large proportion work in other roles, such as administration (Kaleva, 2018).

Finally, technological risks today are accentuated by the fact that progress in technology is not geographically balanced, and the impact manifests inversely in different regions. While the emergence of the smartphone represented a significant loss for Oulu, it became a huge opportunity for California.

### **Commodity price risk and loss of income-generating activity**

Commodities, such as mineral and forest resources, have little or no value differentiation in relation to their place of origin. Their prices are determined, primarily, by supply and demand in global exchange markets. In spite of the efforts made to predict production and consumption rates, there are numerous factors and events that can significantly divert such patterns, for instance, the war in Syria, Brexit or the unexpected tariffs imposed

by the US government on foreign exports. It is therefore nearly impossible to control the prices of commodities locally. For this reason, countries and regions, such as Northern Ostrobothnia, where a significant share of GDP comes from commodity exports, are highly sensitive to global trends and geopolitics and need to be prepared for major fluctuations. For global markets, it is common for a supplier's network to be more spread out and interactions with subcontractors to be less dependent on local actors. Technological innovations, such as automation and robotics, can replace employees in sectors that are still labour-intensive. On the other hand, new innovations can create more flexibility in terms of price and competitiveness.

The loss of an income-generating activity generally involves one or few key actors deciding to close or relocate an industry. There can be many reasons behind this but, most importantly, relocation can make sense economically if, for example, production is cheaper elsewhere or needs to be closer to particular markets. The depletion of the resource is an inevitable reason to shut down production in the mining sector but when this happens it comes as no surprise. In Northern Ostrobothnia, low prices have been a recurrent reason for the closure of mining activity, for example the bankruptcy of the Hitura nickel mine in 2015 and the temporary closure of the gold mine in Raahe (Interview 6). The zinc and copper resources in Pyhäjärvi will soon be depleted and the mine there will close in 2019, resulting in the loss of approximately 600 jobs and a reduced tax flow to the local area. On the other hand, the innovative use of mines has brought new possibilities to Northern Ostrobothnia, where new mining and tunnelling machines have been tested in the old mines, and existing structures have been used as laboratories for crop husbandry and research environments for particle physics (Interview 6). Such endeavours have shown favourable results. There are plans to modernise SSAB steel factory's operations and another company, Ferrovan, intends to restart its production of vanadium in the region in 2021.

New investment in Raahe's steel factory aside, global market conditions for the metal industry might present some challenges for Northern Ostrobothnia. US tariffs on steel imposed in 2018 might affect global market prices and, with more regulated imports to the United States, the exporting countries may need to find substitute buyers for their products, which might disturb global

steel markets (Interview 8). Even though most exports from the SSAB factory in Raahe are to Nordic countries and Europe, the US tariffs could have indirect effects on profitability.

### ***Demand-driven risk***

Variance in demand for a product can relate to a collapse in consumer confidence or purchasing power, or technological advancement and trends that make a product less desirable. In the case of forest-based products, there are different reasons for fluctuations in demand. One of these is that the digital era has significantly reduced the need for paper for communications, paperwork and so on. On the other hand, the recent price trend for pulp has been favourable because of increased demand in Asia, especially in China, where the demand for tissue and cardboard has been increasing (Kauppalehti, 2018). In Oulu, for example, this favourable trend is seen in Stora Enso's initiative to change its production line from paper to pulp mill. It has announced its preparation for this includes an investment of 700 million euros, an ongoing feasibility study and an environmental impact assessment for its factory in Oulu (Kaleva, 2018). The demand for wood is extremely dependent on domestic construction volumes, however, which in turn depend on the overall economic situation in the region and in Finland.

Furthermore, the increasing opportunities arising from the refinement of forest resources offer possibilities such as the compartmentalisation of the industry and expansion of the product supply. Adding value by producing more refined bio-based products, such as chemicals and bio-fuels, is also emphasised in the region's smart specialisation strategy. These opportunities can provide the sector with a more reliable source of income, making it less reliant on domestic consumption and economic cycles. An example of this kind of development is the investment of 200 million euros in a new bio-based power plant to produce district heating and electricity in Oulu (Interview 1 & 2). However, the development of this industry is highly dependent on clear policies and support mechanisms at national and EU level.

### ***Policy-induced and geopolitical risk***

Geopolitical risks result from souring relations between states, tensions, increasing protectionism or liberalisation of markets, or conflicts that disrupt production and consumption (supply and



demand). The EU sanctions on Russia after its incursion in Ukraine and the retaliatory measures that followed from Russia, had a negative impact on Finnish exports, particularly dairy and beef exports. In Nivala-Haapajärvi sub-region (the most southern sub-region in Northern Ostrobothnia), the sanctions resulted in a 30% drop in farmers' income levels (Council of Oulu Region, 2016). At a national level, this meant economic losses of about 400 million euros (Interview 9). Despite some national efforts to promote domestic food exports and additional EU subsidies on milk products, the financial losses resulting from the sanctions were remarkable in Northern Ostrobothnia. The sanctions also had a significant effect on negative price development in EU markets. These events, together with the EU Common Agricultural Policy, have caused a rather polarising trend in the agricultural sector. This means a decrease in the number of farms engaged in small-scale production and an increase in farms with bigger unit sizes.

As the biggest milk producing region with the highest number of dairy farms in Finland (LUKE, 2018), Northern Ostrobothnia has also confronted this trend. However, in recent years, there has been a great deal of new investment in larger scale production by farmers. Production volumes have also remained the same despite the challenging price conditions and the decrease in the total number of farms. Therefore, despite the challenging circumstances, there are positive expectations for productivity. (Interview 9). Together with new investment and, for example, unused potential in crop husbandry, Northern Ostrobothnia is orienting to adapt for the unstable market conditions (Council of Oulu Region, 2016). The most recent stressor for this sector was an announcement in summer 2018 that Valio Ltd, a Finnish manufacturer of dairy products, was about to mark down its producer's prices. This kind of unfavourable price trend brings particular challenges to farmers with a smaller unit size (ibid.).

Actions to counter the Russian sanctions have included attempts by dairy producers to diversify their products by expanding from traditional milk derivatives to more specialised, longer lasting products such as ice-cream and milk powder (Kauppalehti, 2018). There has also been a trend among farmers towards strengthening and diversifying cooperation and the creation of new subcontracting relations based on machines like food/forest harvesters and tractors. This enables farmers

to intensify production while using the best available technology (Kauppalehti, 2018). Finding substitute sources of income may have been challenging to some individual farmers.

These trends and structural changes are similar throughout Finland and therefore the agricultural challenges and the resulting structural changes are mostly seen as an issue that needs political instruments to be adapted at national governance level (Interview 9). Other challenges connected to the agriculture sector include climate change, weather extremes, unstable costs and the terms of the EU Common Agriculture Policy. These have resulted in changes within the sector such as growing unit size, more centralised production and diversification of income sources.

### ***Policy-induced risk***

Changing the administrative structure brings uncertainty about the new system but can also bring improvements such as more efficient management and less bureaucracy, and can provide further support mechanisms for private investors. It can also result in a more complicated and less well functioning system. The regional authority appears to take a rather positive view of the potential of the reform, however, as it can improve dialogue between national and regional levels. According to the regional plan and the implementation plan, substantial resources have been invested in the process leading to the reform and to provide a solid groundwork as basis for the final decision. Thus, a better understanding may be built at national level of the differences between regions and their key economic activities, and support mechanisms provided that are tailored to the specific needs of regions. Nevertheless, the reform includes several political aspects and therefore the consensus might not be the same among all the actors. There is particular disagreement around the details of the reform. For instance, the six biggest cities in Finland have criticised for its unfavourable policies on the areas that are confronting the greatest demographic and economic growth in Finland, claiming that the planned reform would not give enough consideration to consistent urban policies or secure cities as sufficient economical resources (Cities of Helsinki et al., 2017). However, the regional authority in Northern Ostrobothnia is willing and ready to take the driver's seat in this challenge and work towards the best possible scenario.

### ***Stress: Demographic changes and attractiveness***

In addition to risks and shocks, there are a number of stress-factors in Northern Ostrobothnia that even if they do not have abrupt consequences, they have a substantial influence on the long-term development and resilience of the region. Despite a rather young demographic structure, the working age of the labour force is decreasing, which causes particular challenges for rural areas. Most of the population is concentrated in urban areas, particularly in Oulu. The population is ageing and there is difficulty in attracting young skilled workers and students (Interview 4 & 5). At the same time there is a quite high youth unemployment rate (24.1% in 2016) (Interview 1). According to interviews, there are insufficient links between employers and the labour market (Interview 6), and therefore, there is a mismatch between the skills available and those needed, which is already evidenced in the shortage of labour for certain disciplines. One reason mentioned for the lack of attractiveness for people to move to Oulu for work and studies, is the lack of amenities in the city centre and quite dispersed urban settlement (Interview 2). Finally, the distance of Northern Ostrobothnia to Helsinki appears to play in disfavour for the region in national policy making (Interview 1). On the positive side, however, the diversified economic structure of the region makes it less dependent on a single actor. Additionally, there support is given by the region to unemployed people through education programmes to better meet the companies' needs.

### ***Resilience drivers***

The development of a status report on existing economic activities, and effective coordination between regional and national institutions, appear to be the core mechanisms bolstering long-term thinking and preparedness in Northern Ostrobothnia. The exceptional collaborative culture amongst regional actors has demonstrated their excellent capacity for organisation and reaction in the face of serious problems that have a wide impact on all regional structures, such as was the case during the shocking collapse of Nokia.

### ***National mechanism and regional strategies***

Regional councils in Finland are responsible for the strategic planning of regional development. The regional plan, done every fourth year, is a long-term strategic view of the region's objectives to

develop according to its needs and opportunities. The strategy is always completed together with national authorities and ELY-centres (state level agencies responsible for economic development, transport and the environment), in cooperation with local authorities, universities and other relevant regional authorities.

As part of a key project<sup>1</sup> implemented by the Finnish government to boost employment and competitiveness in the regions, the national institutions started to integrate resilience thinking into mechanisms that aim to support structural changes. Support for regions that confront abrupt structural changes (*äkillinen rakennemuutos*, *ÄRM*) is the first, well-established national mechanism. Following many negative abrupt shocks in Finland, the Ministry of Economic Affairs and Employment started to advise regions to take more action to anticipate these. Resilience thinking and preparedness were also intended to be permanently integrated in the region's development plan, including the more detailed regional implementation plan (Interview 7). However, there is so far no formal evaluation of this.

A funding programme, 'Regional Innovation and Experimenting' (AIKO fund), was announced by the Ministry of Economic Affairs and Employment in 2015, for regional councils to support innovation in their regions. In order to receive this national funding, Finnish regions created action plans on how they would react to anticipated structural changes (*ennakoidun rakennemuutoksen suunnitelma*, *ERM*). (Interview 7). To accomplish this, the regional Council of Oulu Region involved all local authorities in evaluating regional resilience, starting with a status report on local authorities' economic and employment structure. An extensive analysis of the existing structures and figures was carried out, considering the national and global trends surrounding each economic sector, in order to identify any potential risks. The regional council examined each risk-bearing sector and compiled a document in which each sector's preparedness for potential forthcoming shocks was anticipated. The document described each identified risk and anticipatory actions (described in chapter 3). The document also indicated an elaborate action plan

---

1 Key projects: Employment and competitiveness. Boosting competitiveness by improving conditions for business and entrepreneurship. <https://valtioneuvosto.fi/en/implementation-of-the-government-programme>

for different authorities and institutions in case of an abrupt structural change. The long- and short-term strategic elements ensuring regional resilience were also incorporated in the recently updated regional implementation plan. This emphasised the importance of anticipating actions to respond to the depletion of the Pyhäsalmi mine, dynamic conditions within the ICT sector in Oulu region and potential economic growth linked to the nuclear power plant.

The far-reaching work done in preparation for the action plan by involving local authorities, targeting efforts towards good background investigation and a true willingness to find a region's strengths, evidenced the region's high commitment to resilience thinking. These efforts were acknowledged at national level and this was one of the main reasons Northern Ostrobothnia was one of the biggest recipients of AIKO funding in 2016–2018 (Interview 7). Well-integrated resilience thinking is also visible in the region's smart specialisation strategy, which aims to diversify the economic structure within the domains that are the strategy's main focus. It is also closely linked to the anticipatory actions.

Recently, the criteria for applying for abrupt structural change funding has been adapted to incorporate positive structural changes as well. This change has the potential to proactively direct development in line with global trends, and profit from the upcoming opportunities before they turn into threats. (Interview 7)

In addition to this, a major change is expected across the regional administration, as the Finnish government is preparing considerable regional reforms that will unquestionably transform many aspects of the existing mechanisms relevant for resilience. The reform aims at improving dialogue between national and regional levels. To facilitate this dialogue, each region is expected to make a 'snapshot' report on its main measures and objectives. This report does not address the question of resilience directly but it does include short analyses of the region's economic structure, its strengths and any anticipated development trends. The process of elaborating the report also supports the regions to be aware of dynamic conditions and evaluate them. The reform has the potential to strengthen the public institutions and their capacity to react to threatening developments. However, if the new organisation does not effectively respond to needs, there is also a risk of it damaging

well-functioning mechanisms or affecting public trust in public authorities.

### ***Improving resilience by 'creative destruction'***

Northern Ostrobothnia's action plan on anticipated structural change includes a detailed plan for abrupt structural change (shocks), such as a large number of employees being dismissed from a single company or other economic challenges affecting an entire sector or production chain. This action plan is largely based on the good practices learned during the technological shock and sudden structural change experienced by the region's high-tech sector when its over-dependence on a single company and a single product – Nokia Corporation and mobile technology – led to notable structural changes between 2001 and 2011.

Nokia's inability to keep up with international mobile phone markets resulted in approximately 3000 job losses in the high-tech cluster, and it affected the whole supply chain, a highly specialised network of subcontractors (Simonen et al., 2016). Simonen et al. (2016) argued that an efficient combination of creative destruction and correctly allocated policy measures were the key factors for a fast recovery. Creative destruction essentially implies a transformation of the economic structure because of the 'mutation' or evolution of the industrial base through the emergence of new technologies. These success factors are also acknowledged in the regional strategy, which identifies swift reactions and close cooperation and communication between key authorities and organisations as prerequisites of the creation of new successful response mechanisms.

Well-functioning policy measures resulted from the ideal triple helix cooperation between versatile public authorities, an established innovation alliance and an encouraging business sector, 'BusinessOulu', owned by the city of Oulu. The 'Tar Group' was a management group or task force consisting of different public authorities, which was established specifically to address the structural change. It allocated 30 million euros of financial support comprised of 'ÄRM' funding from the national government, and ERDF and EGR funding from the EU. (Interview 6)

Funding was allocated to efforts to build up innovative start-up ecosystems, targeted educational events and courses, and projects within the network of innovators – the 'Innovation Alliance' – and the regional SME network. The responsi-



bilities were shared by the Council of Oulu Region, which was responsible for identifying new potential SMEs and developing novel operational environments; TE-services (employment and economic development offices in Finland) together with ELY-centres, which were responsible for providing tailored human resources and targeted educating services; and ELY-centres, which were responsible for allocating financial and functional investments to SMEs (Herala, et al., 2017).

Targeted education projects were an effective way of helping people to find new job opportunities within the high-tech sector. A high participation rate for the education projects was the first sign of people's commitment (Herala, et al., 2017). Besides the financial support, many new, technology-based business incubators were founded in Oulu. Their aim was to create an innovative social network, where unemployed people could also strengthen and develop their new business ideas based on their expertise. This reduction in the mismatch of know-how between potential new employees and employers was and still is one of the main educational aims in Oulu region (Interview 4; Interview 5).

It was not only people's willingness to re-educate themselves and stay in the region but also Nokia's loyalty to the region that was an interesting enabling factor for rebuilding a creative high-tech cluster in Oulu. Nokia supported educational programmes but also gave away unused patents and provided start-ups with financial packages that could further develop Nokia's ideas (Interview 5). 'Creative destruction' is a good description of the ICT sector's development process in Northern Ostrobothnia. Today there are approximately 650 high-tech companies whose need for competent employees is even stronger than it was before the structural change. However, the shortage of competent labour is one of the biggest challenges for the high-tech sector if it is to grow further (Council of Oulu Region, 2018).

The strong entrepreneurial drive of people in Oulu shows their commitment, loyalty and willingness to change and adapt to transforming conditions. Today this entrepreneurial ecosystem is extremely dynamic and there is a fast developing start-up culture and increasingly diversified SME network. During the past five years, more than 500 high-tech start-ups have been established in Oulu (Oulu Finncam, 2018). According to the OECD and Eurostat's definition of high growth en-

terprises, Northern Ostrobothnia is one of the regions with the highest number of high-tech SMEs in Finland. Furthermore, companies in Northern Ostrobothnia had the highest R&D investment in relation to turnover in Finland in 2015 (Ministry of Economic Affairs and Employment of Finland, 2018). Well-grounded financial support from the region is reinforcing its companies' booming potential, and a remarkably high number of new jobs in Finland are created by domestic SMEs (Herala et al., 2017). Northern Ostrobothnia's biggest challenge now is to respond to their needs with targeted education, new investment in the university and ensuring Oulu's attractiveness to an international labour force (Council of Oulu Region, 2018, interviews).

A reallocation of responsibilities and active co-ordination of regional potential are also planned in the region's updated action plan for sudden structural changes. The action plan mentions a detailed plan for setting up a regional management group to coordinate and support the operational work of ensuring the region's capabilities, education, entrepreneurship and communication (Council of Oulu Region, 2018). Besides the large share of AIKO funding, Northern Ostrobothnia also receives sizeable resources from other national and EU funds (i.e. the European regional development fund and European social funds) to improve employment and increase regional competitiveness (Government Notice, 2018). These resources have been essential not only for enabling the region's resilience during the past technological shock but also for strengthening its potentials and directing it onto a more resilient development path. Compared to the EU and national structural funds, AIKO funding is a small-scale resource, targeted specifically at strengthening regional resilience and supporting innovative micro-projects for economic growth (Interviews or Interview 6 & 7).

### ***Resilience as a cross-cutting idea between the key sectors***

The national and EU funds are allocated by the Council of Oulu Region and the ELY-centres. Under regional reform, however, new counties are to be established, and ELY-centres are to be merged with the regional councils under the same administrative unit. Northern Ostrobothnia's ELY-centre funded regional development projects for companies, with approximately 18 million euros in 2017. The most targeted funding was directed at the ICT

sectors, manufacturing metal industry, timber and wood industry and tourism. The funding was intended, in particular, to support companies' economic competitiveness in the region and to enhance their ability to open international markets (Regional Economic Prospects, 2018). The Ministry of Economic Affairs and Employment monitors and coordinates the region's work by anticipating regional development at national level by compiling regional status reports elaborated by the ELY centres (Regional Economic Prospects, 2018). However, it is likely that there will be changes to this mechanism after the regional reform (Interview 6 & 7).

Besides the region's emphasis on the efficient combination of creative destruction and correctly allocated policy measures, our interviews highlighted the region's resilience potential in terms of its smart specialisation strategy. The idea is to strengthen a region's resilience and companies' competitive ability by creating linkages between the ICT sector and traditional industries. Instead of creating a highly specialised high-tech cluster around one product, the strategy is to spread highly skilled capital across all the smart specialisation domains to find more valuable innovations. E-health is a promising example of this kind of development (Interview 4 & 5, University of Oulu, 2018). In addition to the strong ICT and software sector, the smart specialisation strategy focuses on health and wellness technologies and enhancing the basic industry's value chain. In practice, this means support for Oulu University's Health and Technology Centre (CHT), for example. The refinement of by-products of the agriculture and wood industries into new bio-based products and cleantech solutions is another area of growing possibility and interest in Northern Ostrobothnia. The region has 1369 dairy producers (2014 figures) and a long forestry tradition, and there is a good possibility of developing these traditional industries.

A single but significant factor for the region's resilience is Fennovoima's nuclear power plant, which will be located in Pyhäjoki, approximately 100km south of Oulu. It is the largest investment in the region. It is anticipated that it will create significant growth by engaging industry sectors including energy, metal, machinery and construction, and service sectors like transport, accommodation and commercial services (Regional Economic Prospects, 2018). The construction and further operation of the nuclear power plant will

compensate for some of the negative effects of closing the Pyhäsalmi mine, particularly in terms of employment. This is critical, especially because the mining sector is expected to experience the highest structural risks in Northern Ostrobothnia due to the depletion of resources and uncompetitive prices. This risk has been well acknowledged, however, which is why the inventive reuse of the mining infrastructure has been developed. So far, this has meant, for instance, testing the favourable conditions of mines for research into particle physics, testing new mine machinery and using deep tunnels as seed banks.

## **Findings Northern Ostrobothnia case study**

The efficient combination of creative destruction and correctly allocated policy measures were the key factors for fast recovery (Simonen et al., 2017). This was also a key message of our interviews in Northern Ostrobothnia in February 2018.

An interesting finding was the excellent coordination between all levels of government – national, regional and local – in developing mechanisms to cope with threatening developments, particularly the way all levels were involved in the identification of potential risks, and how they led to concrete measures, incorporating them into the regional implementation plan and the structural change support system at a national level.

More specifically, in the face of a real crisis, the key reason for the successful 're-bounce' of the high-tech sector and regional economy is largely attributed to the excellent organisation capacity of the public authorities through the Tar Group and the activation of a serious and far-reaching response. This also explains the importance of strong social networks, loyalty to the region and the hands-on attitude of the regional actors, including the business sector (Nokia in particular) and society at large, especially the people who lost their jobs but chose to stay in the region and set up their own businesses or re-educate themselves to fit the new demands of the labour market.

In a 'central planning' tradition, one way of dealing with job losses and resilience after the closure of a major economic activity is to establish a new state-funded economic activity. The planned nuclear power plant in Northern Ostrobothnia and the creation of an innovative environment for start-ups and SMEs are perhaps the factors with

most potential in creating new job opportunities. Also, by creating a buffer against potential risk related to commodity prices, Northern Ostrobothnia can be more prepared for commodity price variations within the mining, metal or forestry sectors. By investing in education and maintaining an innovative environment, the region can increase its social capital for dynamic conditions. Through a more diversified economic structure and the compartmentalisation of the high-tech and forest industries, the region can also counterbalance its over-dependence on certain demand groups and economic cycles.

The region's geographic location might be one of its most challenging issues. While Oulu is the sixth most populated city in Finland and the region offers attractive job opportunities, it is still largely perceived as remote and cold. Its distance from Helsinki and other major cities also makes it less influential in terms of decision-making.

### ***Added value of resilience measures in Northern Ostrobothnia***

The added value of resilience measures is perhaps most obviously seen in the re-bounce on economic activity and saving jobs; however, the benefits are much wider. For instance, in the experience of Northern Ostrobothnia, resilience measures resulted in a strengthened public administration and ties between different institutions and private actors. Moreover, the changes resulting from the structural organisation appear to have influenced the region's working culture, entrepreneurship and overall long-term vision of regional development. Last but not least, an increased awareness of the risks, trends and developments within the different economic sectors helps all players in society and the economy better to react, prepare and contribute to make the necessary changes for a more resilient future.

## 4.2 VESTMANNAEYJAR (WESTMAN ISLANDS), ICELAND

*by Hjördís Rut Sigurjónsdóttir & Alberto Giacometti*

### Introduction

The Westman Islands, or Vestmannaeyjar, offer an interesting study of economic and social resilience due to the combination of risks and challenges that arise from the islands' climatic and natural conditions, related to their fishing industry and the broader political environment. Due to the difficult climatic conditions, transport is rather unreliable and can obstruct daily life and economic competitiveness. The volcanic character of the island means there is a latent threat of major eruptions, such as the event in 1973 that resulted in the temporary evacuation of the entire population from the island of Heimaey. At the same time, the location is an asset and an essential part of the identity of the community. Its unique landscapes and nature (for example, it is an ideal location for watching puffins) make it an enchanting place to live and offer huge potential for tourism. Expanding the tourism industry, however, is hindered by unreliable transport to the island.

Its solid fishing industry is the foundation of the town's economy. However, the single-industry economy represents a risky economic path. The number of fisheries has continuously decreased, and fishing activity is now accumulated in a few hands. While this has allowed the industry to remain profitable and competitive, the livelihood of the whole society depends on the decisions of a handful of people. Moreover, any political decisions made in Reykjavik related to the fishing quota system could have a significant impact on the entire sector and the communities, like Vestmannaeyjar, that depend on it.

Furthermore, macroeconomic (e.g. the 2008 financial crisis) and geopolitical (e.g. sanctions on Russia) circumstances have a direct impact on currency value fluctuations and the prices of commodities such as fish. The small Icelandic krona is particularly sensitive to fluctuations, affecting revenue from export industries and consumer prices. Value fluctuations in foreign currencies (e.g. the British pound) have a clear impact on the earnings of the fishing industry. Diversification into other

economic sectors in Vestmannaeyjar, such as tourism, could potentially counterbalance the risks associated with fisheries. To date, the fishing industry still dominates the area's economy and labour, yet diversification within the fishing industry is occurring, maximising the use of every part of the fish and diversifying the products. This provides an opportunity for a stronger, more resilient sector.

The 'island spirit', collectivism and social cohesion have significantly contributed to the recovery of the island's community and economy during difficult times. Confronting the challenges in the community is the key driver for keeping society afloat.

### Territorial factors

Vestmannaeyjar is an archipelago located to the south of mainland Iceland. Despite its difficult location, Heimaey, the largest and only inhabited island in Vestmannaeyjar, is the twelfth largest settlement in Iceland, with around 4300 inhabitants. Over a 70-year period (1906–1973) the population of Heimaey, increased from around 700 to 5300 inhabitants. Its proximity to fishing grounds meant it was an advantageous location for the fisheries sector, leading to economic growth and positive population development. The location, however, has caused major difficulties for the islanders. During the first half of the century, shipping accidents were particularly frequent due to the small size of vessels and rough climatic conditions in the open North Atlantic Ocean. Not to mention the major volcanic eruption in 1973 that led to a complete evacuation of the island, which never regained the pre-eruption population level.

The economy of Vestmannaeyjar is mainly based on the fishing industry, which is the major contributor to the island's finances and accounts for around 50% of the work force (Sævaldsson, 2016). Yet, because of its insular condition, the labour market is fairly diverse as, on a day-to-day basis, residents rely on local commerce and service providers (Þorgrímsdóttir et al. 2012). Unemployment is rather low in Vestmannaeyjar, as in the country as whole, and was estimated to be 2.2% in 2016. Participation in the labour market is quite high and has been rising, with an employment rate of 87.7% in 2016 (Sævaldsson, 2016). Major service activities tend to be based around the fishing industry (e.g. machinery garages). Tourism is a growing sector but is strictly seasonal. Public services are robust, and account for a large share of employment, including public administration, the



District Commissioner's Office, secondary school, hospital and the university centre, which provides facilities for distance learning (Icelandic Regional Development Institute, 2012).

Centralisation policies from Reykjavik, however, have removed some services from the island. Residents complain in particular about the decay of health services. For instance, maternity services are now available only in the mainland, forcing families to travel to Reykjavik in plenty of time before a birth is due, bearing the additional costs themselves. The islands are in many senses considered to be in a vulnerable position. Vestmannaeyjar was included in a 2012 Icelandic Regional Development Institute report about vulnerable places in Iceland. The main reason was a decline in population of 14% between 1994 and 2011. Another concern is the uneven ratio between men and women with an over-represented male share, which partly explains the low birth rate. The proportion of foreign residents has increased from 6% in 2010 to 7.2% in 2016, when the national average was 9% (Þorg-rímsdóttir et al., 2012; Sævaldsson, 2016). Over the last couple of years, the migration trends have reversed, and population levels have seen a modest increase (Icelandic Statistic Office, 2018).

## Risk landscape

This chapter intends to provide a mapping of the existing and potential risks to and past events (shocks) for the social and economic development of Vestmannaeyjar. The aim is to illustrate the different types of risks and accumulated stress factors that can lead to abrupt changes in the social and economic structure in the area studied.

### *Natural and environmental risks Volcanic*

In January 1973, Vestmannaeyjar experienced a major volcanic eruption that destroyed one third of all buildings on Heimaey, including 400 homes and businesses. The entire population of Heimaey (5300 inhabitants) was evacuated overnight, except for 200 rescue workers who stayed to mitigate the effects of the eruption. Rescuers successfully pumped sea-water over the lava stream, stopping it from destroying the harbour and blocking access. The eruption lasted five months and during that time it was unclear whether the islanders would be able to resettle back. After the eruption, Heimaey regained two thirds of its population but the rest never returned. Gradually the community recovered, and the population continued to increase to around 4900 inhabitants in 1991.

*The volcanic character of the island means there is a latent threat of major eruptions, such as the event in 1973 that resulted in the temporary evacuation of the entire population from the island of Heimaey.*



The fast recovery and increasing population development should be attributed, to a large extent, to the islanders who were committed to work on the town's recovery, the bold decisions made within the local authority and the companies that supported and invested in this process. Natural conditions were also favourable when volcanic activity was declared over, on 3 July 1973, the brightest time of the year in a particularly good summer. The fisheries, which had moved their operations to other places in Iceland during the eruption, all decided to return (with their jobs) to Vestmannaeyjar. The local authority received financial support from the government and from collections in the Nordic countries and beyond, to make up for lost assets. It had ambitious plans; some of the funds were earmarked for specific developments and in a short time a gymnasium, swimming pool and retirement home were built. The ash and scoria from the eruptions was used as foundations for streets and houses in a new neighbourhood that had been planned in the early days of the reconstruction. The ambition and determination, in addition to favourable weather conditions that summer, all promoted a good atmosphere and fighting spirit within the people. At this time, it was also fashionable to move to the countryside and, in addition to returning residents, newcomers moved to the islands where there was plenty of work in the fisheries and the reconstruction. When a hard winter hit two years later and living conditions became difficult, ash and scoria blowing in the winds, the local authority made an important decision. It decided to start a large land reclamation project by transporting soil to sow on top of the slag to improve living conditions (Interview 1).

A contingency plan in case of volcanic eruption in Vestmannaeyjar has been developed by the civil protection and emergency management in Iceland, the civil protection committee in Vestmannaeyjar and the local police department. The plan includes risk analyses, migration and coordination; the civil protection agency is responsible for implementing the plan together with the police department in Vestmannaeyjar. Advances in technology have lengthened the notice of natural disasters, although such disasters are unpredictable and the notice is still short. Earth vibrations are closely monitored by the Icelandic Meteorological Office. Following the eruption in 1973, a crisis fund was created for the reconstruction of the town and in 1975, a compulsory natural disaster insurance was

imposed by law. Fundraising was made possible by increased taxes in Iceland and also through donations from the Nordic countries, the USA and beyond.

Most importantly, social cohesion has been the core condition for recovery from this and other past events. People in Iceland stick together and help each other out during natural disasters. Fundraisers are particularly common whenever people are going through difficult times. The nation's search and rescue squads also work on a voluntary basis and are extremely important for the state's security system. The rescue teams work closely with the police and fire departments and can be ready at a moment's notice, but what separates the rescue teams from them is that they are based on voluntary work.

Volcanic eruptions are likely to occur again on the island of Heimaey, which is considered one of the most threatened settlements in Iceland. However, whether that will take place over the next 10, 50 or 100 years, is impossible to know. Nevertheless, the islanders do not live in fear of possible eruptions.

### **Mainland**

Volcanic eruptions, earthquakes and mudflows resulting from deglaciation can disrupt the accessibility of Vestmannaeyjar and interrupt the supply of fresh water and electricity that comes from the mainland.

### **Weather (transportation)**

Transportation is perhaps the island's most important problem and recurrent stress factor for both citizens and business. As an island in the middle of the North Atlantic Ocean, it occupies a difficult location with harsh weather conditions that often disrupt transportation. Two harbours on the mainland connect Vestmannaeyjar with the rest of Iceland and the world: a port in Þorlákshöfn, three hours away, and one in Landeyjahöfn, 35 minutes away. Even though the trip to Landeyjahöfn is much shorter, its location has proved to be impractical due to sand accumulation and shallow waters. Therefore, the port can only be reached with some certainty for four months in the year during summer. During the rest of the year, the risk of trips to Landeyjahöfn being cancelled is high. When Landeyjahöfn is unreachable, the ferry sails to the port in Þorlákshöfn and because of the travel time, the frequency is cut to two trips per day, limiting the number of people, vehicles and goods that can be transported. This also restricts tourism, which



has boomed in the rest of Iceland in recent years. A new ferry, designed to cope better with the sandy and shallow waters, is expected to start operating in the spring of 2019. While the new ferry is expected to improve accessibility to Vestmannaeyjar significantly, sailing to Landeyjarhöfn will still not be possible all year round; however, it will be possible for eight to ten months of the year.

### **Fish**

The availability of fish stocks is naturally volatile, and climate change and overfishing disrupt and can even lead to the collapse of fish stocks. Other parts of Iceland, for instance, experienced the sudden collapse of herring stocks in 1969, which led to severe economic consequences for a few fishing towns such as Siglufjörður (Sild.is, n.d.). Changing ocean temperatures can also bring different fish species such as mackerel, which appeared in Icelandic waters shortly after the economic crisis. The fisheries in Vestmannaeyjar, with good vessels and fishing gear, were quick to gain experience and catch the mackerel. At that time, the mackerel that appeared within the Icelandic jurisdiction was not the best quality. However, by getting Matís on board, a non-profit research company specialising in food production, an innovative solution was found to maximize the utilisation of the mackerel and its value at the same time. Yet mackerel can disappear from the Icelandic waters as quickly as it came, which could have a huge impact on Vestmannaeyjar's fisheries since no agreements have been signed for fishing mackerel outside the Icelandic jurisdiction. A similar situation exists regarding other fish species, such as the capelin, which is a very important source of income but supplies of which are highly volatile. These cases exemplify the vulnerability of fisheries to environmental changes, which in turn represent a risk for the entire economy of Vestmannaeyjar (Interview 3).

### **Opportunities**

Despite setbacks related to nature and climatic conditions, Vestmannaeyjar's unique scenery, nature and history provide enormous potential for tourism. The islands are home to one-fifth of the world's puffin population (Hansen et al., 2011) and the chances of seeing these are high during summer. However, negative changes have occurred in the puffin population in recent years associated with changes in the marine environment. The island's volcanic history and the 'Pompeii' of the

North' exhibition that has been created to capture the story of the 1973 eruption provide an additional attraction. Another exhibition shows the submarine volcanic eruption that resulted in the emergence of Surtsey, the youngest island in Vestmannaeyjar. Surtsey was declared a nature reserve in 1965 and included on UNESCO's World Heritage List in 2008 (Eldheimar.is, n.d.). In addition to this, Vestmannaeyjar local authority is planning to open of a beluga whale sanctuary, in collaboration with Merlin Entertainments Parks in China. These attractions provide solid ground from which to expand the tourism sector; however, this is largely hindered by the unreliable transportation to and from the islands.

### **Financial risk**

The Icelandic krona is a small currency in a small economy, making it quick to experience significant value fluctuations. At the same time, a large proportion of the products and services sold in Iceland and Vestmannaeyjar are imported, as well as the fuel used for transport. This makes Iceland's economy quite sensitive to changes in the exchange rates of foreign currencies, as well as oil and other commodity prices. Moreover, any fluctuation in the Icelandic krona has a direct effect on export gains and consumer prices. The business environment, therefore, is quite volatile. A drop in the Icelandic krona is not a negative scenario overall, however, and it is particularly beneficial for export industries such as fisheries and tourism. Conversely, the local economy is greatly affected as it relies almost solely on income from these two sectors (Interview 3).

The first signs of the global financial crisis appeared in July 2007 when the strong krona started to shake. There was a deep fall in February 2008, and by the end of the year the currency had devaluated by 56% (The Central Bank of Iceland, September 2011). While the crisis was largely damaging for Iceland as a whole, the weak krona significantly increased the gains for the fishing industry, in turn benefiting the economy of Vestmannaeyjar. At first the high inflation impacted people's purchasing power and increased household, company and government debt. However, the fisheries on the island were able to withstand the shock and shortly after this the economic situation in Vestmannaeyjar began to improve. The additional resources allowed the industry to make long-term investments in infrastructure, such as storage and



processing facilities in Vestmannaeyjar. These investments have in turn strengthened the industry's competitiveness by reducing the need to use facilities abroad and being better prepared for other eventualities, such as climatic conditions impeding ships from landing fish in other regions and periods of low profitability. Handling the fish themselves also minimises the risks involved in storing it elsewhere as they have better control of the fish.

Furthermore, the extreme fluctuations in currency value have also occurred reversely. For instance, the value of the krona after the crises increased by almost 70% between August 2009 and June 2017 (The Central Bank of Iceland, September 2017). This resulted in lower export values and thus considerably lower revenues for the fish industry, affecting expenditure and salaries in the Icelandic currency. However, fishermen's salaries are tied to fish prices (i.e. paid according to the value of the catch), while fisheries' accounting and financial obligations (e.g. loans and credit) are often tied to foreign currencies (Arion Bank, 2015). In recent years, the Icelandic fish industry has generally managed to increase product value with more processing and better transport systems (Arion Bank, 2015).

Fluctuations in foreign exchange rates also have an impact on the fish industry. For instance, the drop in value of the British pound following the Brexit vote had a negative impact on the demand for Icelandic fish in Britain, which is an important market for the industry. Another external factor that has a significant influence on the local economy, and specifically the revenues of the fish industry, is a change in oil price; the costs of the industry are closely connected to transport (shipping) costs.

To a certain extent, financial risk is regulated and monitored by the Icelandic Central Bank. The key role of the Central Bank is to create stability in the Icelandic economy through monetary policy, especially by keeping prices as stable as possible. The policy is not meant to achieve other goals, such as affecting the trade balance or sustaining high levels of employment, except if these are in line with the inflation goal (of around 2.5%). The Central Bank enforces monetary policy by steering interest rates on the financial market, primarily by determining the nominal interest rates. The nominal interest rates on mortgages to credit institutions then affect other interest rates on the financial market and have a strong impact on currency flows, exchange rates and long-term domestic de-

mand (Icelandic Central Bank, 2017). The Central Bank also purchases and sells foreign exchange reserves to reduce the fluctuation of the Icelandic krona, and restricts and mitigates the effects of external risks related to the small currency (Icelandic Central Bank, n.d.).

### ***Policy-induced risk/risk of losing income-generating activities/single-sector economy***

The individual transferable quota (ITQ) system that regulates the fishing activity is a highly sensitive topic in Iceland and one of the most politicised. It is a recurrent subject of discussion by society at large. The Icelandic ITQ system puts a limit on the total allowable catch (TAC) per fish species over a predetermined timeframe and defines specific fees for the activity. Ship owners were originally entitled to their ITQ shares on a permanent basis; however, amendments were made to the licensing scheme over the years until the ITQ shares 'became fully divisible and independently transferable, making ITQs more akin to permanent property rights' (Pálsson and Helgason, 2000). The transferability of the fishing rights allowed for a gradual but rapid accumulation of ITQ shares into fewer hands. The concentration of ITQ shares, however, responded to a more complex structural transformation in the sector and society. The limitations on the amount of catches imposed by the quota system, a change towards a more service economy, rural-urban migration and technological advancement made it pivotal for the industry to become more optimised. In practice, this led to a reduced number of fisheries, fewer and larger vessels, and a more automated sector.

Evidence shows that the ITQ system has led to a more efficient and integrated sector, from harvesting to processing and marketing, which in turn has significantly increased profitability (Gunnlaugsson et al., 2018). While many argue that these changes were necessary for ensuring the competitiveness of the sector in international markets and securing the sustainable state of the fish stocks, there are voices advocating for a more equal geographical distribution of the quota shares. According to Pálsson and Helgason (2000), 'fishing rights are still very much intertwined with the symbolic notions of national sovereignty, personal autonomy and equity'. These values therefore conflict with the privatisation of fishing rights. To appease this conflict, in 2004 the Government introduced a fishing fee with a two-fold purpose: 'to finance

the direct cost which the government incurs from managing the resource, and provide the public with a fair share of the resource rent generated by the Icelandic fishing industry' (Gunnlaugsson et al., 2018). However, the ITQ system, and especially the fishing fees, remains at the centre of the political debate in Iceland today. Thus, it remains possible that there will be changes in the ITQ system in the future. However, changes are more likely to concern the fees charged for the fish resource rather than radical amendments to the ITQ system. One worry is that the fees may not respond to how the market is performing in real-time, which might affect the finances of fisheries at particular times, making it especially difficult for small fisheries (The Icelandic Regional Development Institute, 2018). It is also argued that fishing fees may increase the optimisation of fisheries and reduce employment. Therefore, it is being proposed that part of the fishing fees should go directly to local authorities dependent on the fishing sector to soften the foreseen effects of increased fees (Eyjafréttir, November 2018).

In Vestmannaeyjar, the introduction of the ITQ system and further structural changes in the sector led to the concentration of the largest five fisheries into two – Vinnslustöðin and Ísfélagið – which, along with technology advantages, resulted in fewer vessels and the loss of jobs. Together, the fisheries in Vestmannaeyjar own 10–12% of the total Icelandic quota shares and 20–33% of the pelagic fish quota shares. The two largest companies own the bulk of the shares, which makes them important, strong companies not only at local level but also at national level. The economy of the town is mostly dependent on the fishing industry; close to 65% of local authority revenues come from the industry's taxes and it accounts for up to 50% of the town's labour force (Sævaldsson, 2012). This makes the islands extremely vulnerable to any potential changes in the quota system, especially if it threatens the presence of the fishing industry in the archipelago.

Aside from threats related to potential changes in the quota system, a unilateral decision by a fishing company to relocate all or part of its fishing activity outside of Vestmannaeyjar represents a major risk. Companies and quota shares being sold to fisheries outside the islands increases this risk. Even though the key fisheries are considered to be loyal to Vestmannaeyjar, one large company, Bergur Huginn, was sold in 2012, along with its

quota shares, to Sildarvinnslan, a company based in east Iceland. While its operations have stayed in the islands so far, this move makes relocation more likely in the future. Furthermore, if one of the key fisheries relocates, the impact would trickle down the supply chain to the fish processing companies that rely on their catch as well as companies that provide services. Therefore, such a scenario would represent a significant economic loss for the region and a large proportion of the jobs, both directly and indirectly, would vanish. In turn, this would most likely lead to steep outmigration.

Nevertheless, there is no current sign that fisheries intend to move away from Vestmannaeyjar. On the contrary, recent investments make it more likely that operations will continue on the island. For instance, refrigerated storage facilities were recently built, reducing the risk of companies relocating, giving the companies more control of the fish, securing better quality and increasing flexibility. The storage facilities on the island also give fish companies an important resistance to disruption in transportation and support fish being transferred in containers where the correct temperature can be guaranteed all the way to the buyers.

### **Geopolitical risk/demand-driven risk**

The international sanctions imposed on Russia following its incursion into Ukraine, had a significant impact on Icelandic fisheries in the long-term. Yet, before the international sanctions were enforced, Russia was already going through a difficult financial situation that led to a sharp decline in the import of foreign goods, including Icelandic fish. Notably, the Ísfélag Vestmannaeyja fisheries lost around 7–8% of their annual revenues (approximately one billion ISK) in 2014, after a Russian buyer failed to pay for fish that had already been shipped. Furthermore, the retaliatory measures imposed by Russia on countries that participated in the international sanctions, including Iceland, led to the total loss of that market. Even though the global demand for fish is high and continuously growing, entering new markets is both costly and time consuming. Fisheries in Vestmannaeyjar eventually managed to penetrate other markets; however, revenues are still lower today than before the geopolitical shock.

The Brexit vote also had an impact on the Icelandic fish industry. It resulted in a drop in exports of fish to Britain due to the abrupt fall of the British pound. The weak pound affected the consum-

ers' purchasing power and consequently fish consumption went down.

The construction of an on-shore freezing storage infrastructure has given the fishing industry in Vestmannaeyjar more flexibility when markets go down unexpectedly. The freezing storage gives the industry more time to find a solution (e.g. alternative markets) when there is a problem in international trade.

### ***Risk of losing income-generating activity***

Stress factors may represent the biggest threat to small territories such as Vestmannaeyjar in the long run. Stress factors differ from risks in the sense that they are not abrupt or unpredictable events, but rather long-term trends. However, accumulated stress can build up to the point of risking major shocks, such as the closure or relocation of a major industry. Even though the islands have a solid fishing industry that shows no signs of moving away, the effects of accumulated stress could threaten competitiveness on the islands. If conditions were to deteriorate further in the future – for example, if there was a shortage of skilled labour – the industries may start looking outwards. Most importantly, stressors have a major impact in terms of hindering the development of new economic opportunities.

The troublesome nature and unreliability of transport in and out of Vestmannaeyjar appears to be the **islands' most extreme problem**. As mentioned under the 'Natural and Environmental Risks' section, rough climatic conditions obstruct sea and air transport, both for passengers and for industry. For more than eight months a year, conditions simply make it impossible to reach Landeyjarhöfn, the nearest port in mainland Iceland. During that time, the port in Þorlákshöfn is used, but the number of trips is reduced, as is the capacity to transport people and goods. Unreliable and limited transportation restricts the development of new economic activities and particularly hinders tourism opportunities, where the islands have enormous potential; because of the inconvenient transport, tourism is strictly seasonal. The inauguration of Landeyjarhöfn port in 2010 has allowed for increased frequency of passenger and cargo transport during the summer season. This has more than doubled the number of passengers from 127,000 in 2010 to 340,000 in 2017 (Alþingi, 2017–2018; Alþingi, 2015–2016). The increasing numbers of visitors during the summer months, however,

puts additional pressure on local residents who also need to access the already limited transport. This situation is expected to improve significantly when the new ferry starts operating. The capacity and number of trips to Landeyjarhöfn will be increased, providing quicker and more reliable transportation for residents and extending the tourist season. However, rough weather conditions will still prevent the new ferry from reaching Landeyjarhöfn for an estimated four months per year.

Outmigration is another trend putting pressure on Vestmannaeyjar, which to an extent is also connected with the difficult transportation. Another reason for outmigration is the loss of basic services due to Reykjavík's policy of centralisation. Specialised medical services, for instance, have been limited/reduced and centralised in Reykjavík, including childbirth. People in Vestmannaeyjar have to travel to the capital to access specialist medical care, and because of the unreliable transport they often need to plan additional time to do so. This is both time-consuming and costly, not to mention risky. Elliði Vignisson, mayor of Vestmannaeyjar at the time of the study, emphasised that keeping the population level stable or even positive is a continuous struggle, even though there has been a modest increase in recent years. In his words, the period from 2009 onwards *'has probably been the most prosperous period in 70 years, still we only grew about 1% a year, so what will happen when things just go back to normal? There is a strong magnetic force in Reykjavík'* (Interview 2). Outmigration from small urban centres to larger ones is a wider, global phenomenon. However, Vignisson's statement suggests that centralisation policies are reinforcing this trend.

Despite the difficulties, Vestmannaeyjar has managed to withstand periods of sharp downturn and population decline, particularly due to its strong 'island spirit' but also because of its highly profitable fishing industry and closeness to fishing grounds. The community's sense of belonging is said to be the most important driving force for its ability to respond to major natural and economic challenges. Cultural activities and a strong sports culture is said to unite people. The annual cultural festivals on the islands are well known and popular on a national level, attracting many people from all parts of Iceland. Vestmannaeyjar's football and handball teams play in the top national leagues, believed to contribute significantly to a boost in collective pride and cohesion. Furthermore, sala-

ries are rather high in Vestmannaeyjar, 108% of the national average and the highest in the south region, where it was just 91% of the national average (The Icelandic Regional Development Institute, 2016). While younger generations are not so keen on working with fish, the labour gap and high salaries have attracted numerous Polish workers. Although the location might prove problematic in many ways, its closeness to fishing grounds remains a strong magnet for the fishing industry to remain in the islands. Moreover, Vestmannaeyjar is located within the main sailing route connecting Reykjavik with Europe, which results in more cargo ships docking in the islands in contrast to other fishing towns in Iceland. Finally, the establishment of a Knowledge Centre and other educational initiatives, as well as regional and national initiatives, provides additional opportunities for the archipelago.

## Resilience drivers

To create new opportunities in such a narrow labour market, the local authority has established a **Knowledge Centre**. Its role is multifaceted but it is designed to create knowledge about the community, provide opportunities for people to expand their skillset and promote innovative ideas. The operation is sponsored by the local authority and local companies, and is also supported by the provision of services and through cooperation contract and funds. The Knowledge Centre functions as a platform where its premises are rented out to organisations and companies in an endeavour to bring together multidimensional operations, for example in business, tourism, cultural activities and education. This creates a space for sharing and receiving ideas, and promoting discussion and innovation.

The 'Ocean-Related Innovation' programme offered at the Knowledge Centre is an effort to increase diversity and raise educational levels on the island. The programme is a rural project and government-funded but developed and operated by the University of Reykjavík, offered on site in Vestmannaeyjar, in Reykjavik, and through distance learning. The aim is to strengthen ties between academia and the fishing industry where students get the opportunity to work on real projects involving processing and the economic challenges faced by the companies. The fish industry is quite traditional, and new and innovative opportunities are often overlooked. New market niches, high-tech solutions, marketing and sales can enhance

the potential of the fish industry, for example by maximising previously unused parts of the fish.

Another initiative is the FabLab, which aims to re-engage young people by enhancing their education and providing social benefits. The FabLab was established in 2008, training young people in both hard and soft skills, and promoting innovation and a wider mindset. Additionally, since 2003 the Viska life-long learning centre has been promoting and providing education that is not offered in regular educational institutions. Viska is located in the Knowledge Centre and also provides facilities for distance learning. While educational options are considerable in relation to the size of the area, it remains challenging to acquire higher and vocational education on the islands.

At the **regional level**, a Regional Plan of Action has been put in place by the Association of Local Authorities in South Iceland (SASS), which includes future visions, aims and concrete actions. Formally, Iceland does not count with an intermediate jurisdictional level (a region), yet SASS, of which Vestmannaeyjar is a member, provides the platform for addressing issues of a wider scope. In alignment with the National Plan for Regional Development, the regional plan defines the priority areas for the allocation of funds, particularly in projects related to employment, rural development and cultural affairs. The goal is to promote positive social development and strengthen the cultural affairs and competitiveness of each region and the country as whole. It is also meant to simplify interaction between the state and local authorities and to ensure transparency in the allocation and management of national funds, as well as shifting decision-making to local level. In this sense, the regional plans are a mechanism to strengthen the influence of the local authorities in Iceland (Association of Local Authorities in South Iceland, 2015).

At the **national level** several activities have been put in place, mainly by the Icelandic Regional Development Institute, to monitor regional development in different parts of Iceland. The National Plan for Regional Development (2018–2024) approved by parliament in summer 2018 defines the national policy on regional affairs. The aim of the plan is to ensure equal opportunities for all citizens in terms of employment, services and living standards, and to promote sustainable development throughout the country. Emphasis is placed on areas suffering prolonged population decline, unemployment and lacklustre labour markets.

The Icelandic Regional Development Institute audits and reports on the state of rural areas in Iceland. Status analyses were published in 2012 and 2014, and in 2016 an analysis was conducted for the country as whole. This is intended to be a foundation for the regional plans of action presenting future visions and priorities, a reference document providing an overview of different segments within the region, regarding infrastructure and different business sectors. The focus is on education, economic development, transportation, official services, primary processing, industry, support systems/mechanisms, international co-operation, and strategic planning for the Regional Development Plan. In addition, service surveys are conducted to evaluate inhabitants' access to services, population development forecasts for local authorities and analysis of income development in different business sectors.

### **Findings Vestmannaeyjar case study**

The risk landscape in Vestmannaeyjar includes factors that are inherent to the islands, such as location, transport, environmental and natural conditions, as well as the single-industry dependency. Moreover, other risks relate to wider social and economic trends, such as fluctuations in currency value, urbanisation and geopolitics. Some of these risks can potentially have shocking and even devastating consequences, such as volcanic activity, collapse of fish stocks, new tariffs and large fluctuations in currency values or commodity prices. Others are not abrupt but instead induce stress on the population, businesses and public institutions, which may also have long-term effects. Accumulated stress, including lack of reliable transport, lack of accessible higher education, limited labour opportunities, shortage of skilled work and outmigration, are perhaps the biggest threats for small regions such as Vestmannaeyjar. Stressors reinforce other stressors in a vicious cycle, reducing competitiveness, pushing more people away and hindering the development of new economic opportunities.

Past experience has shown that the local community has an incredible capacity to recover from difficult and even life-threatening situations. The strong identity associated with the islands, and their highly praised cultural events and sports clubs, are some of the elements that combine to

create the 'island spirit', which is how the community deals with the many challenges it faces. Nevertheless, there are several conditions, defined in this study as 'stress factors', that drive away many families despite the strong community attachment to the islands. Difficult transport conditions and the centralisation of services in Reykjavik, coupled with a trend towards urban lifestyles and creative jobs, results in many people moving away.

However, some key measures are in place that to an extent counterbalance the effects of some of these key risks and stressors, particularly measures related to improving transportation and education, tackling the issue of a lacklustre labour market, identifying innovative, more creative job opportunities, and generally presenting alternatives to the otherwise narrow employment opportunities. Initiatives that approach education in a broader sense, as a platform for creating innovation in society at large, have great potential to increase the attractiveness of Vestmannaeyjar both for existing employees and for those who are entering the labour market. Moreover, such initiatives also reinforce the presence of the fisheries operating in the islands, which are essential for the livelihood of the whole society, as they provide innovative and alternative uses for their traditional product.

Another important finding is that – although it is a positive factor that the citizens of Vestmannaeyjar do not live in panic about potential environmental hazards – constant monitoring and effective response systems are vital for ensuring the long-term survival of the community. When it comes to the fishing industry, it is essential to have sufficient cash flow to buffer the effects of fluctuations in commodity prices and currency values, or markets being disrupted. Cooling storage infrastructures have also proved to be ideal for the better management of resources and the provision of additional flexibility in the timing of shipments.

Finally, challenges may also represent opportunities, as in the case of the archipelago's location, which provides enormous opportunities for attracting tourism and new settlers. Moreover, shocks and stress are geographically unbalanced and what is a misfortune for some may well be beneficial for others, or in other places. This was evident during the financial crisis, which resulted in peak profits for the fishing industry.



## 4.3 ROGALAND, NORWAY

by Mari Wøien & Alberto Giacometti

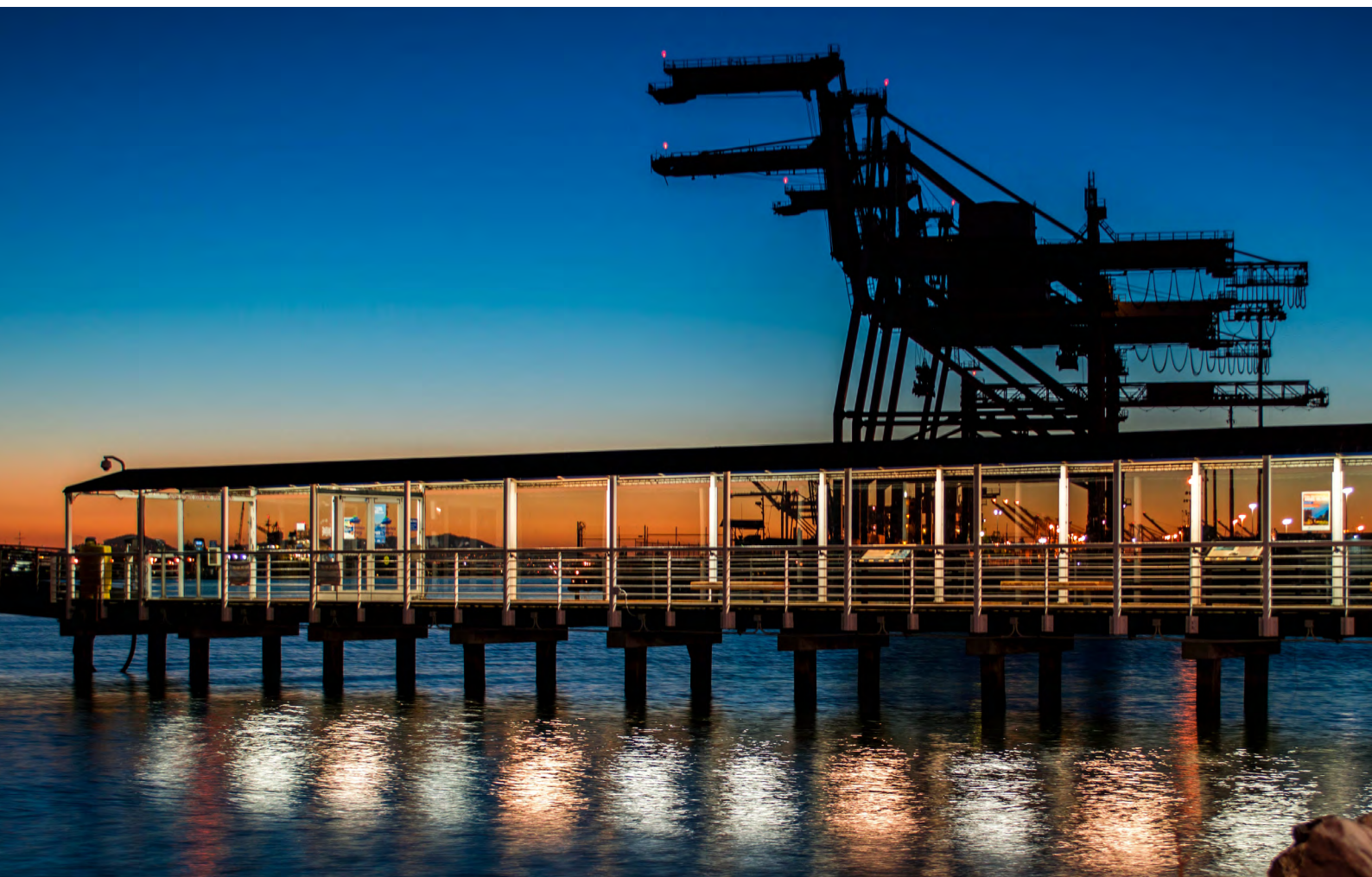
### Introduction

This case study takes a closer look at the risk landscape emerging from the oil and gas crisis that hit Rogaland, a region in the south-western part of Norway in 2014, whilst taking the temperature of the relative resilience of the region in order to build the knowledge-base for responses to crises in the future. Oil and gas have played an important part in building national prosperity in Norway since 1969, not only because of their tremendous revenues but also because of the extent of the employment opportunities the sector has created, both directly and indirectly. The effects of this sector have generally been highly positive but a closer look at the mechanisms below the surface and, for example, its absorption of employment and venture capital, paints a more nuanced picture. This was exemplified when the oil prices fell from US\$115 in June 2014 to US\$55 per barrel

(bbl.) in 2014, and when there was a further plunge in the Europe Brent spot price for oil, which hit its lowest levels of US\$27 bbl. at the start of 2016, leading to a rapid decrease in employment and a flailing economy (EIA, 2018). According to one of the interviewees, the problem is that although the oil industry is highly attractive, it entails significant risks (Interview 8).

However, the abrupt shock and the longevity of the crisis also provided an opportunity to change practices and focus – a so-called ‘positive shock’. Moreover, some of the important opportunities enhanced by the crisis included: the agility the governance structure showed when handling the crisis in trying new methods and new collaborative constellations; the increasingly dynamic regional governance model flowing from the crisis; the diversification of the oil companies towards green energy; new ventures for the service and supplier sectors in new unexplored market segments; and the positive effects the crisis had on other business sectors. The crisis also highlighted the wider social implications and fragility of the

*Oil and gas have played an important part in building national prosperity in Norway since 1969, not only because of their tremendous revenues but also because of the extent of the employment opportunities the sector has created. Photo: Charlie Hang*



regional economic composition tied to the over-dependence on a one-sided natural resource. This is particularly evident in the volatility presented by such an over-dependence when it is exposed to the troughs and highs of global commodity prices, and more so what happens when the bar is raised beyond what is sustainable. The crises also demonstrated the overarching national dimension due to the high values connected to the sector and the region at large, which may have impacted on the national government's response and approach to aiding the region back on its feet.

Following the crisis and the additional funding granted to the larger west coast region (Rogaland and Hordaland in particular), there was a rapid increase in alternative technologies emerging within different sectors, such as the health sector, infrastructure, construction and general environmental technologies. However, with an increase in oil price, these newfound sectors may struggle to remain competitive against the highly profitable petroleum sector.

This case study will consider the relative economic and social resilience of Rogaland as a region, by focusing on the ways in which the oil crisis in 2014 shed light on important functions for *'bouncing forward'* and building resilience for future shocks. Furthermore, the case study will explore the governance structures emerging from the crisis, and the potential the region holds for future diversification of the industrial and economic bases. The aim is to illustrate the weaknesses and strengths of the economic and institutional structure of Rogaland and possible ways to contribute to increased resilience thinking in the region.

## **Territorial factors**

Rogaland is a region located in the south-western part of Norway and is currently comprised of 26 local authority areas. This number will decrease in 2020, when two local authorities will be incorporated into Stavanger local authority, and Sandnes and Forsand local authorities merge (Kartverket, 2018). Rogaland is home to 473,525 people, of which approximately 322,000 people live in the Greater Stavanger region (SSB, 2018; Greater Stavanger, 2015). Stavanger is the third largest city in Norway after Oslo and Bergen. However, the 2017 Regional Development Report for Rogaland shows the lowest population growth in the county since 1951 at 0.32% between 2017 and 2018 (Rogaland Statistikk, 2018). This slow growth

is partly attributed to the outmigration of labour since the oil crisis, and reduced immigration. In the 2017 Regional Development Report, the county stated that when employment is the primary reason for settling, *'(...) it is easier to leave'* (Rogaland Fylkeskommune, 2017).

The industrial make-up of the region has always been tied to the natural resources found in the area, overwhelmingly the sea. The latter part of the nineteenth century was marked by good yields in herring fishing but due to a long-lasting crisis in the 1870s and 1880s, industry, shipyards and trade gradually surpassed herring fishing as the main source of income. The focus was re-structured towards the canning industry, and there were about 300 canned foodstuff factories in the 1920s. This industry had ties back to 1873 when Stavanger Preserving Co. was established to produce provisions for the shipping fleet. Production was particularly high during the First World War when the region exported approximately 350 million cans to both the Entente and the Central Powers. Approximately 400 patents directly connected to the industry were filed between 1880 and 1915 (Forbundet Kysten, n.d.). During the 1920s, nearly 70% of the Norwegian production of canned foods came from Stavanger. In the 1960s and 1970s there was another significant drop in the herring and sprat stock, creating a crisis in the fishing industry that gravely affected the industry. This was partly due to a generally weakened stock because of lower sea temperatures and low levels of available nutrients, but also because of unsustainable herring fishing by the Norwegian fleet, which could not be matched by the natural procreation of the herring stock (Forskning.no, 2005). The seas were fished 'empty'. In 1976, after a few mergers and acquisitions and attempts to save the canning industry, the industry went bankrupt (Forbundet Kysten, n.d.).

Jæren is home to some of the most fertile soil in the country and has a strong agricultural sector, spanning both farming and farming equipment (Interview 9). The county is also known for its quarries, mining industry, maritime industry and IT, and tourism has significantly picked up in recent years (NHO Rogaland, n.d.). Rogaland is the home to popular tourist destinations such as the Pulpit Rock (*Preikestolen*) in Lysefjord, *Kjeragbolten*, and various high cliffs that draw BASE-jumpers from all over the world. After discovering oil in 1969, Rogaland has become the oil and gas capital of



Norway and hosts the headquarters of Equinor (former Statoil), the Norwegian Petroleum Directorate and the Petroleum Safety Authority of Norway. It is also the home of Offshore Northern Seas (ONS), a biennial meeting conference and exhibition for the petroleum sector, gathering approximately 69,000 people from across the world (ONS, 2018; Interview 1).

Considering its industrial and economic history, it appears that Rogaland has been largely dependent on the strength of one industry alone, from herring fishing, to shipyards, to canning and finally oil and gas. As one industry engulfs or surpasses the others, little manoeuvring space remains for the other sectors to compete for human resources on the same level. Although the oil and gas sector in Norway is highly diversified through a highly diverse supplier sector, commodity price shocks have ripple effects far beyond the core industry itself. The industry touches a far greater range of sectors and actors than is immediately evident.

*'When the crisis came, it was a true crisis; there were multiple crises. And you really come to realise how senselessly exposed you are to one-sidedness.'* (Interview 7)

With the oil price crash of 2014, it is interesting to consider the potential for economic and industrial diversification in Rogaland and the strength of the structures imposed during the relatively long period of a feeble oil and gas sector. Regaining its competitiveness and the upsurge in prices in 2018, this is an opportunity to eliminate the path dependency of the recent past.

## **Risk landscape**

This case study offers an overview of the risks present in the Rogaland region, amplified by the challenges that emerged both during and in the aftermath of the oil price drop in 2014. The risks identified are not exhaustive and are based on interviews and desk study research with a specific focus on the oil and gas industry. As stated in the introduction, the aim of this case is to illustrate the weaknesses and strengths of the economic and institutional structure of Rogaland and trace out the possible ways to contribute to increased resilience thinking in the region.

The risk landscape in Rogaland is highly interlinked, as the effects of employment and the supply of employees, the availability of venture capital and

the wellbeing of, for example, the hospitality sector and the construction sector, are both directly and indirectly tied to the strength and competitiveness of the oil and gas sector. Aside from the oil and gas sector, the region has a strong mining sector and some of the most productive quarries in the country, but a larger energy sector (e.g. wind power) and aquaculture are also present. The balance of employment in the technical industries may thus arguably be highly dependent on the ability and scope of technology transfer between sectors, and the availability of retraining and skills development.

Although risks are often co-dependent, it is still possible to discern the different types of risks that the region might be vulnerable to. The list is made with the oil and gas sector in mind, as this has the most wide-reaching effects on the region's resilience in relative terms.

### ***A single-industry economy: natural resource dependency***

Oil and gas extraction have been the source of economic prosperity in Norway since 1969. Rogaland, particularly Stavanger, has been the epicentre of this economic development, and as a result has built up a highly interdependent regional economic structure. With an increasingly high-cost local economy, attractive workplaces and competitive salaries, the sector has absorbed many of the highly educated and highly skilled workers coming to the region. Investment in the region has also been geared towards the oil and gas sector, due to the familiarity of the sector and the safe and secure outputs of financial investments. These factors have proved a challenge to overcome for ensuring the economic and industrial diversification of the area, as potential employees and venture capital have been directed towards the all-encompassing oil and gas sector. The risks tied to oil and gas – natural resource dependency – have wide-reaching effects, and will be illustrated in the section below.

### ***The effects of the petroleum sector on the local economy***

The oil and gas industry is highly interlinked with the general business and service sector and, as such, the gross regional product (GRP) of Rogaland is dominated by a strong oil and gas industry (RFK, 2017; Blomgren et al., 2015). Although the employment rates are not exclusively tied to the oil sector, it is important to note that the oil sector is the

main reason for immigration to the region, both domestically and internationally (Interview 4; RFK, 2017). Oil price fluctuations affect not only the people working in the industry but also the supplier services, technology development, the hospital-ity industry and the construction sector, to mention just a few. Regarding the supplier services and technology development connected to petroleum research and development, it is interesting to consider these as part of the reallocation of human capital in the months and years after the price drop.

Coming second to the public sector in terms of employment, the prosperity of the oil and gas sector plays an overarching sectoral role by influencing a wide range of actors, from taxi drivers, restaurants and hotels to construction firms, technology businesses, academia and the oil and gas companies themselves. Although he had worked with the diversification of the economy, one of the interviewees recognise the difficulties such a strong industry presents in attempting to create a more resilient region:

*'One challenge for a lot of regions in terms of being resilient is having one very strong industry. And then, if you'd like to diversify, and you have economic troubles, it is difficult to get the human and financial resources due to the changes. And when you have an upturn, you have an industry that is being smart, efficient and solid, so they are taking all the people. We have seen that many times. The fishing industry, Boeing in Seattle, Sweden with its military, Gothenburg with the shipyards and car factories... you have seen it several places.'* (Interview 1)

Rogaland has seemingly been dependent on a few dominant sectors as the main financial carriers, and since the early 1970s the petroleum sector has been the major player in the industrial make-up that draws on the available expertise connected to the sea in the area. For example, the wharfs and shipyards in Haugesund and Eigersund play an important role (Interview 5).

The petroleum sector has attracted a highly skilled labour force from across the country and abroad, often alongside additional human capital in the form of spouses and partners – an important aspect for bolstering the regional economic and social composition of the region. The importance of the petroleum sector is arguably thus important not only because of the high returns this sector yields per se, but also due to the wide-

reaching effects it has on the business and service sector in the region at large, as a guarantor for attracting venture capitalists funding new technologies and developments in businesses connected to the petroleum industry.

### **Unemployment rates in Rogaland: the oil price drop**

The unemployment rates in Rogaland have been stable at 1.1% and 2.2% in the period 2008–2013 (NAV, 2017). In the months following the oil price drop, the unemployment rate saw an upsurge from 1.9% at the end of quarter 4 in 2013, growing to 4.5% in 2016 (NAV, 2017). This was unusual, as Rogaland has enjoyed low levels of unemployment below or in line with the national average. However, Rogaland's unemployment rates hit and surpassed the national level in 2015 (NAV, 2017).

There have been several studies on the links between oil production, oil price shocks, job destruction and job reallocation (e.g. Bjørnland & Thorsrud, 2013; Blomgren et al., 2015; Cappelen et al., 2014; Davis & Haltiwagner, 2001; Herrera & Karaki, 2015). Bjørnland and Thorsrud (2015) point to the underestimated effects of international oil and gas price fluctuation on the Norwegian domestic economy, as these may be responsible for up to 30% of the general fluctuations in national GDP. Moreover, these exogenous price fluctuations also explain the employment and salary levels in the petroleum sector to a large extent (ibid., 2015: 25). Bjørnland and Thorsrud also point to the tight relationship between increasing oil prices and the national budget, demonstrating that the budgetary rule (*'Handlingsregelen'*<sup>2</sup>) mirrored this development. It is worth noting, however, that the percentage was adjusted from 4% to 3% in 2017, based on the expected future returns from the Government Pension Fund (Regjeringen, 2018). This adjustment was a result of less stable oil prices in the years after the oil price drop.

In Norway, oil and gas extraction alongside the export of oil pipes made up approximately 21% of GDP in 2013 (Cappelen et al., 2014). The number of people employed by the industry, directly or indirectly, was estimated at around 13% nationally

---

2 <sup>2</sup> 'Handlingsregelen' is a budgetary rule, which was adopted by the Norwegian parliament in 2001. It sets out guidelines regarding the management of the capital gains from the petroleum sector, where a maximum of 3% of the returns from the *Government Pension Fund – Global* may be allocated to the national budget each year (Regjeringen, 2018).

in 2014 (Blomgren et al., 2015). It is important to keep in mind that although the sector employs people across the country, it is most heavily concentrated in the counties of Rogaland, Hordaland, Møre og Romsdal, Akershus and Agder (ibid.). The International Research Institute of Stavanger (IRIS) estimates that approximately 40% of the local labour force in Rogaland (about 99,000 workers) is directly or indirectly connected to the oil and gas industry, considering the extent of the value chain from the operating oil company to equipment suppliers, finance, IT, hospitality and so on (cf Blomgren et al., 2015: 9–13). In the Greater Stavanger region alone, 86,100 people work directly or indirectly in this sector (ibid. 2015: 15), of which 57,000 works in direct relation to the sector (Blomgren et al., 2015: 126) – one third of all employees in business-related activities in the county (ibid.). The definition of the direct and indirect connection to the petroleum sector differs. For example, in Ekeklund's article on employment rates in areas related to petroleum, the figure is lower as the scope is limited to operating companies and companies delivering services and equipment to the petroleum sector (Ekeklund, 2012). However, when considering risks and the potential impact of shocks, it is important to understanding the relative interdependency of one sector, especially in economies heavily dependent on natural resources or a single industry. The extent of this single sector makes for a difficult process for industrial and economic diversification. However, the recent impact on the labour market due to the oil price shock was a wake-up call:

*'With the formidable margins come high costs and high wages, which makes it difficult to think about restructuring towards other opportunities. However, the last few years has shown that the alternative to restructuring is unemployment... it has been a reality check. People have taken different jobs with other wages.'* (Interview 8)

### **Securing the future labour force**

One of the main concerns at present is ensuring the skills and competencies needed for the future are available. Attracting young people to the region is an increasingly difficult problem. The oil and gas sector was previously unprecedented in attracting eager young minds to Rogaland, but these young engineers are no longer moving to the

county. According to the interviews, this could be due to: 1) the fact that the oil and gas sector has until now struggled to regain its financial strength and competitiveness; and/or 2) the green agenda and the reputation of oil and gas as a 'dirty' industry (Interview 4). According to the interviewee from the county administration, young people are changing their career plans due to the negative framing of the oil and gas industry in the media. This, together with a risk-averse attitude towards finding employment, has led young people to move away from the oil and gas sector and other related areas, and often towards sectors that are already saturated.

The challenging period in the oil and gas industry also affected the number of apprenticeships in the region, especially in technology and construction work. Guaranteeing apprenticeships is especially important for ensuring an active labour force in the future and to avoid further school drop-outs. Lower prices meant less capacity in firms and businesses that would provide practical learning opportunities. Unemployment levels amongst young men is still relatively high and this is particularly concerning because their inactivity is increasingly lasting for longer periods of time, according to one interviewee (Interview 2). However, since July 2018, the labour market has seen a positive trend and is increasingly normalising; partly due to an increased number of temporary contracts (Stavanger Aftenblad, 2018). Arguably, the increase in such contracts may imply the need to continue the diversification of the economic structure of the region.

As such, the crisis elevated the need for the region not only to diversify but also to rebrand itself as an 'energy' region. This rebranding for diversification and attractiveness is also stated in Greater Stavanger's Industrial Strategy 2018–2025: *'[...] we must develop the oil position to become an energy region. This is dependent on a willingness to develop'* (Greater Stavanger, 2018: 9).

Creating a sound institutional structure that supports the development of skills for existing opportunities is paramount for the viability of the future labour force. The crisis in Rogaland and Greater Stavanger exemplifies how far these ripples reach in jeopardising not only the present but also the future. Arguably, this is one of the strongest arguments for diversifying the economic structures and creating an attractive region for the future.

## Geopolitical and commodity price shocks

As a small, open economy highly dependent on natural resources, Norway is exposed to exogenous factors, whether these are changes on the geopolitical platform or global market exchange rates. Norway's oil economy is thus highly vulnerable to changes in commodity prices, caught between the oil- and gas-producing giants of Saudi Arabia and Russia within the Organisation of Petroleum Exporting Countries (OPEC), and the USA. Prices dropped by 70% in the period 2014–2016, a shock that was primarily supply-driven, riding on the technological breakthrough of US shale gas production and a slowdown in oil importing countries due to the overall drag in global economic activity (World Bank, 2018). Despite attempts to diversify export commodities, oil-exporting countries continue to have some of the least diverse economic structures in the world (ibid.).

The oil price drop in 2014 was not the first commodity price shock felt in this industry since the dawn of Norwegian petroleum exploration. According to one interviewee, the rapid escalation of oil prices in the 1970s, just as Norway entered the scene, helped push the country to become a competent oil-exporting economy, due to the high oil prices set by OPEC. As oil-producing countries outside OPEC became increasingly profitable, the result was stagnation in market demand, causing OPEC to lower its price to US\$10 per barrel to ensure its market share (The Economist, 1999). However, OPEC significantly underestimated the ability of other oil-producing nations to capitalise on the favourable situation of the low dollar per barrel price. With a long history in shipping and the processing industry, Norway focused heavily on technological development to cap costs, and took on OPEC by being able to match the lower price levels set by the organisation, one interviewee recounts.

The oil crisis in 1998 was the result of keen, new oil-producing nations and the discovery of new oil fields in the Gulf of Mexico and the United States, alongside the Asian financial crisis (Forbes, 2015; Fortune, 2015). With a significant increase in global production levels alongside a rapidly shrinking demand for oil from Asia, demand was not high enough to meet the high levels of production (ibid.; The Economist, 1999). In Norway, this led to the restructuring of the oil industry. The crisis lasted only months but during this time, the greater Stavanger region created the Greater Stavanger

Consortium, a political organisation working to collaborate on economic development and the diversification of the industrial basis, recognising that there was a need to create 'critical mass' to overcome challenges in the future (Interview 3). However, it is a 'truth universally acknowledged' amongst the key actors in the local authority areas forming Greater Stavanger that even if a strategy had been in place for diversifying the economic structure in the years leading up to the crisis in 2014, the challenges following the oil crisis would still have unfolded in a similar way. This is because the clear majority of funding and finance available was channelled towards the oil and gas industry due to its formidable, exorbitant returns (Greater Stavanger, 2018; Interview 8). This amplifies the absorption capacity of the oil and gas sector, and its effects on the region's power to restructure and influence the development of new business opportunities in different sectors. This optimism for the future is legitimate, though it is highly dependent on the continued innovative prowess of the oil and gas industry in Rogaland, and also its ability to diversify further. Despite the diversification of product portfolios, such as Equinor's (Stat-oil) move towards wind power, the market is still not quick enough to adapt to new energy sources (Interview 8; Interview 6). According to one of the interviewees, the problem is that the government is not investing enough in alternative energy markets:

*'There is little demand for this locally. The regulations are too fuzzy [for alternative energy markets], and the business case is thus too risky. The whole rhetoric of maximising output per [Norwegian] krone doesn't work [...] We invested in hydropower. That was a long-term strategy. But it is not the same for wind power.'*

The oil price shock in 2014 was a real crisis for those involved. The disruptions that were felt most strongly were related to the extensive impact oil and gas have on the labour market and employment in the region.

## Technological shock

The oil price drop was the result of both technological advancements and significant changes in supply and demand in net oil-importing countries. Oil production in Norway saw a formidable upturn in the early 2000s, with a soaring oil price per barrel combined with increasing gas production. However, moving towards 2013–2014, oil production

slowed, and costs continued to climb without sufficient attention being paid to price development generally. There was also an increased focus on the green transition and renewables and changing attitudes towards oil and gas extraction politically (Interview 8; Interview 7; Interview 1). These domestic issues were also affected by general developments on the global stage with the US shale gas technological 'revolution' and hydraulic fracturing ('fracking'). The United States caught oil producers off guard by doubling its production levels after an intensive period of innovation (Interview 5; Forbes, 2018a; Forbes, 2018b).

The technological shock generated by the serious acceleration of technology development in the US shale gas industry can largely be attributed to geopolitical changes, according to Forbes (2018a). With OPEC allowing prices to drop to 'ruinously' low levels in an attempt to disrupt shale technology development and the US path to energy independence, US shale gas companies responded by investing in innovation, cutting costs and increasing their efficiency (Forbes, 2018a). Moreover, the production of shale gas is demonstrably competitive at US\$50–55 per barrel (TU, 2017). States such as Pennsylvania and New York are reportedly becoming energy exporters, and the northern states are overtaking the Gulf region as the largest gas producers in the United States (Forbes, 2018b). One of the interviewees recalls:

*'I have worked with and in the oil industry for nearly 50 years. That the USA was to become self-sufficient in terms of oil, even though they were net exporters in 1977–78, no one, no one could have imagined this.'* (Interview 7)

Events in the oil and gas sector in Norway in 2013–2014 were later exacerbated by the sudden amplified strength of the United States as a gas-producing nation in 2016, and the saturated market affected the costs and price development. Although the technological development of shale gas was revolutionising and had been simmering underneath the surface, it was nevertheless its effect on competing energy markets and dramatic price drop to US\$34 that was the real shock (Interview 5).

## Resilience drivers

The agility of the regional system in Rogaland became evident after the crisis in 2014, as new, ad hoc constellations were formed between various

actors in the public and private sectors. Although funds were allocated to help the region get back on its feet, the regional actors were given the autonomy to restructure and rebuild the region, with minimal interference from the government:

*'Both NAV<sup>3</sup> and the county council and the municipality went above and beyond the boundaries of our typical role descriptions. [The government] let us fix it ourselves. And this is a very important lesson. The government must stay put. One needs to trust that the local actors know where it hurts and how to fix it.'* (Interview 2)

The next section illustrates the way the region responded to the disruption and challenges that followed the oil price drop.

## Policies and role of institutions

A society's ability to organise the central actors in the region demonstrates the adaptive capacity that society may display when disaster strikes. Although financial mechanisms were in place to ensure tax rebates and extra funds towards business development, the signal coming from the government was to work through the crisis at the local level. Looking back at the structures predating the crisis, the flexibility and capacity for change within the region has become significantly better, a change noted by all the interviewees for this case study. This was also helped by the existence of personal networks in the region:

*'This region is known for its ability to collaborate. It is large enough for variation, but small enough to know each other. And that means trust. It helps create a foundation [...] It has been a competitive advantage in this region.'* (Interview 8)

Key actors in the region created a consortium called 'Active Efforts' (Aktive Grep), comprised of the county governor, the education authorities (i.e. the county administration), the Norwegian Labour and Welfare Administration (NAV), the Norwegian Labour Organisation, the Norwegian Trade Association and the Chamber of Commerce in the Stavanger region, to synchronise their efforts and ensure that the crisis was adequately addressed in all sectors. The government also provided significant funds to ameliorate the situation in the state

---

3 The Norwegian Labour and Welfare Administration



budget in 2016 and the revised national budget in May 2016 (Regjeringen, 2015; 2016). Additionally, the symbolic effect of ministers visiting the area during the crisis was of particular importance, according to NAV (Interview 2).

The flexibility given to the local branches of national agencies is also remarkable. For example, the local NAV office reorganised its capacities in order to adequately address the dire unemployment situation, and to balance the situation until a new path had been forged. In dealing with the crisis, the local NAV contacted the directorate to ask for more resources to handle the large workloads (Interview 2). The regional NAV office was unprepared for the momentous task that lay before it, as it normally worked with a much lower unemployment rate of 1.7–2.3%. Because of the gravity of the situation, the directorate in Oslo allowed the local office to go beyond its budget. Adopting a proactive approach, the NAV office created a team to call everyone who registered with the employment services, to ameliorate the situation by demonstrating that there was a network to help them back on their feet. It also took the initiative to request new classes and training programmes from the education department at the county administration, and subsequently contacted all registered unemployed youth to encourage further education and training to avoid a larger increase of unemployment than was necessary (Interview 4; Interview 2). As one of the interviewees stated:

*'What constitutes resilience... it has many factors. But for this region one of the single most important factors for building resilience is culture-based, and what role you have for resolving the issue. It's about cooperation, trust and about mutual respect.'* (Interview 5)

The new clientele was also different from those who normally made use of NAV's services. This group was highly educated and not accustomed to losing their jobs or working in volatile sectors. They differed from industry workers, who tend to be more risk-aware due to factors such as low educational attainment, however that might be compensated by many years of experience. The highest numbers of unemployed men in Rogaland were in construction, industry and IT, with percentage changes of 111%, 158% and 221% respectively from the year before; consultancy also saw a dramatic increase in unemployment at 149% change (NAV,

2015). NAV contacted regional businesses and companies to set up a scheme to get people back into work, consciously avoiding the oil and gas sector (Interview 5; Interview 2). Supporting these businesses, NAV communicated that they had the resources to train new employees if the companies were willing to develop new products. In this way, productivity and innovation could continue to thrive, and there could be new entrepreneurial discoveries through the new competencies that came with the companies.

The governor's office of Stavanger and NAV also jointly created a meeting space in the old export terminal in Stavanger city centre, rebranding it the 'Terminal of Opportunities'. The symbolism in creating this terminal was important; it demonstrated that the public authorities were actively working to improve people's situations. The terminal provided a space for the recently unemployed to work on their CVs, network, participate in seminars and motivational talks, and prepare for interviews. It became an informal meeting place for people facilitated by NAV, a role it had never previously had. Nevertheless, it was the most important role NAV could play at the time:

*'We had to break away from the old way of working within this organisation. The normal way did not work with this situation.'* (Interview 2)

The media also played an important role in spreading the message about the severity of the crisis, encouraging people to leave if they had the chance to do so, as the situation looked as though it would become even more dire. NAV Stavanger actively used the media to relay the message of tough times ahead and encourage people to find jobs elsewhere. By so doing, NAV bought itself time and capacity as people moved elsewhere to find opportunities. This use of the media is also interesting in terms of the difficulties of ensuring skills and competencies for the future, in that the media painted a dire picture of the situation in Rogaland, whilst not highlighting the possibilities in other sectors, according to the interviewees.

The main reasons people moved to Rogaland had by and large been for employment, thus a lot of people, especially foreigners, now moved away. However, there was still a level of loyalty connected to the region as some people chose to stay and instead changed their career path. The most dramatic example is the petroleum engineer who



became a preschool teacher, but there are also interesting examples of oil flow engineers working with medical technologies (Interview 5; Interview 8). Some people may have stayed behind because of their experience of previous price shocks and the expectation that the situation would get better. However, the price shocks in 2008 and 1998 were far shorter than the one that hit in mid-2014.

### **The Government's Pension Fund**

Although the Government's Pension Fund abroad is not a new measure, it is nevertheless an important resilience measure for the country at large. The Government Pension Fund, which was mentioned earlier in this chapter, is a 'savings account' to safeguard for the future rising public pension expenditures and it 'supports long term considerations in the spending of the government's petroleum revenues' (Government, n.d.) The fund is divided in two: the Government's Pension Fund Global and the Pension Fund Norway. The main responsibility is vested in the Ministry of Finance, and the operation of the two funds is carried out by Norges Bank and *Folketrygdfondet* (Government, n.d. 1). The investment strategy is based on a principle of 'maximis[ing] the return on fund assets within a moderate level of risk', and the Government's Pension Fund Global is dispersed across 9000 companies in 72 countries (per 2017. NBIM n.d.).

### **Creative and attractive region: a positive shock**

It was evident from the interviews for this case study that the oil price drop, although a shock, was a positive wake-up call for the region at large. It drew attention to the weaknesses of the regional industrial and economic bases and led to a significant reframing of the region's strengths at large. According to the Greater Stavanger Consortium, the rebranding of the region as an energy region is gaining some foothold as the region is increasingly promoting Rogaland as 'being more than oil and gas' (Interview 3). This is not only important for attracting future investment both nationally and internationally, but also for attracting labour and young people interested in green technology and green growth (Interview 4; Interview 3). The oil and gas sector seemingly are also bowing to the green wave sweeping across the country. Most notable is Statoil, whose name changed to Equinor in May 2018 to reflect an increasingly broad product portfolio, which may be seen as a sign of the power of a

powerful new green discourse (Interview 8; Interview 7; Equinor, 2018). The next section takes a look at the renewed focus and measures taken to broaden the scope for economic and social resilience.

### **Entrepreneurship and new opportunities**

Innovation Norway, the national innovation agency, experienced a record number of applications for start-ups in Stavanger in the first half of 2015. Innovation Norway Rogaland provided an 'establishment fund' for new enterprises that demonstrate innovative aspects and can prove that they fill a market niche (Stavanger Aftenblad, 2015b). The regional newspaper Stavanger Aftenblad notes that for 2014, Innovation Norway provided 32 MNOK for 103 different cases. By June 2015, Innovation Norway had already funded 107 cases at a total cost of 34 MNOK. It appears that most of these ideas come from young entrepreneurs in the technology sector or established 'oil workers' who finally have the chance to realise their ideas. Moreover, Innovation Norway Rogaland (2016) provided a total of 59 MNOK, spread across 220 start-ups in 2015 – more than in any other region in Norway. These were mainly invested in start-ups dealing with environmental technologies (41 MNOK) (ibid.).

The establishment of new SMEs is also in line with the government's intentions (Innovation Norway, 2016), and there was a general trend towards start-ups and entrepreneurship in the country at large. Ensuring a favourable milieu that buttressed entrepreneurs was high on the agenda, and Innovation Norway Rogaland contributed by creating hot desk office spaces for entrepreneurs and start-ups, both in Stavanger and Rogaland (Interview 9). Despite the intentions to catalyse change, there is nevertheless more activity tied to existing companies than to new ones (Interview 9). Most of this activity happens in already established sectors due to the opportunities presented through technology and knowledge transfers, which is perhaps most evident in medical technology, infrastructure and the marine sector for fish farming (Interview 9; Forskning.no, 2016a). Roxcel, an engineering and management firm traditionally supplying drilling and rig products, is one company that has expanded its portfolio to include fish farming (currently patent pending) and infrastructure and system solutions for smart city initiatives (e.g. interactive signs) (Roxcel, 2018; Dagens Næringsliv, 2017). The interviewee from Innovation Norway also men-

tioned the new focus on developing aspects of the smart city concept, connecting ICT and welfare technologies (Interview 9).

### **Investment in other sectors**

The central government provided the west coast of Norway with funding through the national budget for 2016, to help the counties put in place the necessary measures for recovery, though this had little or no earmarking (Regjeringen, 2016). Innovation Norway was given some extra funding towards their establishment fund and Innovation Contracts, their innovation venture capital fund. There were also central ameliorations made to the regulations regarding daily allowances and the ability to create start-ups, as well as daily allowances paid during retraining. These were important central governmental changes to help the region get on its feet again. As such, the oil price drop could be reframed in a positive sense. As one of the interviewees stated:

*'It was just as much a catalyst as it was a shock. And that sounds more positive, doesn't it? Shock is very negative. It is more **fruitful to think of it as a catalyst.**'* (Interview 5)

It is also interesting to note that 2017 had the highest levels of investment in agriculture in decades (Interview 9). The crisis in 2014 was highly negative for the oil industry but was nevertheless positive for the export sector in Rogaland and Norway at large (Innovation Norway, 2015). A lower Norwegian krone compared to the euro and the US dollar created greater market access, and the export sector prospered (Interview 5; Innovation Norway, 2015). As an already outward-looking regional economy, the supplier industry was able to capitalise on the situation by exploiting its existing networks and markets with a more favourable currency:

*'Both the seafood industry and the petroleum service industry are flourishing. We are still very optimistic for many reasons [...] For example, sub-sea technologies developed by Aker; they generate massive income for Norway, and it'll continue for the next 40–60 years.'* (Interview 5)

Rogaland is a large agricultural county but is seldom given the attention and funding to the extent that the sector requires. According to an inter-

viewee from Innovation Norway Rogaland, the competition for the funding available for the agricultural sector was very tough in 2017. Whether this upsurge in applications for investment support is connected to the cap in jobs in the oil sector is speculative, but it is known that it has been common practice for farmers to work offshore as well as in agriculture. The restructuring of the oil and gas sector might therefore have been a catalyst for investment in agriculture, as the farmers returned to work on their farms full time (Interview 9). At the same time, the effects on aquaculture and other nature-based sectors, for example, are less prone to geopolitical shocks – and although natural shocks due to changing weather conditions is problematic, it is a known and considered risk (Interview 8).

The region's economic diversity is often overlooked. Since the oil price drop, it has been able to attract new engineers and workers that they otherwise could not have attracted, in the marine sector, the IT sector and the public sector (Interview 9). Nordic Edge is an interesting initiative rebranding the region as being able to provide more than a focus on oil and gas, by conveying a positive image focusing on the future smart cities and modern welfare technologies. Nordic Edge is 'a non-profit corporation owned by private companies working in close cooperation with local authorities and city administrations to promote solutions for smarter cities and communities', such as Stavanger local authority, Greater Stavanger, the power company Lyse and local banks, and big players on the international scene such as Microsoft (Nordic Edge, 2018), and is a form of strategic policy development in practice. Nordic Edge gives the region an opportunity to rebrand and add to a wider portfolio:

*'It is important to communicate and illustrate that we are more than oil and gas. We're an energy region with other opportunities as well. That is why the smart city initiative is so important.'* (Interview 3).

### **Venture capital**

It is important to realise the importance of the role of venture capital in creating new, profitable sectors. This is also tied to the reason why few entirely new sectors or developments have resulted from the decline in oil prices. The restructuring of an industrial base takes time, as companies and sectors learn to navigate a new market segment and build rapport with customers and investors.

Venture capital is risk-averse and will rarely place its bets in market segments that it does not know.

According to one of the interviewees, it is not an issue of funds but an issue of competence and knowledge about new technologies (e.g. AI and algorithms), and the capability of existing large business actors to organise, attract venture capital and redirect venture capital away from real estate. A good example of this is the initiative by Smedvik, SR bank and Lyse, which created a venture fund and promised to invest 50% if the state invested 50% (Interview 8). There are other similar seeding funds established across Norway, most of which were established after 2014. For example, the Renewable Fund 'Nysnø Klimainvesteringer AS' is a government-owned investment firm looking to invest in climate-friendly technologies (Nysnø, 2018). This is an example of how to ensure the government takes a proactive role in smoothening out the 'bumpy risk landscape' that follows entrepreneurial development processes in new technology fields (cf. e.g. Mazzucato, 2013). Long-term investment strategies are needed in order to move to a more diversified energy mix. Interesting movements are also happening within the oil sector itself, as oil and gas companies diversify their energy mix.

## Findings Rogaland case study

The risk landscape in Rogaland is heavily dominated by the oil and gas industry, and as a small and open economy both the sector as well as the region are vulnerable to an array of risks and potential shocks, such as commodity price shocks, technology shocks, geopolitical shocks and natural disasters. The absorption capacity of the oil and gas sector is perhaps the most challenging aspect for buffering against risks, exemplified in the rapid increase in unemployment in the months and years after the oil price shock. This highlights the need for effective coordination between regional actors, and the necessity of quick responses from the national level in bolstering the capacity of the regional authorities to act locally. The experienced diversification of the industrial sector is predominantly tied to the oil industry in the area, as investors were drawn to 'guaranteed' profitable return, which was detrimental to some of the smaller companies in other sectors. However, it should be noted that the economic structure in Rogaland is more diverse, but less attention is given to other sectors and the relative returns are often compared to those of the oil and gas sector.

The oil price shock could be also considered as a positive shock despite its dire impact on the labour market, not only in Rogaland but also across Norway. It played the role of a catalyst for change and a wake-up call regarding costs and sustainable salaries. It also helped restructuring and reframing the branding of Rogaland county as a region with more to offer beyond oil and gas – as an 'energy region', a region of advanced technology and a hub for smart city-initiatives. The crisis also tested the regional actors' ability to cooperate and demonstrated the importance of close networks and the power of trust and symbolism. Moreover, it demonstrated the region's ability to take control of a situation and accurately prescribe the 'medicine' needed to alleviate the pain, albeit with financial support through state budgets and the flexibility of the national agencies to allow for regional autonomy over the organisation of work. The governments quick response and concern were also important factors for hindering an increasingly wide-spread crisis. This also indicated the importance of the region and the sector for the overall Norwegian economy.

As such, the plunge in the oil price was a necessary caveat for pointing out the vulnerabilities of the region, and it also lifted a veil on the impact and power of the changing discourse in the national and global arena regarding attracting new labour for the future, and the prowess and flexibility of the regional machinery. As former oil engineers changed career paths, it opened up the way to realise the possibilities within technology transfers and other sectors were able to capitalise on skills and knowledge not previously accessible to them.

However, with oil prices on the rise and an industry that is more internationally competitive than ever, diversification of the economic base is a difficult balancing act. Companies are winning tenders again and Aibel in Haugesund will take on one of the largest constructions in the oil industry in a decade, the Johan Sverdrup platform, bringing 3000 additional jobs, a significant number of which will be based in the region (NRK, 2018; Regjeringen, 2016).

The success of diversification depends greatly on the sector's ability to move beyond oil and gas in the low periods, and the ability to attract investment and employees to alternative sectors. As the oil and gas sector is rising slowly to its feet, the regional actors should not lose sight of their goal to create a more dynamic and resilient Rogaland county.

## 4.4 NORRBOTTEN, SWEDEN

by Alberto Giacometti

### Introduction

Norrbotten, the northernmost region in Sweden is an interesting case through which to study resilience because of its incredible dependence on the extraction of natural resources and the associated risk of commodity price shocks. Paired with that threat is the issue of low population and pressing demographic trends that threaten the competitiveness and availability of labour and sufficient services for the local populations. At the same time, the region's outstanding capacity to innovate and collaborate keeps its society afloat and extremely successful in attracting new economic opportunities in technology sectors and, modestly, in tourism.

A solid mining industry, together with steel, paper, pulp and other processing industries, make the economy of Norrbotten one of the richest in Sweden. Moreover, its enormous hydropower production not only enables the secure functioning of such industries but also makes new industries attractive. Such as been the case with the relatively new emerging sector of digital data storage, starting with the establishment of a Facebook data centre.

Luleå Technical University has brought much innovation to the region and refreshed its demographic profile with a large number of local and foreign students, researchers and firms associated with the university's R&D initiatives and

start-up incubators. The university also plays an important role through the key expertise it has developed around the mining and space industries, with a branch in Kiruna where the European Space Agency is located. The innovation profile of the region has allowed it to overcome difficulties in the technological sector in the past, and to automate its key industries, partly to compensate for the shortage of labour. It also provides promising opportunities for developing e-services to improve the attractiveness of and service delivery in the region. Finally, the innovative, hands-on culture has enabled the region to turn some of its weaknesses, such as low temperatures and a cold, dark climate, into a competitive advantage and develop new economic activities.

On a separate note, climate change is particularly affecting reindeer herding patterns, which in turn threatens the region's intangible cultural heritage, specifically that of the Sami community.

### Territorial factors

Norrbotten has a population of less than 250,000 inhabitants, and is in the northernmost part of Sweden, sharing borders with both Finland and Norway. The region has a multicultural heritage and is home to Sami, Finnish and Swedish communities. Mineral resources and forestry have defined the economy of Norrbotten since the nineteenth century. Today, 90% of Europe's iron-ore extraction comes from Norrbotten alone. Thanks to its natural resources, Norrbotten produces a significant surplus of hydropower, which accounts for

*A solid mining industry, together with steel, paper, pulp and other processing industries, make the economy of Norrbotten one of the richest in Sweden.*





13% of national power consumption. This in turn has enabled the establishment of large processing industries, such as steel and paper-pulp, and more recently data centres or facilities for the storage of digital information. Developments in other sectors provide interesting growth potential including ICT, tourism and higher education. However, while these sectors are showing positive signs of development, they far from outbalance the profits deriving from natural resources (Interview 2). In terms of employment, however, basic industry is no longer absorbing the majority of the labour force. In Luleå, for instance, the university has become a major employer (Interview 5). Yet there are geographical and demographic differences in terms of employment. Luleå is moving from being mainly industrial to a more service-oriented economy, while the mining sector dominates employment in Kiruna. Moreover, the employment rate is higher for men than women, while the level of education is higher for women than men (Norrbotten Strategy, 2020). This is seemingly related to the male-dominated industrial base of the region.

Due especially to the increasing price of iron ore and other mineral commodities, the region experienced steady economic growth between 1995 and 2012, except for the 2008–2010 period when commodity prices dropped as a result of the global financial crisis. In this period, GDP per capita made an impressive leap from 4.9% below the national average to 9.7% above it (OECD, 2017). Employment rose steadily over the same period and showed an even stronger acceleration after 2011 (ibid.). Even though automation has reduced the need for labour within the mining industry, employment has increased within the university and ICT sector, while public services and industries based on natural resources remain important employers through their supply chains. Despite the exceptional economic performance, population declined 0.26% annually on average between 1995 and 2012 (ibid.). The population has tended to concentrate in the urban centres, mostly close to the coastal areas, leaving a vast sparsely populated landmass. According to one informant, 'some municipalities have a population density as low as 0.2 inhabitants per km<sup>2</sup>' (Interview 2). In spite of the rural-urban migration pattern, growth in the cities of Luleå and Piteå is considerably below the national average. Therefore, the low population growth, paired with an ageing population and promising job opportunities, calls for measures to

attract newcomers to the region. Attractiveness is a key challenge, however, in a region that is located around the polar circle.

## **Risk landscape**

This chapter provides a mapping of different types of risks identified in the region of Norrbotten, including past events, and present and potential challenges. The aim is to illustrate the different types of situation that can lead to abrupt changes in the social and economic structure of the region or parts of the region.

## **Commodity price fluctuation**

The extraction of mineral resources and forestry, and the processing industries that transform these resources (i.e. the steel and paper-pulp industries) represent a major share of Norrbotten's economy. Mineral resources alone (i.e. iron, copper) account for 60% of gross regional product (GRP) (Interview 1), and 90% of Europe's iron-ore production. While these resources provide high profits, they are vulnerable to price fluctuations that are to a large extent unpredictable, since they are influenced by the state of the global economy and geopolitics (including measures targeting natural resources specifically, e.g. US tariffs on European steel). In 2009, for instance, there was a drastic drop in commodity prices as a consequence of the global financial crisis. During this time, Norrbotten experienced a significant drop in GRP due to its high dependence on natural resources. The overall impact, however, was not so strong due to the short duration of the crisis and because the mining companies had a buffer (cash accumulated during periods of high prices) that enabled them to cope with the low prices for a period of time. The most affected companies, however, were those down the supply chain, which were less prepared and depended heavily on local industries to provide their services. It appears that companies that provide services to the mining industry are 'fat enough', earning high profits, and do not invest enough in exploring other markets (Interview 1).

In terms of jobs, a large proportion of employment is still dependent on industries based on natural resources, directly and indirectly, through the numerous small and large companies that provide services and products (e.g. IT companies). This is the case despite the fact that the mining and processing industries have become highly automated. On the positive side, when basic industries are

highly automated and technologically advanced it makes them more competitive in the global market, especially considering the high cost of labour in Sweden compared to other parts of the globe. Automation also compensates to a certain extent for the shortage of labour in the region. Additionally, the growing employment opportunities in education, IT, health, tourism and the public sector lower the risk of jobs being lost when basic industries are in trouble. However, such diversification of the employment base is geographically uneven. While manufacturing is no longer the largest employer in Luleå, the situation remains quite different in Peteå and mining towns such as Kiruna and Gällivare. Therefore, vulnerability to commodity price fluctuations is also geographically uneven in Norrbotten. Diversification within the sectors, or 'related variety' may also be a way around this, such as the interesting innovations emerging from the mining industry that have uses outside the sector, such as sensors and ventilation systems. Likewise, innovations emerging, or improving, from cooperation between sectors build value chains and expand beyond what is possible within one industry alone, such as 5G technologies and the testing of drones within the mines.

### **Loss of income-generating activity**

A certain critical mass (population density) is necessary to justify the presence of industries and the delivery of services, not to mention the development of new economic activities. This is challenged, however, by Norrbotten's low population density and aggravated by demographic trends such as an ageing population, the depopulation of rural areas, the brain drain and low population growth in urban areas. Moreover, the long distances to other cities and the climate make it difficult to attract new people. According to one informant at the regional administration: 'People want to be in urban centres, where things are happening, so we need to make the region more attractive, we need good communication and transport, which is not so good now' (Interview 1). A low level of attractiveness puts pressure on public services, and leads to a shortage of labour in many economic activities and within the public sector.

There is currently considerable discussion in Norrbotten about employability, due to the mismatch between available skills and employers' demands. As one informant puts it: 'There are few people and few people with the right skills, the

skills needed for the industries based in the region – this is now seriously considered as a potential growth disturbance' (Interview 2). The share of unskilled young people has increased in the region since the crisis (OECD, 2017). Low-skilled jobs are in high demand and offer high salaries, which results in a large number of drop-outs from high school and higher education. Educational attainment is gender imbalanced, with a larger share of educated women than men. One explanation for this is the structure of the labour market, which is characterised by male-dominated industries that are less attractive to women, who tend towards gaining higher education and often seeking highly skilled jobs outside the region.

A different kind of challenge related to the loss of economic activities is the limited availability of natural resources. Indeed, iron-ore deposits in Kiruna are expected to be depleted within a few decades (Chen et al., 2003). This may seem like a long time but new economic activities normally take time to develop, and even longer to reach a good position in the market and generate ties with supply chains and local institutions, especially considering the time and resources needed to develop the skills within the local population to serve new economic sectors. Diversification is not easily achievable in small communities, however, especially on the same scale. Some scattered possibilities include tourism, car testing, the public sector and the EU Space Station in Kiruna. Another form of diversification is 'related variety', which implies extending and building up value chains beyond what is possible in one industry alone but requires collaboration between industries to develop new business solutions. Examples of this include the ventilation systems and sensors that are developed for mining activity whose use has been extended to other purposes; and the collaboration between the IT and public sectors to develop digitalised services such as e-health and solutions for distance education.

Despite the negative trends, Norrbotten is among the highest ranked regions on innovation across the EU, built around a close collaboration network between Luleå Technical University, the industry and the public institutions. The region has also been able to take advantage of its strengths (e.g. hydropower, infrastructure) and even what are normally thought as weaknesses, such as coldness and darkness, to attract industries that benefit from these conditions, such as data centres,



car-testing and tourism. These opportunities are dealt with in more depth in later sections.

### **Technological risk**

Emerging technologies, particularly the smartphone, hit the mobile phone and high-tech industry hard in Norrbotten. Both Telia and Ericsson's research branch moved away from the region, resulting in significant job losses. Many of the professionals working in the field, however, stayed in the region and created their own companies. The structure of the IT sector was completely transformed from a few large companies into a system of numerous small firms and start-ups. It has also changed focus, from being product-based to being mostly service-based. According to many, these transformations have made the sector much more dynamic and healthier as it is more flexible and adaptable to changing markets and technologies. Today there is high demand for skilled jobs, but a shortage of competences within the sector (Interview 2; Interview 3). The IT sector is also part of a larger innovation system that is among the highest ranked across the EU. It is argued that innovation is driven by the industries working in close collaboration with Luleå Technical University (LTU).

The small size and existing networks around Luleå appear to be an advantage for establishing a new company, particularly due to the city's closeness to people and accessibility to the university, research, fund-raisers and banks: 'If you have an idea and you want to start a business you can easily meet a high ranking person in the bank and get credit, whereas in Stockholm it would be very hard' (Interview 3). There are good support systems for starting a company, such as grants for companies from the region, and incubators, which are needed for start-ups. Within the incubators, there are professionals who provide assistance with loans, advice on planning the growth of the company and other kinds of support. The university and the research carried out close to the companies are also important in creating an entrepreneurial environment.

Nevertheless, creative destruction, through the emergence of new technologies around the world, remains one of the key challenges for the high-tech industry. While the sector is much more adaptable today, its competitiveness strongly depends on staying at the forefront of technology globally. Moreover, to remain competitive and keep growing, the sector needs to attract new talented

people from abroad. Luleå's population development, however, is much slower than in other urban centres in Sweden, primarily due to its location and cold temperatures. The city also lacks some key amenities that are needed for international families to move in, such as an English school (Interview 3). Furthermore, the IT companies are also affected when there is trouble in other sectors: 'If there is a drop in the price of iron, LKAB [mining company] stops buying their services. But if the price goes up, they also buy more IT services, replace old systems, buy better technology' (Interview 3).

Another development that offers some opportunities to the high-tech sector is the establishment of rapidly expanding data centres (facilities for the storage of digital information), which began with the establishment of Facebook in 2011. Several other companies have now built data centres in Luleå and the neighbouring municipality of Boden (e.g. Hydro66). However, it is not clear whether the data centres could provide meaningful opportunities to other technological companies or to the innovation system in the long run.

### **Policy-induced/geopolitical risk**

Brexit is a key geopolitical issue identified in Norrbotten, including the impact it will have on the EU budgets, particularly the ERDF funds, which are of importance in aiding regional structural changes and boosting cooperation between regions (Interview 1). Britain's rupture with the EU will most certainly result in budgetary cuts and a restructuring of the resources directed to the regions (Interview 2). There is a fear that resources will be cut especially to the richest regions of Europe, Norrbotten being one of them.

Active collaboration with neighbouring regions and other areas in Europe is of high importance for the Norrbotten region, not least because of its peripheral location. Moreover, the melting ice in the Arctic Sea is opening many opportunities that are of strategic importance, not only to the immediate vicinities but also globally. The opening of new transport routes in the Arctic Sea and the exploration for oil and other mineral resources that is now possible, is a major geopolitical game-changer. For this reason, cooperation with other Arctic regions is of great importance for Norrbotten, as well as the EU and countries as far as India and China, which may have an enormous influence on future development in the region.

A more recent geopolitical risk derives from the US-led 'trade war' and suddenly increasing protectionism, including tariffs on strategic resources such as steel. Norrbotten's steel company, SSAB, also produces steel in the US and therefore has been able to avoid the tariffs so far. Yet the long-term impact of the measure is still unclear.

### **Natural/environmental risk**

Changing climatic conditions are having a meaningful impact on reindeer herding, a key source of the livelihood and cultural identity of the Sami people. The reindeer are struggling to find enough food during the winter season, which has led to a change in the herding patterns moving from inland to coastal areas (Interview 1). As most of Norrbotten's population is concentrated along the coastline, the sudden increase in reindeer herding in the area has generated reaction from residents and land-owners. While reindeer herding may not appear as a significant sector for the region in terms of profits, it is of vital importance for many Sami people, not only economically but also as a way of life and a cultural heritage. Moreover, the Sami culture, including reindeer herding, provides great potential for the tourism industry, which is considered as one alternative to the otherwise exploitative and industrial character of the key economic sectors in the region. Reindeer herding also safeguards the human presence around vast rural areas with an extremely low population density. According to one interview at the regional administration, this issue has not received sufficient attention so far; however, 'the national agenda 2030, demands a stronger emphasis on social aspects within the new regional strategy' (Interview 1). An increased focus is therefore expected on the socio-economic impacts of climate change.

From a global perspective, climate change also threatens food security and peace throughout Europe. According to an interview in Luleå municipality, the global trend for mass-food-production has resulted in a significant drop in prices and increased availability of food products. Consequently, the consumption of local produce has decreased, knowledge of local food production has been lost and dependence on food imports has increased (Interview 5). Unpredictable weather conditions, extreme droughts and floods worldwide, therefore, may result in abrupt scarcity of certain food products. In one informant's words: 'if more serious climatic issues were to happen abroad,

food could become very scarce, and we are not prepared for that' (ibid.).

Furthermore, the increasing social awareness of environmental issues has the potential to generate much opposition and even block large economic activities in the region such as mining and the steel industry (Interview 1). While this seems not to be a big issue today, some people think they should stay alert about this possible scenario.

### **Resilience drivers**

Perhaps the biggest strengths in Norrbotten are the hands-on and collaborative working culture, which is evident both within the formal institutions and informally through the existing networks; and the open, problem-solving attitudes. As neatly put by an informant, 'we are a very proactive culture, we don't just talk, we are used to solving things, taking action' (Interview 4). Another informant adds: 'we are very much about triple-helix set-ups; we work in close collaboration with the public sector, the companies and the universities; it is something we are very good at, it works very well' (Interview 3). The closeness between people, partly due to the relatively small population, is a key facilitator for collaboration. As an interviewee puts it, 'key people are only one phone call away' (Interview 4). 'Top level people in the public sector meet with the companies at the different events, so there is a personal connection with a lot of people, which is very important for the region to grow' (Interview 3). An informant from the private sector adds, 'we have direct contact with the mayors, we can make things happen quicker than other places' (Interview 6). Moreover, trust is an essential condition driving collaboration among regional actors (Interview 4).

Collaboration is also well established. Around 70 years ago, Norrbotten was the first region in Sweden to create an association of local authorities, 'Norrbotten Kommuner' (NK), in an effort to strengthen ties with each other and coordinate actions. The first chairman of the organisation famously said in 1946: 'It is stormy, and it will continue to be hard for the local authorities, and therefore we need to work together and be strong' (Interview 4). The same informant adds: 'This is still very relevant today'. Norrbotten pioneered this form of local authority organisation, 'perhaps because of the geographical location [distant from central government and the rest of Europe]' (ibid.). The organisation, therefore, has also brought Norrbotten's local authorities closer to national decision-

making through the six members of the board sitting in parliament in Stockholm, and at EU level through the North Sweden office in Brussels (ibid.). NK works in close collaboration with the regional administration (Interview 1) on matters of regional development. Despite the two bodies operating on the same jurisdictional level, the advantage of NK is that it represents the interests of the local authorities, which have a larger mandate than the regional administration. Moreover, NK brings additional perspectives from those of the local authorities themselves, which are more strategic and apolitical. Through different committees, the organisation addresses issues related to R&D and innovation, capacity-building in the labour market, and education, such as the opportunities offered by digitalisation in skills development and e-health (Interview 4). From a resilience point of view, an interesting angle is the flexibility that the organisation provides. 'We have built up a political framework that we can quickly refer to and establish a plan of action in case something happens' (ibid.).

Another key resilience driver is the strong, dynamic innovation system present in Norrbotten, which is ranked among the highest in the EU. Some argue that this is driven to a large extent by the industries, which are highly advanced technologically and invest significantly in research (Interview 3). 'A large percentage of the research conducted in LTU is externally funded [by companies], and much of it is applied sciences, so it has a very strong impact on development, to industry' (Interview 2). Innovative industries are not limited to the high-tech sector, which is highly dynamic today, but also traditional industries such as mining, steel, paper and pulp, which are highly automated and globally competitive. For instance, LKAB, the state-owned iron-ore mine in Kiruna has announced that the next level in the mine will be completely human-free (Interview 1). The mining industry is also a forerunner in technological innovation in a broader sense, developing solutions that have a use beyond the sector, such as sensors used for monitoring land vibrations, and ventilation systems. The close collaboration among industries is also showing interesting results in terms of innovation, such as digital solutions developed by the tech industry and tested inside the mines more than 1000 metres underground, such as the 4G and 5G wireless communication technologies and drones (Interview 2).

Moreover, good support systems from the public sector, finance and the university, in addition

to the closeness to people and networks, are excellent conditions under which companies can thrive. 'There are grants given to companies from the region and incubators, where start-ups can find people to discuss about loans and how to plan the growth of the company' (Interview 3). LTU plays a particularly important role as one of the most collaborative universities in Sweden (ibid.) and in attracting talent. According to an informant, 'the university came in 1971 and drove an enormous change to the city – it's a big employer, does a lot of research, brings a lot of students – it has actually changed the demographic profile of the city' (Interview 5). 'Additionally, LTU is known as 'the' mining and ore university, this is really where the mining competence is concentrated – all the engineers, the geoscientists and companies are here' (Interview 3). The university also has a role in the space sector, with a branch in Kiruna that provides education and support to the European Space Agency (ibid.). All in all, the university plays a central role in the development of the region. According to an interview: 'The university is not only in the region but very much for the region' (Interview 2).

Research and innovation is also a priority within the regional strategy in connection with the public administration and delivery of basic services (Interview 1). An informant asserts that: 'research and innovation within the public sector is becoming more important, so we are working closely with the universities addressing digitalisation, capacity building in the labour market, education, e-health' (Interview 4). Healthcare, for instance, is critical as people in the region are getting older, which means more people falling ill and fewer tax payers. Thus e-health may provide some solutions to these challenges (Interview 1). At the same time, these changes need to secure 'good services and healthcare for young people without raising taxes, as otherwise it won't be attractive, it won't be possible to live in certain areas' (Interview 4). Despite digitalisation threatening to generate job losses, Norrbotten generally has the opposite problem, with a significant labour shortage (Interview 1). Therefore, if Norrbotten is able to make a quick transition, it 'could gain a competitive advantage and sell services to other regions' (Interview 1). Youth capacity-building in relation to their long-term employability is another critical issue: 'Young people have it very easy in terms of employment, which leads to a problem in education attainment; they are not getting enough, or the "right educa-

tion''' (Interview 1). Therefore, Norrbotten's 2020 strategy emphasises the need for a labour force with the appropriate skills as central to assuring the 'region's competitiveness, growth and attractiveness', for which it puts the emphasis on more flexible education and life-long learning.

On a different note, conditions that are normally considered as weaknesses, such as the cold weather, darkness and low population density, have also flipped into a competitive advantage for Norrbotten. 'Several car manufacturers have brought their winter testing facilities to sparsely populated areas, where you cannot have worse winter conditions, to test car parts [e.g. batteries, breaks] and performance', without encountering any 'paparazzi' threatening to reveal their new models to the media (Interview 2). 'This brings in money during the winter, mostly services, hotels, restaurants and know-how on running tests' (Interview 3). Likewise, Facebook installed its first data centre outside the United States in Norrbotten, partly because energy consumption for cooling servers is much lower in extremely low temperatures (Interview 2). Lastly, winter tourism is becoming more attractive. Winter sports, complete darkness, silence, astonishing landscapes, the aurora borealis and the Sami culture are some of the attractions gaining significant attention. Emerging efforts in the sector are being coordinated and promoted by Swedish Lapland, an organisation that is partly financed by the regional administration of Norrbotten. These efforts are showing positive results, although 'it is hard to know if travels are business- or tourism-related – there is a lot of activity in the hotel industry, but many come because of the mining industry or the car testing facilities' (Interview 4). The future of tourism looks promising nevertheless.

Energy security is another, most important reason why Facebook chose to build its data centre outside Luleå. The huge facilities used for the storage of digital information require vast amounts of electricity for cooling the servers. In addition, the servers must never stop, so energy security is crucial. Its 'positive path-dependence' played in Norrbotten's favour, since 'the whole grid is built for the processing industry' (Interview 3). 'Processing industries and mining require large amounts of electricity, and a safety net – that's why there has never been a power outage since the 1980s' (Interview 2). There is 'triple redundancy' in the infrastructure, as there are several hydropower

stations nearby, so there is a high level of security (Interview 3). Additionally, not all areas in Sweden, or Europe, 'have sufficient power-capacity, and setting up the wires is very expensive; that's why it makes sense to be close to the power source' (ibid.). What's more, the renewable origin of the electric power gives a positive image to companies choosing to store their servers in Norrbotten. Hydro66, a company that rents out space for other companies' servers, has used this as a branding strategy, which is even reflected in its company name (Interview 6). Today, several other data centres have been established in Norrbotten, including a research centre on data centres.

Finally, an interesting development for the future is that the region has started a process of scenario analyses, forecasting and examining trends, in preparation for the new regional strategy (Interview 1). In this case the higher risks already identified are the commodity price fluctuations of natural resources, including the forestry, mineral and steel industries (Ibid.). They are also looking into new opportunities and other industries that have the potential to expand, such as the data centres in which Norrbotten has an excellent competitive advantage in terms of infrastructure energy security and low temperatures (ibid.). Moreover, 'the national government, through agenda 2030, demands a stronger emphasis on the social aspects of the new regional strategy so there will be a change', for instance by taking the issues related to Sami reindeer herders more seriously (ibid.).

## Findings Norrbotten case

Commodity price fluctuation is clearly the biggest threat to Norrbotten's economic and social resilience. A large proportion of employment in the region is dependent on the natural resources industries: 'If the world economy goes up and down, everything in the region goes up and down – we are very sensitive to commodity prices variations' (Interview 3). In this respect, a significant finding is the importance of buffering. Profits from natural resource extraction are highly fluctuating and dependent on global trends and geopolitics, and thus national or even regional actors are thus far from being in control. The situation could have become critical if the prices remained low for longer periods of time. Yet, the industry's high surplus allows it to save a large share of the profits as a buffer for times of significant price drop. However, apart from the large companies, the suppliers may

not always be prepared for such times. Often the most affected during commodity price shocks are the companies down the supply chain, whose services are cut and that are not flexible enough to service other businesses or other markets. Looking closely to value chains, the impact of dropping commodity prices hits industries that are completely distinct from natural resource extraction. 'If there is a drop in the price of iron and LKAB was to slow down, then it affects ICT, they stop buying their services, they have to cut down. And if the price goes up, they also buy more ICT services, they replace old systems but better technology, so then there is a boom for ICT' (Interview 3).

An interesting finding is that even though there is a single activity that hugely dominates the income generated in the region, diversification in employment is very important for job security, especially if it is not in any way connected to that activity supply chain. While some industries might not be significantly profitable, they provide some degree of security in cases when commodity price fluctuations affect the natural resources-based industries. Today, the mining industry in Norrbotten relies significantly less on human labour, and in fact LKAB, the state-owned iron-ore mine in Kiruna, has announced that the next level in the mine will be completely human-free. Luleå's employment depends more on services than basic industry. This means that, even if there is a big fall in commodity prices and overall GRP suffers a strong dip, the livelihoods of the region's citizens are less at risk because employment is less dependent on natural resources.

Diversification, however, is geographically uneven. While creating room for the diversification of the industrial base is essential for job security, it remains a major challenge in places like Kiruna and other towns in Norrbotten that remain heavily dependent on natural resources in terms of both profits and employment. In this case, employing concepts such as entrepreneurial discovery processes (EDP) and allowing for related variety within the mining sector may provide some alternative job opportunities (e.g. ventilation systems, sensors, 5G technologies). As seen in Norrbotten, a good innovation system can provide significant opportunities in the long run and generate jobs that are not dependent on the extraction of natural resources, thus building a different future for a region that is highly at risk of abrupt events.

One key finding is the importance of 'redun-

dancy'. Redundancy of energy sources is of enormous importance in terms of processing industries' ability to keep functioning '24/7', every day of the year. They can't afford to stop, and thus energy security is not enough; they need triple energy security. This has proved to be a competitive advantage and holds potential for other heavy industries and data centres to establish themselves in the region, as was the case with Facebook.

Another important threat is the accumulated stress deriving from the negative demographic trends, ageing population, urbanisation, gender imbalances in education and labour opportunities, and unattractiveness. While none of these are shocking events, there is latent potential loss in competitiveness and economic opportunities, due to the struggle to find the right human capital. At the same time, loss of economic activities and insufficient diverse labour opportunities and other amenities in sparsely populated areas lead to further population decline due to outmigration. In this way, these negative trends become cyclical, representing a major threat in the long run. Norrbotten's extremely successful innovation system counterbalances to a certain degree some of these trends, particularly in its largest urban centres.

Nevertheless, Norrbotten would require a significant demographic shift and much broader diversification of its industrial base to be considered resilient to commodity price shocks. However, this is not necessarily realistic within a short time-frame, particularly in specific parts of the region. In the long run, one thing that Norrbotten may consider is the possibility of planning for economic decline, which is a realistic scenario, at least for some parts of the region that receive most of their profits from finite resources.

On a different note, climate change is particularly affecting reindeer herding patterns, impacting on the Sami people. Their presence in coastal areas, which is now more usual than it was, means it is possible that conflict with other residents may escalate. The Sami herders represent an important presence in Norrbotten's vast and sparsely populated areas and are an intangible cultural heritage of the region. These issues do not seem to gain sufficient attention.

Despite these difficulties, a key lesson from Norrbotten is its incredible capacity to innovate and to transform weaknesses into opportunities and use path dependency to attract industries that can use existing infrastructures and capital.



## 4.5 VEJLE, DENMARK

*by Alberto Giacometti, Lise Smed Olsen  
(Oxford Research) & Laura Fagerlund*

### Introduction

Vejle, in South Denmark, is an interesting case with which to study resilience in the Nordic context. Vejle is the only Nordic city that has joined the '100 Resilience Cities' (100RC) network, a global network created by the Rockefeller Foundation in 2013. 100RC aims to help cities around the world to become more resilient to the physical, social and economic challenges they are facing. Vejle Local Authority submitted its application to the 100RC in 2015, in which it emphasised the city's experience in community building in vulnerable residential areas. Vejle is also interesting from the perspective of its risk landscape, as the city is highly diversified and to a large extent able to cope with risks affecting its economic structure. However, the city is also coping with transformations in its labour market and technological, demographic, natural and political challenges.

As part of the 100RC network, Vejle has developed its own Resilience Strategy targeting city-specific challenges. This case provides an interesting approach from which to address resilience from the public administration, as it introduces system thinking to the local authority strategies, into the way work is organised and into individual projects. This includes a holistic, long-term approach, a strong emphasis on trends and technologies and a cross-organisational working practice combining the expertise of different departments and in new partnerships. Moreover, it introduces a proactive approach to challenges and the prevention of potential risks that otherwise would arise if not continuously monitored and addressed by working 'in new ways'. To make this possible, Vejle has appointed a Chief Resilience Officer, as have the other cities in the 100RC network, who is responsible for introducing the resilience perspective into the day-to-day work in the local authority.

Vejle's Resilience Strategy's four pillars focus on co-creation, social cohesion, climate mitigation and adaption, and smart city solutions. Vejle's point of departure is closer to ecological and social resilience perspectives. These priorities respond to the key challenges identified in the region, such as climate change and flooding, as well as to social aspects surrounding, for example, immigration and

demographic trends. Vejle's public officials aim to build stronger social capital (social resilience) in times of 'growing apathy and lack of social cohesion'. The strategy also emphasises the importance of working together with different stakeholders in various constellations, including businesses. The strategy does not address in detail the risks associated with Vejle's key economic sectors and businesses. Nevertheless, the holistic and cross-departmental approach to resilience in Vejle incorporates in various ways the role of businesses and start-ups developing in new sectors, in driving positive change and in helping the city's society and economy to be more adaptable to changing conditions. Technological developments and the increasingly turbulent labour market are some of the trends challenging the region's competitiveness, and these are tackled through the strategy's pillars, actions and projects. For example, when it comes to green tech, the city of Vejle partnered with a private investor to expand this new sector and support start-ups.

### Territorial factors

Vejle has a population of around 114,000 inhabitants, of which approximately 56,500 live in the city. The municipality has experienced a positive population trend: from 2012 to 2017 the number of inhabitants grew by 5.5%. This increase is mostly thanks to positive net migration. Historically, Vejle and its surroundings have been an important industrial centre; today, however, it is a hub for entrepreneurs, tourism, energy companies and IT. Just over 78% of the inhabitants of the Vejle area are employed, and this has grown by 3.1% from 2015 to 2016, with 70% of citizens employed in the private sector. Here, the food and construction sectors absorb the largest share of employment (both around 20%). However, productivity development within the private sector is negative, declining by 0.4% during the period 2013–2015. Only 3% of the work force are employed in the public sector (Kontur, 2017). Vejle is expected to increase the work force, the number of people employed, education levels and tourism in the city. This is mostly thanks to promising sectors such as private trading and service, construction, industry, transport and healthcare.

Vejle Municipality is part of the Triangle Region, a formal partnership between seven neighbouring municipalities (Billund, Fredericia, Haderslev, Kolding, Middelfart, Vejen and Vejle). The collaboration is managed by the region's secretariat and the



*Vejle is an interesting case, as the city is highly diversified and to a large extent able to cope with risks affecting its economic structure. Photo: Oliver Foerstner*

bureau, which consists of the municipalities' mayors. The aim of the partnership is to strengthen the region's growth and production by combining the municipalities' respective strengths. With around 37.000 industrial jobs, the Triangle Region is Denmark's most important industrial region. The Triangle Region expects manufacturing companies to move their business to, or keep them in, Denmark, and have therefore developed several actions with the aim of renewing and strengthening industry. For instance, companies can get support from the region's consultants specialising in manufacturing businesses. The Triangle Region is also an important logistics centre, being strategically located between Germany and Scandinavia. Companies working within the sectors of technology, tourism, energy and service provision show a promising growth pattern as well (The Triangle Region). The regional strategy for growth and development, Det Gode Liv, also mentions welfare and healthcare innovation, and experience industries as promising sectors.

Vejle is the administrative centre of South Denmark Region, which covers 22 municipalities

and has a total population of 1,2 million. The region's SMEs have a positive outlook on the future, expecting growth and increasing employment. Wholesale and advanced production are expected to show most growth. According to State of the Region 2017, while businesses are thriving, 28% of them have had a hard time recruiting. As this can have serious consequences on the competitiveness of the regional economy, the report emphasises the importance of working closer with educational institutions and attracting a qualified work force.

### **Risk landscape**

As an initial step in developing the Resilience Strategy, Vejle Local Authority has identified some of its core challenges, which include: climate change and flooding; urbanisation; infrastructure demand; changing industries, global economies and new technology; and demographic changes in society. These challenges consist of a mix of risks that potentially lead to abrupt events or shocks (e.g. a flood) and stress factors that have long-term consequences for the social and economic structure of Vejle (e.g. changing industries and the future

labour market and welfare system). In addition to the challenges identified within the work of the Resilience Strategy, this section also reveals some of the risks or challenges connected to Vejle's business community.

### **Natural, environmental and seasonal risks**

**Climate change is perhaps the biggest risk for Vejle.** Vejle is predicted to be underwater by 2100 and is one of ten areas in Denmark where there is a significant flood risk due to rising sea levels, increasing rainfall and flooding. Over the past few hundred years, Vejle has experienced floods every four or five years (i.e. as seasonal shocks). Over the past decade, floods have become more frequent. Flooding causes major damage to coastal areas, resulting in material losses and increased pressure on the basic infrastructures and provision of services. The increasing water level and frequency of these events may potentially lead to a major shock with greater material loss, and the possible spread of disease due to the sewage system overflowing. The social and economic costs can be high, including the displacement of citizens. An additional complication is that flood prevention cannot be restricted to the areas vulnerable to floods but requires interventions upstream/uphill within the city to retain the water. However, citizens living uphill are normally not aware of this or don't feel responsible for floods in other parts of the city. As the Chief Resilience Officer (CRO) puts it, 'one of the biggest challenges is to try to change people's behaviour, especially with a problem that is not theirs'. She adds, 'the challenge is to make people connect to the city and think of it as a whole'.

### **Technological trends and changing labour markets**

Being part of a globalised society and economy, Vejle is closely influenced by changing conditions and trends. Changing economies and new technologies create a turbulent job market and introduce vulnerable employment conditions. According to the Business Policy Consultant at Vejle Local Authority, one of the biggest concerns for industry is 'Industry 4.0, the future of business in the digital era, and how to reinvent the business model accordingly' (Interview 2). The digital revolution is a global trend affecting all industries globally; however, some are undergoing a more rapid transformation than others, and it therefore affects distinct geographies differently. 'For the western part

of Denmark this is more of a concern because our industrial structure is more based on production [manufacture], than the eastern part, where the capital region is' (ibid.). In addition to manufacturing industry, digitalisation is also a major issue for logistics, which is a key sector in Vejle. 'Logistics is one of the sectors undergoing a great transformation, with driverless vehicles, drones and automation in general, which is fundamentally changing the industry' (ibid.). Yet the transport and logistics sectors have already been shrinking for some time due to competition with other countries.

While digitalisation threatens to render many jobs redundant, this seems not to generate much concern in Vejle. The unemployment rate is rather low, at 3.3%, and workers have an easy time finding new jobs in other industries (Interview 2). On the contrary, the biggest issue for industries in Vejle today is getting hold of skilled labour. 'There is a shortage of labour with certain qualifications; our industry needs many engineers and it has trouble recruiting them' (Interview 2). Yet there is also difficulty in finding manual labour, such as carpenters, and metal and machine workers. Limitations related to the shortage of labour are: first, the relatively small size of the labour market; second, the absence of a university in Vejle; and third, a national shortage of engineers, many of whom are more easily attracted to companies based in the capital region (Interview 2). The local authority has been working to promote vocational education at school level, which is receiving a positive response. This is a long-term investment, however, and thus the impact on the labour market is not visible so far.

Emerging digital technologies also raise concerns related to cybersecurity, social exclusion and competitiveness (Resilience Strategy, 2016–2020). Keeping up with technology is crucial for retaining competitiveness and particularly important for a local economy that significantly depends on processing and manufacturing industries but that has been betting on emerging industries such as green tech.

### **Risks related to demographic trends and loss of competitiveness**

A changing demographic structure with an ageing society and increased immigrant population puts pressure on the provision of services and overall competitiveness of Vejle's economy. Public social services are being challenged by a growing number of elderly people, as well as chronic illnesses



and other health problems related to unhealthy lifestyles across different age groups. Newcomers may have trouble finding employment without upgrading their skills. However, there is also a trend for young, highly educated professionals to move to Vejle. Moreover, failed integration could cause polarisation in the society. According to the Resilience Chief, 'the city is not well prepared for the immigrants and refugees coming from unstable countries'. Yet the loss of social cohesion is not related to immigration alone but is a recurrent condition across economic status, culture and local identities. Improving the city's flexibility and adaptability, and strengthening social cohesion, are raised in the Resilience Strategy as important actions to better cope with the long-term effects of immigration.

Furthermore, increasing urbanisation is putting pressure on Vejle's existing infrastructure and the quality of life of its citizens. For instance, apartments are getting smaller, there are fewer green areas in certain neighbourhoods and traffic congestion is increasing. Vejle has experienced a shortage of student housing, making it difficult to attract students. However, a significant increase in the number of student apartments being built recently has reduced this problem (Growth Barometer, Vejle Municipality).

### **Political and geopolitical risks**

Political decisions such as increasing interest rates, changing tax regimes, increasing the money supply abruptly, and adding new prohibitions, regulation or tariffs on foreign goods, have a direct impact on businesses. Likewise, measures imposed in foreign countries have an impact on local businesses. In Vejle, 'for companies that rely on the British market, Brexit could be an issue, and companies trading with the US are concerned about current world politics' (Interview 2). Broader changes resulting from EU budget reforms after Brexit do not seem to be of much concern but businesses worry 'primarily about market access; for instance the food sector has an important stake in those markets [Britain and USA]' (ibid.).

The role of the regions in Denmark is changing with the reform that comes into force in January 2019, which entails them no longer undertaking responsibilities for business development. The administration of the EU structural funds (ERDF and ESF), which until now has been the responsibility of the regional growth forums (RGF), will become

the responsibility of Denmark's Business Promotion Board in 2019. This could generate a decline in understanding between local and regional administrative levels and potentially less effective mechanisms of support for businesses. Some argue that the national Business Promotion Board is too far away from the regions, and without the regions the local authorities will lack a strategic facilitator to bring them together to solve societal challenges. The impact this will have on business development is uncertain, but administrative changes always have the potential to disrupt functioning mechanisms of support.

Besides being responsible for the EU structural funds, the six RGFs (one per region and one for Bornholm) are responsible for deciding the regional development and growth strategies and the regional development funds assigned by the state. The RGFs are also responsible for monitoring and ensuring development in the peripheral areas. The regions will maintain responsibility for developing regional development strategies in the areas of public transport, culture, education, environment, infrastructure, development of the peripheral areas, nature and recreational purposes, green transition, climate adaptation and cross-border collaboration. With the changed governance structure, the regions will have the possibility of applying for regional development funds managed by Denmark's Business Promotion Board for initiatives in the areas for which they are still responsible. This opens new opportunities for the regions to more clearly establish their role as facilitators for regional development. The reform is not likely to pose a real risk for business development in the municipality of Vejle. Organisations and institutions that are today beneficiaries of EU structural funds will still be able to apply to the national Board for funds. However, some uncertainty can be observed from beneficiaries, including in Vejle, about future access to funds through the national Board.

### **Financial risk**

In a deeply globalised economy and society, the consequences of financial crises can be severe for local economies. Financial institutions are tightly interlinked globally, which means that local crises spread quickly to other countries and local economies. The global financial crisis that started in 2007 had severe consequences for Denmark, resulting in failed banks, falling housing prices and increased unemployment. In Vejle, unemployment

increased four-fold after the financial crisis. The construction sector cut its number of employees to a fifth of its previous number (vafo.dk). Nevertheless, the experience of Vejle and the whole of the Southern Denmark region was less severe than Denmark's capital region. Unemployment in Vejle is generally low, and today employment levels have completely recovered from 5.6% in 2011 to 3.8% in 2017 (mikonomi.dk). In comparison with other regions, Southern Denmark has experienced remarkable progress since the financial crisis. The GDP growth rate was around 1.3% between 2009 and 2015, comparable only with the capital region, while in the rest of the country it grew by an average of 1% or lower. Vejle's ability to resist the crisis has been attributed to a large extent to the high diversification of its industrial base and the presence of strong manufacturing industries (Interview 2). Moreover, the support given by the local authority to entrepreneurship and to boost emerging industries appears to have contributed to the adaptability of businesses (ibid.). However, housing prices in Vejle remain at 4.9% below pre-crisis levels (vafo.dk).

In general terms, the financial system in Denmark is very solid and most companies have good access to finance. However, there are a few exceptions, as the Business Policy Consultant at Vejle Local Authority notes: 'It can still be difficult to find investors for finance for entrepreneurship and more risky investments,' (Interview 2). She adds, 'it is also small businesses in rural areas that do not easily get access to finance, or at least the loans have higher interest rates' (ibid.).

## Resilience drivers

Vejle has a highly diversified economy, which makes it rather resilient to risks associated with individual sectors. Vejle's location is very strategic within Denmark and in relation to the rest of Europe, making it an important logistics node: 'This is an advantage for our companies, you can get anywhere in Denmark within two hours and to Hamburg within three' (Interview 2). Moreover, the labour force is highly qualified and said to be loyal in the sense that 'employees tend to move jobs less frequently compared to other places' (ibid.). This is interesting for companies, as they invest in training people. The city also has a strong business community and cooperative business culture. 'Companies are good at cooperating with each other, with external partners, the local authority, knowledge

partners and so on' (ibid.). Despite the lack of a university in the city, the local authority and the Business and Innovation Park in Vejle, have close partnerships with universities across Denmark to attract labour to the city, through education projects, internships and job fairs (ibid.). At the same time, the local authority is promoting vocational career paths at school level, by showing teenagers the career opportunities that exist within those fields. To cope with the shortage of labour, one strategy is 'to integrate immigrants into the labour market, by showing them the opportunities offered in vocational fields' (ibid.). Re-education programmes are also important in assisting workers to move to different industries.

Over time, Vejle's businesses and institutions have shown themselves to be quite adaptable to changing conditions. During the financial crisis, many became unemployed in Vejle; however, today the city has 'even exceeded the number of jobs compared to the pre-crisis numbers' (Interview 2). The Business Policy Consultant at Vejle Local Authority believes that 'businesses are quite resilient and adaptable; many businesses have been able to come back from the crisis within a few years of the crisis'. Moreover, the local authority has also shown its ability to adapt and be receptive to new ways of doing things. For instance, during the peak of the crisis, the local authority partnered with a private investor 'to build a Green Tech House, and Innovation Centre, to make Vejle an attractive place for new sectors, like green tech, that are growing'. Vejle is also increasingly supporting start-ups and emerging sectors by establishing new types of partnerships and working across departments within the public administration. This holistic approach by the public administration has been further reinforced by Vejle's involvement in the 100 Resilience Cities (100RC) network and programme organised by the Rockefeller Foundation.

## Developing the Resilience Strategy

Vejle city started developing its Resilience Strategy in 2014 and it was completed in 2016. The strategy is shaped by the 100RC's framework, and by identifying gaps in Vejle's existing approach to the city's resilience. The 100RC network provides support on how to strengthen Vejle's absorptive capacity or ability to resist and respond to shocks and stress. Departing from the assumption that the future is uncertain, the strategy recognises resilience as the interplay of a city's strengths, weaknesses,



shocks and stresses, and how it responds to unforeseen events. Member cities in the 100RC are given the resources and support to develop a roadmap along four fronts: the Chief Resilience Officer (CRO); the Resilience Strategy; an innovative platform; and a global network (Vejle Resilience Strategy). Cities receive funding and logistical guidance to appoint a CRO position in the city government. The CRO leads the city's resilience efforts by bringing in stakeholders from across silos of government and sectors of society. In this way, the CRO can be regarded as a tool in working towards resilience. Furthermore, cities receive technical support to develop a Resilience Strategy. The Rockefeller Foundation partnered with the design firm Arup to create the City Resilience Framework (CRF). The framework is based on extensive research and evaluation of cities' experiences around the world and reveals a set of factors that strengthen urban resilience. The CRF is an important tool in developing cities' resilience strategies. Cities also get access to the 100RC platform of private sector and NGO services to support strategy development and implementation, and inclusion in the 100RC network where cities share knowledge and best practices (100RC website).

Once a CRO was appointed, Vejle developed its Resilience Strategy in partnership with the 100RC. As a first step, Vejle identified its key challenges through an extensive participative process involving not only the different departments within the public administration but also the citizenship at large including NGOs, businesses and housing associations. As the current CRO expressed: 'You need to know your challenges first, and know them well'. After distilling their core challenges, Vejle built a strategy based on the City Council's vision, 'Vejle – We Make It Happen', and its values of co-creation, innovation and sustainable growth. The Resilience Strategy was structured around four themes, or pillars: co-creation, climate resilience, social resilience and smart city solutions. These are explained in detail as follows.

**Co-creation pillar:** emphasises the need to work cross-sectorally in close partnership with different private and public actors to build capacity and develop innovative solutions. '**A co-creating city**' includes actions to establish a Resilient Vejle Committee, which is responsible for monitoring the implementation of the strategy, coordinating the actions across the different stakeholders and raising any new challenges. Also, Vejle and the

city's educational institution aim to develop strong educational, inclusive offers that benefit the most vulnerable groups as well as the most talented. This is in line with resilient thinking that embraces education. Also, more practical solutions, such as retrofitting communal halls into flexible meeting places fall under this pillar.

**Climate resilience pillar:** focuses especially on turning water into an asset and using it as an advantage for the city's 'urban and social capital'. This pillar also aims to make sustainable use of resources and further adopt renewable energy and green transport. '**A climate-resilient city**' includes several actions targeting the risk of flooding, including a feasibility study to better understand the economic component of flood protection. Concrete actions to manage water are also designed to develop spaces for bringing the community together and to provide environments where people feel safe and in which they are proud to live. The Resilience Strategy also presents concrete actions to encourage more biking, better waste collection and community gardening, to name a few.

**Social resilience pillar:** focuses on increasing socio-economic cohesion, working closely with the citizenship, particularly the youth, to reduce the risk of polarisation, as well as with businesses to deliver 'better and smarter' services. '**A socially resilient city**' includes actions such as West City, where social housing, the Spinning Mill (one of Denmark's largest development and innovation environments), FabLab (a digital fabrication, design and innovation training school for students) and several urban gardens are situated. A coordination group is to be set up to create ties between all the initiatives in place. One initiative is to develop platforms where citizens can actively engage and interact with each other to promote innovation, art and businesses. Four-year master plans are expected to improve the social housing environments in Løget (989 households) and Nørremarken (1061 households). These plans are aimed at strengthening social cohesion, stimulating economic growth and reducing the gap between neighbourhoods in Vejle. For instance, through the initiative 'Stairways Ambassadors', citizens help new residents to settle in with the aim of building inclusive societies. This pillar puts particular attention on youth, improving their quality of life and providing them with opportunities, for example by targeting vulnerable groups (drug addicts, homeless youth, and young people with mental health issues). The

'SPOR 18' initiative aims to help young people to address problems such as loneliness, sadness, anxiety, sexuality and stress, while the initiative 'Through Fire and Water' builds self-esteem and confidence and instils a sense of community spirit by training vulnerable young people in firefighting skills. Furthermore, Vejle Local Authority has developed a set of actions to prevent radicalisation among youth. Depending on how a young person is acting, those concerned can respond according to a yellow, orange or red level (SSP Team Vejle). Immigrants and refugees are other important target groups. Discussion groups are to be organised where refugees and migrants can talk about current topics and practice their Danish. Several initiatives aim to improve opportunities to engage in sports, including setting up a Disability Sports Council. Another initiative is the annual award for the most inclusive businesses, which will encourage companies to integrate citizens in the labour market.

**Smart city pillar:** builds on the need to embrace new technologies and digital solutions to improve the city's efficiency, create opportunities, support education and facilitate public access to services. **'A smart city'** involves actions for the improvement of digital infrastructure, or smart technology, such as wireless communications and sensors. Vejle aims to conduct a feasibility study into an intelligent traffic system and its contribution to a greener and better managed urban environment. Making data freely available is another way Vejle expects to support economic growth and ensure transparency. The city is committed to developing plans to include those who find it hard to navigate through the digital world. For instance, the initiative 'Vejle Digital School' prepares the younger generation for future, digital jobs. Even though the turbulent job market is one of Vejle's core challenges, there are no specific actions for the current work force to respond to the challenge. Job generation is, however, a potential outcome of many of the actions.

A fundamental principle for the strategy's four pillars was to 'integrate across the public sector and include citizens and businesses' (Vejle's Resilience Strategy). As many people are not familiar with the concept of resilience, Vejle evaluated the possibility of using a Danish term instead. This proved challenging, as an accurate translation of the word doesn't exist. Vejle instead chose to invite its citizens to define the word 'resilience' and what it means in the context of Vejle. As a result,

the city produced a book titled 'Change the world for 50 kr' that contains a compilation of citizens' ideas of how to make Vejle a more attractive place to live. This illustrates the strong citizen participation in Vejle's work on resilience. Citizens are part of the implementation process as well, as they are important facilitators in many of the actions.

Vejle Local Authority also involved stakeholders in the strategy development process, but immediate connections to stakeholders (other than municipal departments) in the implementation process is vaguer. Vejle Local Authority is inviting partners to join the work on resilience. This has proved difficult, as there is limited funding for Vejle's work on resilience. For instance, there has been limited involvement by NGOs since they depend on members' funding. However, the resilience initiative has received a lot of attention from students and universities, which is especially important given there are no universities in Vejle.

Businesses are involved in Vejle's resilience work in many ways, even though economic resilience isn't a core pillar in the strategy. Vejle is collaborating with businesses, especially start-ups, through the Green Tech Centre and the city's Resilience House. There is also a 'Business Resilience Cup', an annual competition that challenges companies to find solutions to real problems. The event brings together start-ups, corporations and the 100RC with the aim of generating global impact, while focusing on climate change ([rcbusinesscup.com](http://rcbusinesscup.com)).

These initiatives have not led to specific actions in the strategy to strengthen resilience in the business sector, in the sense that the focus of the strategy has not been to identify the specific elements and mechanisms that help the economic sectors to cope with risks and global trends. Yet it is clear that economic growth is a desirable outcome that has been taken into account during the strategy development process. However, the strategy and the initiatives around resilience show a growing understanding of Vejle's own strengths and weaknesses, which are key to anticipating shocks. Vejle Local Authority also acknowledges the need to work with businesses, and improve technology and education, which are important aspects in boosting competitiveness, providing better tools for businesses and preparing the work force to meet future needs.

In the implementation phase between 2016 and 2020, the strategy sets out to: create a resilient city and strong local communities; enable Vejle's busi-

nesses to create value from the Resilience Strategy; become an innovation laboratory for resilience; pioneer a progressive, co-creating and invigorating city management; and demonstrate how small 'provincial cities' can become the new pioneers in city innovation. The implementation process includes realising the 100 actions listed in the strategy; establishing partnerships for resilience within Vejle; facilitating dialogue and engagement on the resilience agenda; engaging with 100RC and the platform partners; and institutionalising the Resilience Strategy. The Strategy, as stated in its co-creating pillar, is intended to be mobilising, bringing together stakeholders to address challenges and implement actions.

Of the 100 planned actions, 41 are planned to be implemented before 2020, while the rest have a longer timeframe. The actions have 'owners' who are responsible for their implementation. The implementation takes place according to the action's time frame: short-term (within 2 years); medium-term (within 2-5 years); and long-term (beyond 5 years). Indicators to measure the implementation are not included. This is also linked to the strategy's purpose of mobilising stakeholders to develop initiatives that will implement the strategy.

### **Resilience in practice**

There are three main ways in which Vejle Local Authority has benefited from working with resilience. First, the international network provides knowledge and a global perspective. Second, cross-sectoral collaboration has enabled more collaboration between municipal departments. Third, resilience thinking has resulted in holistic solutions.

**The benefits of being part of an international network:** The immediate benefit for Vejle Local Authority from its membership of the 100RC is the knowledge and tools it has gained to adopt a strategic and integrated approach for resilience. The network provides easy access to other cities, most of them much bigger cities than Vejle, from which to ask for advice or inspiration. The close and easy communication between Chief Resilience Officers within the network provides the ideal platform to access hands-on and concrete solutions already in practice elsewhere and ready to be copied by other cities. For instance, after the terror attack in Paris, France, the CRO in Paris asked cities in 100RC to share their tools for preventing radicalisation. Vejle has a strategy for this purpose and shared its knowledge with Paris. This would not have hap-

pened without the network. This shows how being part of the 100RC has brought Vejle useful and valuable networks. The partners also collaborate in different ways, such as in hosting events such as the Business Resilience Cup. The cup provides an opportunity for foreign companies not only to discover Vejle's vibrant business community but also to see how a city can work with resilience in practice: 'Many industries have an interest in seeing how they can improve their business model to become more environmentally friendly, both as a way to save costs by saving resources and as a competitive advantage by adding value to their product, showing they are "green"' (Interview 2). The Business Resilience Cup also provides local industries with inspiration and contacts. Vejle receives many international visitors due to its involvement in the 100RC, many of whom visit the Green Tech Centre and the Resilience House.

### **Strengthened cross-sectoral collaboration:**

Vejle has not necessarily identified unknown challenges but it has learned to approach them through co-creation, involving several municipal departments and new partners. Developing a Resilience Strategy has supported resilience thinking in the public sector, while the private sector has also been involved. Furthermore, the co-creating way of working has strengthened collaboration between the municipal departments. Interviewees highlight that the high priority given to the Resilience Strategy by the City Manager is a key to successful implementation. From the beginning, there were objections to the strategy from some local politicians and different administrations. Strong leadership has been important in the process, leading to the situation today where the Strategy is being implemented. The City Manager in particular has been concerned with breaking down 'silos' and strengthening cross-sector collaboration within the local administration. This mindset was also important when projects such as the Green Tech Centre and the Resilience House were realised as public-private partnerships. The process of developing the strategy has particularly strengthened collaboration between the Environment and Planning Department and the Social Department, which has led to more sustainable urban development projects being implemented today. Notably, these development projects also include citizens in new ways. While cross-sectoral collaboration and citizen involvement is not entirely new, the resilience project has enhanced un-

derstanding of the importance of strategically allocating resources to generate dialogue between the local authority and the private community. 'For instance, when we want to attract young people to choose a vocational path, we need to work together with business and the school departments – none of us can tackle that issue alone so we need to work together' (Interview 2).

**Holistic thinking:** Thinking cross-sectorally, and long-term, has also led to more systemic and holistic thinking. One concrete example is the 'Fjordbyen' project, which involves a new development area by the harbour. Vejle would have intervened in the harbour area to prevent floods even without the resilience initiative. However, resilience thinking has profoundly shaped the project by including a social approach. In the CRO's words: 'If there was no resilience project we would of course have dealt with the water problem, but now we try to deal with challenges in a different way'. The Fjordbyen is used as a laboratory for climate change adaption and flood control to improve flood management. This takes place through exploring innovative and integrated solutions, for example by retrofitting new public spaces. Looking beyond the immediate purpose of water management, the project considers how to strengthen the city and social cohesion. The Resilience Strategy facilitates a discussion around not only constructing a sluice or a dam to keep water out but also establishing a recreational area around it that will create more life in the city. There has also been a mobilising aspect to this in terms of engaging citizens in the project – how they will help each other in case of a flood, getting sand bags, helping the elderly, and so on.

Furthermore, the extensive process of involvement has stimulated the city to reflect more broadly on acknowledging the risks and long-term effects, and to understand how important it is to think from a long-term perspective and across disciplines to design solutions that can help strengthen the public institutions, socio-economic structure and infrastructures to be better prepared for global trends and future developments. This process has also been crucial in raising awareness by society at large about the existing risks, and the factors that help both the city and individuals to cope with potential eventualities. Giving the ownership of this process to the citizens was thought to be essential in generating an impact.

So far there is no clear picture of the long-term implications of the identified challenges when it

comes to the capacity of the city to absorb and adapt to major shocks and long-term stress. Likewise, when it comes to the economic perspective, the CRO explains that, so far, they 'haven't seen an obvious opportunity to work with business in a way that can help and strengthen them'. Nevertheless, Vejle Local Authority works in close collaboration with the business sector and business consultants to identify ways in which the resilience project can be useful for them. Moreover, businesses seem to find it important that the local authority has adopted resilience thinking in its business policy to improve environmental sustainability, social well-being and successful businesses. One concrete example is the initiative around the Resilience House, as part of the Green Tech Centre.

### **The Green Tech Centre and the Resilience House – test and demonstration**

The Green Tech Centre was established before the development of the Resilience Strategy as a 'light house for green technology in Vejle North' in 2014. It was established as a combined business park, testing and demonstration facility. The facilities were established partly with local authority funds and partly with private funds (the Kirk family/owner of LEGO). It is a public-private organisation that includes triple-helix partners.

The Green Tech Centre attracts approximately 6000 visitors per year from Denmark and abroad. Around 30 green profile companies rent office space at the Green Tech Centre. Together, the companies have more than 200 employees. The Green Tech Lab is a business incubator for start-ups, where businesses have access to testing, demonstration and prototype production facilities. The lab also attracts start-ups from outside Vejle and, for example, in some cases a business is based in Copenhagen but one of its employees or projects is based at the Green Tech Centre. It has become a hub for the development of environmental technology businesses. Private investors are connected to the centre, such as the owners of the Green Tech Centre, who invest some of their capital in young start-ups. The testing and demonstration facilities help the businesses to attract investments and grow. When they leave the lab, some of the companies choose to stay at the Green Tech Centre and rent office space there. The Green Tech Centre maintains an open innovation principle, which encourages networking and learn-

ing between triple-helix actors in the network.

As part of the Resilience Strategy, another addition was made to the Green Tech Centre. The Resilience House, which opened in 2017, has close links to the climate resilience and smart city pillars. It is intended as an innovation and educational centre for the demonstration and commercialisation of resilient solutions within energy, climate, water and data. The Resilience House is home to 30 businesses and organisations (State of Green). It is also the office of Resilience Lab Denmark, a Quattro Helix cooperation between research and educational institutions, companies, authorities and users. Based on simulations of Vejle in 2050 and in close cooperation with stakeholders, Resilience Lab Denmark has modelled future incidents (i.e. risks and stressors). Risks are, for example, power outages, flooding, torrential rain and internet outages. Stressors include increases in water levels, quantities of renewable energy in the grid and quantities of data.

As far as possible, the house was constructed using recycled materials. When the Green Tech Centre was constructed, there was a focus on optimising energy efficiency. This was taken a step further with the Resilience House, which also integrates renewable energy sources with heat pumps and solar panels. The sustainable construction process involved local SMEs in the process.

### **Smart city – resilience facilitates more ambitious urban development**

Smart city initiatives fall within the remit of Vejle's Department for Environment and Planning. The department has a long list of ideas for projects and has implemented several of these, some of them funded by a local authority fund for smart city development and some by the public administrations involved. According to the Head of Department, the process of developing the Resilience Strategy has made it possible to be more ambitious with urban development projects. With the development of the strategy, the different public administrations gained a better understanding of each other through discussions about resilience. This has made it easier to find common ground today in connection with urban planning and development projects.

For example, the development of a new residential area, called Rosborg, has been in the pipeline for several years, but ambitions have changed with the introduction of the Resilience Strategy,

under which the Rosborg development has become one of the strategy's lighthouse projects. The residential area will be developed on the current recycling site, which will be relocated. This site is based near the Ådalen stream, an area at special risk of flooding. In the preparation process, the local authority has involved investors, neighbours and citizens in how to create an attractive green residential area, through means such as workshops. The Resilience Strategy facilitates discussion with investors about the need to construct something that will last longer and create life in the area.

The local authority has invested in a 3D cave. This has made it possible for politicians to visualise planned residential areas such as Rosborg. As part of this project the 3D model was used to visualise the exact areas suitable for construction. The 3D cave has also been used as a communication tool between businesses that wish to expand and the local authority's Environment and Planning Department.

For the public, the local authority has established the Ecolarium, a knowledge centre and experimentarium focusing on the environment and climate. Every year, more than 80,000 children, young people and adults from Denmark and abroad visit the Ecolarium to see the exhibitions and to join teaching and guided tours. This project was launched before the Resilience Strategy, after which it became more focused on sustainability as an integrated part of the city.

### **Findings Vejle case**

The 100RC network has shaped the understanding of resilience and ways of working in Vejle. Vejle has interpreted the resilience concept, recognising that Vejle must change or develop to a certain degree to adapt to new conditions, such as more frequent floods, emerging technologies and transforming labour markets. The strategy and its individual actions are, therefore, an attempt to address the challenges proactively and thus anticipate and prevent shocks rather than merely responding to them. In a way, this proactive approach attempts to turn Vejle's challenges into assets, for example taking advantage of water to improve the urban landscape and create cohesion, and using technologies to improve its competitiveness, service provision and social inclusion.

Vejle represents an interesting example with which to study resilience as it provides a concrete interpretation of how to work with resilience at a local level.



Vejle's involvement in 100RC has had an overarching influence on its policies and working practices, and has led to concrete projects, and initiatives. This has improved the results of projects and raised the awareness of the local population of some of the city's vulnerabilities. This last element is particularly important, given that citizens cannot fully rely on the public administration's ability to react to major shocks and that the individual actions of the citizenship are important too. In this sense, a society that is aware of the risks is better equipped to react to major events. Giving ownership of the process to the citizens by inviting them to provide input on what the issues are and what makes the city a better place, has been thought to be a key way of creating awareness. Other factors that can strengthen their ability to cope with such events are social inclusion, digital technologies and education.

It is particularly challenging to introduce holistic thinking when public institutions specialise in a particular field. Likewise, the citizenship at large has trouble connecting with the problems of the city as a whole when these problems may be far from where they live or people cannot see how they can make a difference.

Although Vejle did not pay specific attention to the risks associated to its industries or the overall resilience of its economic structure, the far-reaching exercise of identifying their core challenges has revealed some key threats to the city's economic and social wellbeing. This process of working with resilience appears to have being an important learning process and shows the potential to generate further reflection on how better to integrate the economic perspective into Vejle's resilience work.

# 5. Findings

The five case studies presented in this report have brought forward many interesting results. On the one hand, the risk landscape in all cases appears highly connected to exogenous factors. On the other hand, the ways in which such threats become explicit depend on the industrial base of the region, its organisational structures, flexibility and timing, among many other endogenous conditions. Therefore, the ability of regions and their multiple actors to respond to unwanted developments depends greatly on a complex combination of factors: the type or nature of the disturbance, its intensity, its interrelation with other threats and stress factors, and the inherent capacities of the region to resist, respond and reorganise its fundamental structures to cope with change. This chapter provides a detailed account of the findings by addressing each research question separately in a cross-case comparison.

## Response to Research Question 1: *What risks/shocks are the Nordic regions vulnerable to?*

A categorisation of the different types of shocks/risks and stressors presented in the theory chapter (chapter 2), is useful in identifying and comparing the shocks/risks and stressors the Nordic regions are vulnerable to (Table 5). Note that this is not an exhaustive list and is based on those risks and stressors mentioned during the empirical study. Moreover, risks are attributed to the regions where they were mentioned and does not mean others are not vulnerable to them.

Such a categorisation helps an understanding of the causes of economic turmoil and potential imbalances to the social structure. However, risks and shocks never exist in isolation. They are inter-related with other risks and conditions that may amplify or play down the impact of shocks. Thus,

**Table 5: Mapping of the risk, shocks and stressors identified in the five studied regions. Abbreviations: Northern Ostrobothnia (NO), Vestmannaeyjar (VME), Rogaland (RL), Norrbotten (NB), Vejle (V)**

Types of shocks/risks	Hazard type	Findings
Covariate	Financial	Small and unstable currency (VME) Financial crises – past and future (NO, VME, RL, NB, V)
	Technological	Smartphones introduced in the market, collapse of Nokia (NO), impact on Telia and Ericsson (NB); Shale gas technological 'revolution', leading to price shock (RL); automation and digitalisation: impact on jobs and skills (NO, VME, RL, NB, V) Cybersecurity, social exclusion and competitiveness (V)
	Commodity price	Iron-ore and other minerals (NO, NB) Forest-based products (NO, NB) Fish (VME) Oil and gas (RL)
	Demand-driven	Decline in paper consumption (NO, NB) Loss of Russian market in fish and dairy products, due to economic crisis and sanctions (VME, NO)
	Policy-induced and regulatory	Regional reforms (NO, V) Fishing quota system and fees (VME) Centralisation of services (VME) The green transition (RL)



	Geopolitical	Repercussions of international sanctions on Russia (NO, VME) Brexit vote (NO, NB, VME, V) OPEC's internal challenges and upsurge of alternative energy mixes (RL) USA's increasing protectionism (NB, V)
	Environmental	Volcanic activity, Extreme weather conditions, potential collapse of fish stocks (VME) Flooding and climate change (V) Impact of the green transition on oil and gas industry (RL) Impact of climate change on reindeer herding (NB) Food security and peace (NB)
<b>Idiosyncratic</b>		Over-dependence on a single or few industries (NO, VME, RL, NB) Risk of loss of income-generating activity
<b>Seasonal</b>		Reindeer herding – changing patterns in winter (NB)
<b>Stressors</b>		Ageing population, urbanisation, demographic pressure (NO, NB, V) Unreliable transportation (VME) Insufficient infrastructure (NB) Shortage of labour, shortage of specific skills (NO, RL, NB, V) Challenges with education attainment and retraining (VME, RL, NB, V) Male-dominated industries (NB, RL) High youth unemployment (NO) Attractiveness (NO, VME, NB, V, RL) Unhealthy lifestyles (NB, V) Monopoly of financial resources in dominant industry (RL)
<b>Positive shocks</b>		Disturbances leading to shape development path, reorganisation of institutional structures and industrial composition, tackling unsustainable practices and establishing new working cultures, strengthening social bonds and/or open business opportunities (NO, VME, RL, NB, V)

an understanding of a specific event requires a holistic view of all the factors contributing to economic turmoil, even if there was one reason triggering the shock. A clear example is a commodity prices shock. Commodity prices are directly connected with the state of the global economy, geopolitics and any eventuality affecting supply and demand, such as natural disasters, wars, technological shifts, the discovery of new resource deposits, and so on.

As a result, **commodity prices** are highly fluctuating. A high dependence on commodities in many Nordic regions is therefore a major risk. This was evident in Rogaland, Vestmannaeyjar, Norrbotten and Northern Ostrobothnia, which are heavily dependent on oil, fish, mineral extraction and forestry, respectively. In these cases, the causes triggering a drop and shocks in commodity prices have varied significantly. For instance, the collapse of the oil price in 2014 resulted from a mix of a technological shock, a lagging global economy and the geopolitical context. The drop in the price of mineral resources instead was the result of the global financial crisis. **Regions depending on com-**

**modity prices** have the tendency to get too comfortable when prices are high. When the prices drop, the first ones to suffer are companies down the supply chain. These firms are of all sizes, but many are often of small and medium size, and depend solely on a single or few clients such as the LKAB mining company in Norrbotten, Vinnslustöðin and Ísfélagið fisheries in Vestmannaeyjar, or Equinor in Rogaland. These key companies control the resources and thus have an immense influence on the measures taken, such as cuts in received services during times of low profitability. The impact of such cuts can reach other industries such as IT services provided to the mining industry.

**Technological risk** is revealed as one of the biggest challenges in all the cases studied in terms of the competitiveness of industries, employment, provision of public services and all aspects of citizens' lives. Global competition and technological innovations played a key role in outcompeting Nokia, Telia and Ericsson in Northern Ostrobothnia and Norrbotten. The collapse of the price of oil leading to financial trouble and unemployment in Rogaland, was partly the result of the US shale

gas technology 'revolution'. Moreover, as new technologies render certain jobs obsolete, the regions studied are challenged in upgrading the skillset of those who become unemployable. Technology appears to lead to certain health-related problems related to a sedentary life (e.g. Norrbotten) and issues regarding cybersecurity (e.g. Vejle).

**Financial risk** was mostly mentioned in relation to the crisis in 2008–2010 and the different consequences it had on the regions studied. What is clear is the awareness-raising that the crisis had on the unpredictability of global events and the severe consequences it may have on local economies. In Iceland, however, the issue of holding a small currency is of specific concern, given its high value volatility as a consequence of exogenous and endogenous developments. **Currency value volatility** represents an unstable environment for investments and has direct effects on consumers' purchasing power. The availability of financial resources did not appear to be a challenge in the cases studied, yet these may not all be equally accessible. For instance, small businesses in Vejle's countryside may not easily access credit, and financial resources in Rogaland tend to be largely monopolised around the energy sector.

**Political risk** does not appear to be a significant threat to the regions studied; on the contrary, there appears to be a high degree of trust and effective coordination between business and public institutions. However, regional reforms in all Nordic regions have raised a certain degree of uncertainty. Additionally, the distance to national policy-making appears to be challenging, for instance, in stopping the centralisation of health services to Reykjavik and the insufficient investment in infrastructure in Norrbotten and Northern Ostrobothnia. **Geopolitical risk** instead, appears as a major challenge for all regions, for instance, the loss, or potential loss, of markets in Russia, the United States and Britain as a result of sanctions, new tariffs and the intention to exit from the EU respectively. The Brexit vote also represents a threat to the EU's budgets for regional structural change (ERDF funds), which seems to be important for cross-border collaboration in Norrbotten and Northern Ostrobothnia. For Rogaland, the internal discordance in the Organisation of Petroleum Exporting Countries (OPEC) and shifting global power regimes in the energy sector represents a challenge.

**Socio-economic impact of environment-related risks** is critical for Vejle, which is expected to be

completely underwater within the next 100 years, and for Vestmannaeyjar, which is at permanent risk of volcanic activity and extreme weather conditions. In these two cases, all aspects of citizens' lives and the economy are at play in case of an environmental eventuality. Yet aside from catastrophic events, climatic conditions represent a day-to-day challenge for the transportation of passengers and goods in Vestmannaeyjar, in turn affecting the development of economic opportunities. In Norrbotten, the accessibility of reindeer food and in turn the Sami herder's traditions are being threatened by climate change. Furthermore, events such as droughts, floods and other natural disasters taking place around the world may threaten food security and increase immigration towards the Nordic regions.

**Demand-driven risks** have been identified mostly in connection with other risks, such as internal economic crisis in Russia and the Brexit vote leading to Icelandic fisheries losing markets. Likewise, technological developments in the telephone industry and digital devices led to a collapse in demand for Nokia phones and paper.

**Over-dependence on a single or few industries** is seen not only as the inverse of diversification but to an extent as the cause of it. The dominance of the petroleum industry in Rogaland, for instance, absorbs most of the competences in the region, leaving little space for workers to be employed in other industries, or to set up their own entrepreneurship.

Furthermore, this study has identified a large variety of forms of **stress and stressors**, which may not be perceived as shocking but that represent major challenges to the long-term development of the regions. The unreliability of transportation, the centralisation of basic services to Reykjavik, a lacklustre labour market and the lack of creative jobs, are some of the stressors identified in Vestmannaeyjar. These in turn weaken the region's competitiveness and its potential to diversify and attract new people, making potential new shocks more likely and more damaging. Similarly, in Norrbotten and Northern Ostrobothnia, the urbanisation patterns, ageing population and extremely low population density in the rural areas make it difficult to exploit the potential of the region and to provide services and amenities. Insufficient labour, mismatch of skills and brain-drain are also common in these regions, as well as in Vejle and Rogaland. Often, the effects of stressors reinforce

other stressors in a series of negative feedback loops. The accumulation of stress may then provoke a major shock if, for instance, a major employer decides to relocate outside of the region.

Lastly, the abrupt transformation in the regional economic structure has often led to positive outcomes, so called '**positive shocks**', by shaping the development path, reorganising institutional structures and industrial composition, tackling unsustainable practices and establishing new working cultures and opening opportunities. Such was the case in Rogaland with the oil price shock, which served as a catalyst for restructuring and shaping the development path by rebranding as an 'energy region' to capitalise on its potentials beyond oil and gas. Even more radically, the technological shock in Northern Ostrobothnia and Norrbotten led to the reconstruction of a healthier and more dynamic high-tech sector. The introduction of the fishing quota system in Iceland, although not a shock but a long-term process in which many were cut out of the business, allowed for a more sustainable and competitive business. Moreover, the detrimental effects of disturbances for some often results in gains for others. Such was the case in Iceland, where the decline in currency value brought higher profits to the fish industries.

## **Response to Research Question 2: *What are the drivers of regional resilience?***

The case studies and literature raised a number of features that contribute to the adaptive capacity of regional economies and societies. These include: 1) spreading the risk through diversification; 2) evoking disturbance and welcoming change; 3) a capacity to respond and change shape through self-organisation and reorganisation; 4) generating understanding; and 5) coordinating the interplay between diversity, disturbance and reorganisation through proactive management and inclusive governance practices (this last point coincides with Research Question 3 and is elaborated in that section).

**Spreading the risk through diversification has multiple nuances, such as:**

- Diversification of the industrial base
- Diversification of employment
- Diversification of industries' portfolios (related variety)
- Diversification of markets
- Multi-use public spaces and infrastructures

Perhaps the most obvious way to spread risks is through the diversification of the industrial base by the generation of new economic activities. This makes it possible for the overall economy to withstand disturbances associated with individual industries. An interesting example of business promotion is the close collaboration between Luleå Technical University and industry, and the surrounding innovation system that effectively assists business promotion and scaling up start-ups. Another example is the Business Cup organised in Vejle each year to promote business development by showing foreign industries the potential of the region and by generating a platform for knowledge exchange and learning. However, generating economic activities is a lengthy and resource-consuming process and particularly challenging for rural areas and small cities.

Diversification of employment appears to be highly important. While certain industries might not represent a large share of the economic gains made in a region, their role in absorbing part of the labour market may be crucial for job security. For instance, tourism, car-testing and data centres are some of the emerging activities in Norrbotten. These far from balance the region's over-dependence on the profits made from the mining industry but they are completely disconnected industries, which would secure a certain number of jobs when commodity prices fluctuations affect the industries based on natural resources.

Diversification is geographically uneven. Norrbotten and Northern Ostrobothnia have made positive gains in creating room for the diversification of their industrial base; however, it remains a major challenge in places like Kiruna, Raahe and other smaller towns that remain heavily dependent on natural resources in terms of both profits and employment. In this case, employing concepts such as entrepreneurial discovery processes (EDP), allowing for related variety within existing industries, may provide some alternative job opportunities.

Diversification within industries, or related variety, is achieved by maximizing the different possible uses of resources available. This often involves the spillover of knowledge between industries, which in collaboration lead to an expansion of the value chain beyond what is possible by one industry alone. Examples of this were identified in the mining sector in Norrbotten with the development of ventilation systems, sensors, digital tech-



nologies (i.e. 4G and 5G) and drone testing. Similarly, the existing structures and caves in Northern Ostrobothnia's mines are being used as laboratories for crop husbandry and as a research environment for particle physics. In the case of Rogaland, the petroleum industry has seen the potential of extending its expertise in offshore installations to serve other purposes, such as wind energy and aquaculture. In Vestmannaeyjar, the 'Ocean Related Innovation' education programme is promoting the development of innovative uses of the marine resources.

Moreover, market diversification is crucial for companies to resist demand-driven shocks, which in turn can be provoked by technological, geopolitical and financial risk, among other things. Examples of market loss were identified in Vestmannaeyjar and Northern Ostrobothnia as a consequence of the international sanctions imposed on Russia, and the Brexit vote. The latter had an impact on the value of the British pound, which in turn reduced consumers' demand for imported goods in the UK. Another example is the insufficient market diversification of Norrbotten's mining industry supply chain. Suppliers relying on one or few clients within the region may need to expand their client portfolio to withstand a potential commodity price shock.

In addition to diversification, in some cases, duplication or **redundancy** serves as a way to spread the risk. This is especially important when it comes to infrastructure. In Norrbotten for instance, processing industries require stable electricity at all times, since they never stop operating. For this reason, Norrbotten has built several hydropower plants and electrical infrastructures that guarantee the stable provision of electricity. In addition to minimising the risk, this has proved to be a competitive advantage in attracting Facebook and other data centres to the region. A different case is transportation in Vestmannaeyjar, which is largely unreliable and thus different alternatives are needed for securing the island's connection with mainland Iceland.

Vejle's work provides a different example of spreading risks and diversification by incorporating holistic thinking within their administration. Infrastructure projects for flood control, for instance, are now designed to served additional purposes, such as social inclusion and attractiveness.

Finally, a rather different and interesting example of spreading risk was evidenced by Norr-

botten's steel company, SSAB, which, by owning a subsidiary in the United States, has so far avoided the negative effects of the US protectionism led by President Trump, which specifically targets European steel.

### **Evoking disturbance and profit from weaknesses:**

Shocking events and disturbances are not only negative; on the contrary, much can be gained from crisis. 'Creative destruction', an old but still influential concept, highlights the process of destruction of one industry or firm due to the emergence of new technologies. In this case, new technologies bring opportunities of renewal and adaptation to new realities, market demands and social changes. They offer opportunities to become more efficient by adopting new tools that simplify old industrial processes, improving working conditions and minimizing hazards such as environmental degradation and natural disasters. The same is true of other forms of disturbance; in Rogaland, for instance, the commodity price shock was argued to be a necessary shock to shape the unsustainable development path that concentrated the risk in the petroleum industry.

Creative destruction and disturbances in general are not geographically balanced. Emerging technologies may benefit one region but bring about the collapse of industries in another region, with devastating effects for the local population. A good understanding of the nature of disturbances and a close awareness of the region's own weaknesses is strategically important to actively turn them into opportunities. Coming back to Rogaland, the collapse in oil prices represented an opportunity to recruit workers in other industries that previously could not afford them, as well as in the public sector, and to seek diversification and related variety by provoking knowledge spillovers to other energy industries and aquaculture. A different example is the case of the high-tech industry in Northern Ostrobothnia and Norrbotten. After a period of downturn and profound transformation, the sector re-emerged and is today much healthier and more dynamic, offering positive growth potential. In Vestmannaeyjar, the volatile currency is particularly risky. The fish industry, however, has taken advantage of times of low value to make long-term investments in infrastructure and expand the value chain. In Norrbotten, automation in the mining and processing

industries has been an effective way to compensate for the shortage of labour, reduce the risk of job losses and stay competitive. Moreover, weaknesses such as low population density, high dependence on natural resources, cold temperatures and darkness have been turned into an advantage, diversifying the economic structure and bringing data centres, car testing, tourism and the space industry to the area.

Being alert and undertaking continuous adaptation allows a region to stay competitive. Entrepreneurial discovery, experimentation, R&D, flexible education programmes and life-long educational opportunities are some ways to induce change. To minimise the negative effects of inevitable disturbances, however, it is necessary to **pair entrepreneurial and technological discovery with diversity (spread the risk)**.

### **Capacity to respond and change shape through self-organisation and reorganisation**

The **capacity to respond does not imply strength necessarily**, but rather the ability to absorb change by shaping existing institutions, reorganising work and partnerships, reevaluating strategies and adjusting education programmes, making sure that all the parts of the system are able to transition into the new conditions. The cases of Northern Ostrobothnia and Rogaland are particularly interesting in this regard. Northern Ostrobothnia created a task force called the 'Tar Group' consisting of different public authorities established specifically to address the structural change. Similarly, in Rogaland, the 'Active Efforts' consortium was established together with the county governor, the education authorities, the employment office and trade organisations to synchronise their response. In both cases, significant resources were devoted to facilitating a structural transformation of the economy and working structures. In doing so, new working cultures and forms of collaboration emerged. An additional element in Rogaland was the strategy of rebranding itself as an energy region to show its forward thinking nature and commitment to the green agenda, despite the petroleum sector remaining largely unchanged.

Another example is the resilience work done in Vejle, which, rather than being reactive, takes a proactive and preventive approach to address the city's challenges. Vejle has been able to break down the municipal administration from the thematic 'silos' to a cross-sectoral and participative

way of working. This has improved the local authority's capacity to respond by developing more holistic solutions.

Moreover, in several cases the exceptional response of the society at large has been highlighted as indispensable for coping with past events and current challenges. The 'island spirit' in Vestmannaeyjar, the 'Jæreske spirit' in Rogaland, the closeness of the people in Norrbotten and the loyalty to the region in Northern Ostrobothnia describe how a hands-on attitude, and a strong sense of community and belonging have been of outmost importance in coping with difficult situations. The 1973 eruption in Vestmannaeyjar was an extreme situation that reminded people that the mechanisms of response designed by the public institutions are never enough. Even in less dramatic situations, regions are always at risk of unpredictable events, and thus need a proactive and engaged citizenship.

### **Generating understanding**

Monitoring is the first step to being prepared. It may seem obvious that it is crucial to monitor the state of things closely, yet this it is too often not done. Taking any action to strengthen a region's resilience first requires a clear understanding of questions such as: Resilience of what systems (e.g. industries, institutions, infrastructures)? Resilience to what threats, whether endogenous (e.g. local stressors, weaknesses) or exogenous (e.g. technological trends, green transition, geopolitical shifts, debt crises)?

An excellent example is the thorough exercise conducted in Northern Ostrobothnia to monitor the challenges in the region. The regional council, in collaboration with the local authorities, elaborated a status study about local industries and the challenges, global trends and technologies they were facing. This preparatory work was particularly useful for building up a good, comprehensive strategy for structural change (*äkillisen rakennemuutoksen suunnitelma*), as required by the Ministry of Economic Affairs and Employment. The strategy, in turn, was successful in attracting funding for 'Regional Innovation and Experimenting' (AIKO fund).

Aside from the trends directly related to the regional industries, it is essential to monitor other trends such as trust levels amongst citizens, urbanisation, education, migration and climate change, to name but a few, which may lead to sub-

stantial changes in the social structure and in turn affect economic performance.

Another example is the Resilience House in Vejle and the overall efforts made to establish resilience thinking in the society and the business sector, and in that way encourage reflection about practices and structures that may be unsustainable. In turn, this is an indirect way to monitor and reveal any emerging issues. When it comes to natural hazards, advance monitoring systems and risk management plans with effective response systems are vital for safeguarding citizens' lives and wellbeing, particularly in places like Vestmannaeyjar where the risk of natural disaster is high.

Furthermore, in addition to monitoring, a society that is aware of the risks is better equipped to react to major events. **Knowing the unpredictability of shocks, especially in terms of timing, intensity and context (in combination with other risks, stressors and opportunities, or lack of them) is important in order to acknowledge that regions can never be prepared enough, and thus public institutions cannot be expected to cope with disturbances alone.** Therefore, awareness of both the risks and the limitations of the public institutions in predicting and responding to disturbances is crucial for society and the business sector. It is important that they do not get too comfortable and that they are aware that effective recovery depends on the sum of individual actions.

### **Response to Research Question 3: What is the role of regions (and their different actors) in anticipating and reacting to shocks?**

Previous sections have shown the wide complexity of exogenous and endogenous factors that put regions at risk and the equally complex combination of factors that build regional resilience. Likewise, **anticipating and reacting to shocks also depends on the collective and individual actions of all actors in the region, as well as many from outside the region** (e.g. national authorities, the EU, foreign investors). **Public authorities at different levels have a key role in coordinating and building functioning systems** through the provision of services and by creating institutions and mechanisms of support for society and businesses to thrive. Businesses play their role not only by sustaining an economic basis and providing employment but also by developing new solutions for societal challenges. Financial institutions are also key in funding business

development and generating new opportunities for the region. Moreover, this study has shown the particularly important role of society at large.

**The capacity of a region to respond to changing conditions and all sorts of challenges appears to be tightly connected to human agency and human relations.** This includes social values and norms, loyalty, trust levels amongst people, sense of community and attitudes towards collaboration and driving change. **There is a certain limit to what public institutions can do**, particularly when it comes to uncertain developments. Therefore, there is a need to rely on people and the society's ability to self-organise. Previous sections have referred to the **community spirit** in the regions studied as being crucial for coping with difficult times, such as the volcanic eruption in 1973 in Vestmannaeyjar, the technological shock in Northern Ostrobothnia and Norrbotten and the oil price shock in Rogaland. In all these cases, the strong links between regional actors were not only important for coping with shocks but were also reinforced as a result of the collective efforts. This in turn strengthened their collaborative and entrepreneurial cultures for the years and challenges to come. In Vejle, strengthening the sense of community and social responsibility has been raised as essential for dealing with water management and future floods.

Such acknowledgement of the role of social capital puts emphasis on the importance of regional and local authorities in enhancing community-building, trust, collaboration, citizen participation and empowerment. However, for the community to act, authorities need to **generate awareness** of the risks as well as the opportunities and tools available. It is also important for citizens to know when nothing can be done to prevent major shocks and, in that way, generate solidarity between people. In Vestmannaeyjar, and in Iceland as a whole, solidarity amongst people, both practically and financially, has proved to be of enormous importance for recovering from environmental shocks.

Furthermore, regional and local authorities have the main role in coordinating actions, developing and implementing strategic plans that take into account societal, economic and technological trends. The case studies have revealed some key actions that the public authorities can take:

- Monitor and generate awareness
- Spread risk through diversification (see more in previous sections)

- Evoke disturbance: welcome change, invest in entrepreneurial discovery, R&D, networking
- Generate a good entrepreneurial milieu: promote collaboration and reorganisation
- Leadership: strategic and integrated approaches, support businesses and citizens initiatives
- Enhance community spirit
- Build open, transparent and flexible public institutions
- Develop a system for learning: less rigid systems, allowing variability; build capacity (e.g. skills, education, trust)
- Regulate unsustainable developments

Some of the listed actions may be more easily addressed at a national level, for instance the design of education programmes, which is normally the responsibility of national level authorities. The same may be true for funding structural change and infrastructure, as well as compensatory measures taken to relieve the negative effects of political decisions. In some cases, action is needed from the EU level, such as the cash reserves used to compensate farmers who were affected by the export ban to Russia in 2014. However, in such cases the local and regional authorities still hold an important role in facilitating and guiding the implementation of measures decided at higher levels.

#### **Response to Research Question 4: *How can strong and weak signals of changing regional resilience be recognised?***

This study has been based on an evolutionary approach to economic resilience, which, contrary to the notion of equilibrium, assumes continuous change in the economy. As such, an evolutionary approach implies that regional resilience is never stable but is continuously changing along exogenous and endogenous trends and developments in the economy, politics, technological development, markets, competition, education levels, social values, trust levels and so on.

The common feature of all kinds of shock is the element of surprise or unpredictability, at least in

terms of timing, intensity and context. As mentioned in the theory (chapter 2) the difference between a risk and a shock is that risk implies probability, and shock implies the event itself. Therefore, the event itself is normally unforeseeable, yet it is possible to gain a certain level of awareness of the risk landscape and stress factors that may amplify the probability of shocks. This study has raised a wide variety of risk types and stressors, which can be understood as signals for changing or potential changing resilience levels.

A deep understanding of the regions' industries, institutions, social structures and values is essential in identifying signals that may disrupt their regular performance. A useful example is the thorough work conducted by Northern Ostrobothnia County Council to monitor the status of its industries. Another example is Vejle's holistic work on resilience. These kinds of exercise provide an opportunity to reflect on vulnerabilities and unsustainable developments. An interesting approach in Vejle is the peer-learning system established through the 100 Resilience Cities network, which allows the city to exchange practices with other cities around the world and learn from their experiences. Additionally, Vejle's Business Resilience Cup is an excellent opportunity to bring in outsiders and experts in different fields who can provide a fair and objective opinion of how things are organised in the city.

Furthermore, stress is particularly worth highlighting as a signal. Because of the gradual and long-term character of stressors, there is a tendency to neglect them until they lead to severe consequences. Outmigration from rural areas and small towns is a common condition in most of the cases studied; gender imbalances and places that are unattractive prospects to settle in are some of the examples that lead to loss in competitiveness and economic opportunities.

Finally, R&D, entrepreneurial discovery and cross-sectoral coordination are some of the ways to welcome signals, hunt for them, evoke disturbance and thus take advantage of them by turning them into opportunities.

# 6. Recommendations

The list of selected recommendations in Table 6 has been prepared based on the results of the two-year comparative study on regional resilience in Nordic regions. The recommendations are targeted towards policy-makers and professionals working with regional planning and territorial

development, risk management, business development and innovation at local, regional and national levels. Moreover, this report and recommendations is relevant to anyone interested in regional economic and social resilience.

**Table 6: List of recommendations for building resilient regions**

1.	<p><b>Generate awareness:</b> Conduct scenario analyses and identify risks and potential shocks. Once risks are identified learn how shape the regional organisational structures to better fit changing conditions. One key way of identifying risks is by monitoring and generating understanding on:</p> <ul style="list-style-type: none"> <li>■ <b>Exogenous / global trends</b> (e.g. new technologies, changing consumer demand, competition, liberalising or increasing protectionism of strategic markets, climate change effects)</li> <li>■ <b>Endogenous / local conditions</b> (e.g. available and needed skills, access to research results and financial resources, infrastructure, trust levels among actors, political decisions).</li> </ul>
2.	<p><b>Spread the risks:</b></p> <ul style="list-style-type: none"> <li>■ <b>Diversification of the industrial base:</b> Invest in entrepreneurship, R&amp;D, scaling up start-ups</li> <li>■ <b>Related variety:</b> Encourage industries to expand their value chain</li> <li>■ <b>Market diversification:</b> Encourage industries to explore different markets</li> <li>■ <b>Diversification of jobs:</b> Create jobs in various industries and the public sector</li> <li>■ <b>Multi-use infrastructures and public spaces:</b> Broaden the impact of single investments (e.g. Vejle's flood control infrastructures used for social gatherings and recreation).</li> </ul>
3.	<p><b>Build a buffer:</b> A financial buffer is crucial to withstand times of trouble. This is especially important for regions that overly depend on a single industry and/or commodity exports. In such cases it is strategically sensible to take advantage of high revenues to conduct long-term investments (e.g. improve infrastructure, renovate machinery, invest in R&amp;D):</p> <ul style="list-style-type: none"> <li>■ Focus should be placed on the supply chain. Suppliers may suffer the most from commodity price and technological shocks.</li> </ul>
4.	<p><b>Evoke disturbance:</b> Inducing disturbance is necessary for keeping up with changes in society, technology, the economy and (geo)politics. Being alert and undertaking continuous adaptation allows for staying competitive. Entrepreneurial discovery, experimentation, R&amp;D, flexible education programmes and life-long educational opportunities are some ways to induce change. To minimise the negative effects of disturbance, however, it is necessary to <b>pair entrepreneurial and technological discovery with diversity (spread the risks, see Recommendation 2).</b></p>
5.	<p><b>Develop flexible institutions:</b> Flexible and proactive institutions can better adapt to changing conditions by actively shaping with change:</p> <ul style="list-style-type: none"> <li>■ Develop a system for learning: allow variability, be transparent about the challenges, welcome feedback, and establish mechanisms of active participation.</li> <li>■ Take advantage of digital technologies (e.g. e-state).</li> </ul>
6.	<p><b>Turn weaknesses into opportunities:</b> Know your weaknesses well and take advantage of their positive sides (e.g. cold weather and darkness in Norrbotten has been turned into an advantage for car testing, building data centres and promoting winter tourism).</p>



7.	<b>Secure alternative solutions:</b> Energy-security demands duplication of power sources and infrastructure. Likewise, regions with difficult and harsh weather conditions require alternative transportation means and routes. Business development may benefit from multiple strategies distinguishing different types of industries and geographies (e.g. urban and rural).
8.	<b>Rely on citizens and build trust:</b> Regional institutions and businesses can never be fully prepared for coping with unwanted developments, such as the sudden collapse of an industry due to technological development or a major natural disaster. However, the solidarity and ability of local actors to self-organise depend on the trust levels and overall awareness of the risks. Therefore, regional authorities need to boost the community spirit, openly discuss the challenges with the citizenship and encourage participation. In this way, authorities could better rely on citizens' ability to self-organise and their solidarity with each other.
9.	<b>Stay competitive to prevent and respond to disturbances.</b> Focus on: <ul style="list-style-type: none"> <li>■ Human capital: Capacity building, re-education, vocational and adaptive education systems</li> <li>■ Social capital: Build trust and bonds between citizens</li> <li>■ Organisational capital: trust among regional institutions and actors</li> <li>■ Attractiveness: Invest in culture, diversity, healthy lifestyles, and international environments</li> <li>■ Technology: Use digital technologies to improve public services to better reach sparsely populated areas</li> <li>■ Think long-term: Evaluate long-term economic cycles, and global trends.</li> </ul>
10.	<b>Use regulation when needed:</b> Impede unsustainable developments such as the concentration of labour and investment in a single industry or building and construction practices in risk areas (e.g. the use of concrete in backyards impeding water filtration in areas at risk of flooding).
11.	<b>Build realistic scenarios:</b> Consider the option of taking alternative development paths, even if it involves economic decline. For instance, regions that depend on highly profitable commodity exports may not be able to replace them with similarly profitable economic activities within the foreseeable future.

# References

## References Literature

- Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R., & Rockström, J. (2005, August 12). Social-ecological resilience to coastal disasters. *Science*. American Association for the Advancement of Science. <https://doi.org/10.1126/science.1112122>
- Bonß, W. (2016). 'The notion of Resilience: Trajectories and Social Science Perspectives'. In A. Mauer (Ed.) *New Perspectives on Resilience in Socio-Economic Spheres*. Springer VS. E-book. p. 9–24.
- Brassett, J., Croft, S., & Vaughan-Williams, N. (2013). 'Introduction: An agenda for resilience research in politics and international relations', *Politics*, 33, 4, p. 221–228.
- Bristow, G. & Healy, A. (2014). 'Regional Resilience: An Agency Perspective', *Regional Studies*, 48:5, p. 923–935.
- Brooks, C., Vorley, T., & Williams, N. (2015). 'The role of civic leadership in fostering economic resilience in City Regions', *Policy Studies*, 37:1., 1–16.
- Christopherson, S., Michie, J., & Tyler, P 2010, 'Regional resilience: theoretical and empirical perspectives', *Cambridge Journal Of Regions, Economy & Society*, 3, 1, p. 3
- Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E., & Webb, J. (2008). A place-based model for understanding community resilience to natural disasters. *Global Environmental Change*, 18, 598–606 Contents. <https://doi.org/10.1016/j.gloenvcha.2008.07.013>
- Davies, S. n.d., 'Regional resilience in the 2008–2010 downturn: comparative evidence from European countries', *Cambridge Journal of Regions Economy and Society*, 4, 3, pp. 369–382
- Di Caro, P. (2014). 'Recessions, recoveries and regional resilience: Evidence on Italy', *Cambridge Journal of Regions, Economy and Society*, 8, 2, p. 273–291.
- Economics Online. Global Shocks. Website: [http://economicsonline.co.uk/Global\\_economics/Global\\_shocks.html](http://economicsonline.co.uk/Global_economics/Global_shocks.html) Access: 19/10/2017
- EU Commission (2017). Communication from the Commission to the European Parliament, The Council, the European Economic and Social Committee, and the Committee of the Regions: Strengthening Innovation in Europe's Regions: Strategies for resilient, inclusive and sustainable growth.
- Giacometti A., Teräs J., Perjo L., Wøien M., Sigurjonsdottir H., & Rinne T. (2018). *Regional Economic and Social Resilience: Conceptual Debate and Implications for Nordic Regions*. Discussion paper prepared for Nordic thematic group for innovative and resilient regions, January 2018, Stockholm.
- Glacier, E. L. (2003). *Reinventing Boston: 1640–2003*. Working Paper 10166, National Bureau of Economic Research, 1050 Massachusetts Avenue, Cambridge, MA 02138
- Gylfason, T., Holmström, B., et al. (2010). *Nordics in Global Crisis: Vulnerability and Resilience*. The Research Institute of the Finnish Economy (ETLA), Publisher: Taloustieto Oy, Helsinki, ISBN 978-951-628-495-1
- Hamilton, L., Otterstad, O. and Ögmundardóttir, H. (2006). Rise and fall of the herring towns: impacts of climate and human teleconnections. In *Climate Change and the Economics of the World's Fisheries*. R. Hannesson, M. Barange, and S. Herrick Jr (eds.). Edward Elgar Publishing. <http://www.elgaronline.com/view/1845424476.00009.xml>.
- Holm, J. R. and Østergaard, C. R. (2015). *Regional Employment Growth, Shocks and Regional Industrial Resilience: A Quantitative Analysis of the Danish ICT Sector*. *Regional Studies*, volume 49, pages95–112, Routledge, doi:10.1080/00343404.2013.787159.
- Hu, X., & Hassink, R. (2015). 'Overcoming the Dualism between Adaptation and Adaptability in Regional Economic Resilience', *Papers in Evolutionary Economic Geography*.
- Huggins, R., & Thompson, P. (2015). 'Local entrepreneurial resilience and culture: The role of social values in fostering economic recovery', *Cambridge Journal of Regions, Economy And Society*, 8, 2, p. 313–330.

- Kampa, M., & Castanas, E. (2008). Human health effects of air pollution. *Environmental Pollution*, 151(2), 362–367. <https://doi.org/10.1016/J.ENVPOL.2007.06.012>
- Keck, M. & Sakdapolrak, P. (2013). 'What is social resilience? Lessons learned and ways forward', *Erdekunde*, Vol 67, No. 1, 5–19.
- Martin, R., Sunley, P., Gardiner, B., & Tyler, P. (2016) How Regions React to Recessions: Resilience and the Role of Economic Structure, *Regional Studies*, 50:4, 561–585, DOI: 10.1080/00343404.2015.1136410
- Lall, R. (2012). From failure to failure: The politics of international banking regulation, *Review of International Political Economy*, 19(4), pp. 609–638
- Martin, R. n.d. (2012). 'Regional economic resilience, hysteresis and recessionary shocks', *Journal of Economic Geography*, 12, 1, pp. 1–32, Social Sciences.
- Martin, R. & Sunley, P. (2015). 'On the notion of regional economic resilience: conceptualization and explanation', *Journal of Economic Geography*, 15, p. 1–42.
- Martin, R., Sunley, P., Gardiner, B., & Tyler, P. (2016) How Regions React to Recessions: Resilience and the Role of Economic Structure, *Regional Studies*, 50:4, 561–585, DOI: 10.1080/00343404.2015.1136410
- Mulligan, M., Steely, W., Rickards, L., & Fünfgeld, H. (2016). 'Keywords in planning: what do we mean by 'community resilience'?' *International Planning Studies* Vol 21 2016, Issue 4.
- Muštra, V., Šimundić, B., & Kuliš, Z. (2016). 'Effects of smart specialization on regional economic resilience in EU', First SMARTER Conference on Smart Specialisation and Territorial Development: Changing Patterns of Territorial Policy: Smart Specialisation & Innovation in Europe.
- Overseas Development Institute (ODI) (2016). Analysis of Resilience Measurement Frameworks and Approaches.
- OECD (2014). Guidelines for resilience systems analysis, OECD Publishing.
- OECD (2016). Resilient Cities – Preliminary Version. <http://www.oecd.org/cfe/regional-policy/resilient-cities-report-preliminary-version.pdf>
- Patz, J. A., Campbell-Lendrum, D., Holloway, T., & Foley, J. A. (2005). Impact of regional climate change on human health. *Nature*, 438(7066), 310–317. <https://doi.org/10.1038/nature04188>
- Pendall, R., Foster, K. A. & Cowell, M. (2010). Resilience and regions: building understanding of the metaphor, *Cambridge Journal of Regions, Economy and Society*, 3, 59–70.
- Sensier, M., Bristow, G., & Healy, A. (2016). Measuring Regional Economic Resilience across Europe: Operationalizing a complex concept, *Spatial Economic Analysis*, 11:2, 128–151, DOI: 10.1080/17421772.2016.1129435
- Rosling, H., Rosling Roennlund, A. & Rosling, O. (2018) Factfulness. Publisher Hodder & Stoughton General Division, London, UK. ISBN10 1473637465
- Teräs, J. , Oinas P. (2017) Collective competence and economic resilience in the three industrial transformations of Oulu. Presentation at the American Association of Geographers Annual Conference (AAG 2017).
- Wiens, J. A. (2015). Review of An Ecosystem Services Approach to Assessing the Impacts of the Deepwater Horizon Oil Spill in the Gulf of Mexico. *Fisheries* (Vol. 40).
- Wilkinson, C. (2010). Resilience Thinking and Strategic Planning: Summary Report of Professional Development Activities with Luleå Kommun.
- World Bank Group (2016). Climate-Driven Water Scarcity Could Hit Economic Growth by Up to 6 Percent in Some Regions, Says World Bank. Retrieved November 1, 2018, from <http://www.worldbank.org/en/news/press-release/2016/05/03/climate-driven-water-scarcity-could-hit-economic-growth-by-up-to-6-percent-in-some-regions-says-world-bank>

## References Northern Ostrobothnia case:

- Cities of Helsinki, Espoo, Tampere, Vantaa, Oulu and Turku (15.6.2017). Official statement: Kannanotto: Kuusi suurinta kaupunkia: Sote- ja maakuntaudistuksen toteutus harkittava uudelleen)
- Council of Oulu Region, (2018) The implementation of regional plan 2018. Pohjois-Pohjanmaan maakuntaohjelman toimeenpanosuunnitelma 2018.
- Council of Oulu Region, (2016) Action plan for anticipated structural changes, Pohjois-Pohjanmaan ennakoidun rakennemuutoksen varautumissuunnitelmaa.

- Council of Oulu Region, (2015) Status report on municipalities economic and employment structure. Pohjois-Pohjanmaan kuntien elinkeino- ja työllisyysrakenne, Ennakoivan rakennemuutokset hallinnan lähtökohtia.
- Herala, J., Simonen, J. and Svento, R. (2017) Oulun seutu äkillisen rakennemuutoksen alueena. Kansantaloudellinen aikakausikirja -113vsk. -2/2017
- Herala, J., Karhinen, S., Orenius, S., Simonen, J. & Svento, J. (2017) Lupva Tuho -Tie Eteen Päin: Oulu äkillisen rakennemuutoksen alueena.
- Kaleva: Local newspaper. Stora Enso harkitsee jätti investointia Ouluun: Paperitehdas muuttuisi pakkauskartonkitehtaaksi, 28.6.2018, <https://www.kaleva.fi/uutiset/talous/stora-enso-harkitsee-jatti-investointia-ouluun-paperitehdas-muuttuisi-pakkauskartonkitehtaaksi/797893/>
- Kaleva: Local newspaper. Oulu kamppailuun osaajista 16.05.2018 <http://www.kaleva.fi/mielipide/paakirjoitukset/oulu-kamppailuun-osaajista/793635/>
- Kauppalehti (Multichannel news outlet focusing on economic phenomena and the money market in the digital era), Sellun hinta pysyy korkeana , 15.8.2018, <https://www.kauppalehti.fi/uutiset/sellun-hinta-pysyy-korkeana/rpHUNbwJ>
- Ministry of Economic Affairs and Employment of Finland (2018), Regional Economic Prospects, ELY-centre of Northern Ostrobothnia, (p. 317–343)
- Alueelliset kehitysnäkymät, Kevät 2018, Pohjois-Pohjanmaan ELY-keskus [http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160786/TEMrap\\_11\\_2018\\_Alueelliset\\_kehitysnakymat.pdf](http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160786/TEMrap_11_2018_Alueelliset_kehitysnakymat.pdf)
- LUKE Natural Resource Institute Finland, Statistics database, Milk production by ELY centre annually [http://statdb.luke.fi/PXWeb/pxweb/en/LUKE/LUKE\\_\\_02%20Maatalous\\_\\_04%20Tuotanto\\_\\_04%20Alueittainen%20maidontuotanto/01\\_Maidontuotanto\\_ELY\\_v.px/?rid=a6bf97a2-c8c8-4952-8c8b-dab3df6b8e04](http://statdb.luke.fi/PXWeb/pxweb/en/LUKE/LUKE__02%20Maatalous__04%20Tuotanto__04%20Alueittainen%20maidontuotanto/01_Maidontuotanto_ELY_v.px/?rid=a6bf97a2-c8c8-4952-8c8b-dab3df6b8e04), 15.8.2018
- Ministry of Economic Affairs and Employment of Finland (2018), Regional prospects: Alueelliset kehitysnäkymät, Kevät 2018, p. 317–355, [http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160786/TEMrap\\_11\\_2018\\_Alueelliset\\_kehitysnakymat.pdf](http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160786/TEMrap_11_2018_Alueelliset_kehitysnakymat.pdf) , 15.8.2018
- Ministry of Economic Affairs and Employment of Finland (2018) Aluekehittämisen tilannekuva, (2018), Pohjois-Pohjanmaa. (Snapshot of regional development)
- Ministry of Economic Affairs and Employment of Finland. Abrupt structural change (ÄRM). Website: <https://tem.fi/akillinen-rakennemuutos-arm> Retrieved: March, 2018
- Ministry of Economic Affairs and Employment of Finland. Government Notice: Decision of the territorial transmission of Structural Funds to the regions 8 February 2018. <https://tem.fi/documents/1410877/2817500/valtioneuvoston+p%C3%A4%C3%A4t%C3%B6s+rakenneraha+stovarojen+alueellisesta+jaosta.pdf/76c71d97-d103-4278-b95a-922a10de8cdb/valtioneuvoston+p%C3%A4%C3%A4t%C3%B6s+rakenn+erastovarojen+alueellisesta+jaosta.pdf.pdf> accessed 07.10.2018
- Nordregio database, 2018
- Oulu Chamber of Commerce (2018), Ruotsissa halutaan insinööreiksi – Suomessakin onneksi toimenpiteitä. <https://www.oulunkauppakamari.fi/viestint%C3%A4/ajankohtaista> accessed 03.07.2018
- Simonen J. & Koivumäki T. & Seppänen V. & Sohlo S. & Svento R. 2016. What Happened to the Growth? – The Case of the ICT Industry in Oulu, Finland. International Journal of Entrepreneurship and Small Business, vol. 29.
- Statistics Finland (2018) Population 31.12.2017 [http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin\\_\\_vrm\\_\\_vaerak/statfin\\_vaerak\\_pxt\\_004.px/table/tableViewLayout2/?rid=459d4812-44eb-4612-8516-9c4e97ca23fa](http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin/StatFin__vrm__vaerak/statfin_vaerak_pxt_004.px/table/tableViewLayout2/?rid=459d4812-44eb-4612-8516-9c4e97ca23fa)

### **Interviews Northern Ostrobothnia:**

**\*Note:** The order of the interview list does not correspond to the numbering used in the text

- Aalto Heikki, Bothnian Arc Committee
- Claes Krüger, The city of Oulu
- Johanna Osenius, Ministry of Economic Affairs and Employment in Finland.
- Kari Mäntyjärvi, Research Director, Oulu University
- Keisanen Päivi, The Council of Oulu Region
- Timo Mäkitalo, The city of Oulu
- Simonen Jaakko, Professor of Economics at Oulu Business School, University of Oulu

- Svento Rauli, Professor of Economics at Oulu Business School, University of Oulu.
- Timo Lehtiniemi, Centre for Economic Development, Transport and the Environment in Northern Ostrobothnia. Head of the rural unit

## References Vestmannaeyjar case:

Althingi (The Icelandic Parliament). (2015–2016).

Bill to act regarding tender for new ferry to Vestmannaeyjar. Retrieved 13. September 2018 from: <https://www.althingi.is/altext/pdf/145/s/1283.pdf>

Althingi/The Icelandic Parliament (2018).

Response from the Minister of the interior to a query from a member of the parliament. Retrieved 2. September 2018 from <https://www.althingi.is/altext/148/s/0926.html>

Arion bank. (2015). Icelandic Fish Industry – status and future. Retrieved 4. October 2018 from: [http://www.sjavarklasinn.is/wp-content/uploads/2016/02/Arion\\_2015-stada\\_og\\_framtid.pdf](http://www.sjavarklasinn.is/wp-content/uploads/2016/02/Arion_2015-stada_og_framtid.pdf)

Association of Local Authorities in South Iceland.

(2015). Regional Plan of Action. Retrieved 4. September 2018 from: <http://sass.is/wordpress/wp-content/uploads/2015/09/S%C3%B3knar%C3%A1%C3%A6tlun-2015-til-2019.pdf>

Eldheimar.is (n.d.). Interactive Exhibition.

Retrieved 12. September 2018 from: <http://eldheimar.is/en/about-museum/>

Eyjafréttir. (November 2018). Mikil áhætta af hagræðingu: Getur komið illa niður á rekstri sveitarfélaganna. Vol. 31. Pp. 27.

Gunnlaugsson S. B., Kristofersson D., Agnarsson S., (2018). Fishing for a fee: Resource rent taxation in Iceland's fisheries. Elsevier, Ocean and Coastal Management 163 (2018) 141–150

Hansen, E. S., Sigursteinsson, M., and Garðarsson, A., (2011). Lundatal Vestmannaeyja. – Bliki 31: 15–24.

Icelandic Regional Development Institute/

Byggðastofnun. (2012). Retrived 18. April 2018 from: [https://www.byggdastofnun.is/static/files/Skyrslur/Samfelag/Samfelag\\_atvinnulif\\_og\\_ibuathroun\\_skyrslan\\_i\\_heild.pdf](https://www.byggdastofnun.is/static/files/Skyrslur/Samfelag/Samfelag_atvinnulif_og_ibuathroun_skyrslan_i_heild.pdf)

Icelandic statistic office/Hagstofa Íslands.

(2018). Retrieved 19. October 2018 from: [http://px.hagstofa.is/pxis/pxweb/is/lbuar/lbuar\\_\\_mannfjoldi\\_\\_2\\_byggdir\\_\\_sveitarfelog/MAN02001.px/chart/](http://px.hagstofa.is/pxis/pxweb/is/lbuar/lbuar__mannfjoldi__2_byggdir__sveitarfelog/MAN02001.px/chart/)

[chartViewLine/?rxid=3d0499eb-cfc9-4ad3-a441-23f305dbfa68](http://www.althingi.is/altext/pdf/145/s/1283.pdf)

Pálsson, G., and Helgason, A. (2000). Quota systems and resource management: Icelandic Fishing. Stefansson Arctic Institute. Retrieved 7. October, 2018 from: [http://www.thearctic.is/articles/cases/quotasystems/enska/kafli\\_0200.htm](http://www.thearctic.is/articles/cases/quotasystems/enska/kafli_0200.htm)

Sævaldsson, H. (2012). Sala útgerðarfélagins Bergur-Huginn ehf. frá Vestmanneyjum. Retrieved 6. April 2018 from: <http://sjavarutvegssveitarfelog.is/wp-content/uploads/2013/01/Sala-%C3%A1-Berg-Huginn.pdf>

Sild.is. (n.d.). The herring history. Retrieved 4. October 2018 from: <http://www.sild.is/sildarsagan/sildarsagan/>

The Icelandic Central Bank. (2017). Minutes of the Monetary Policy Committee of the Central Bank of Iceland. Retrieved 4. September 2018 from: [https://www.sedlabanki.is/library/Skraarsafn/Peningastefnuneftnd/Fundargerdir-2017/Fundargerdir\\_peningastefnuneftndar\\_november\\_2017.pdf](https://www.sedlabanki.is/library/Skraarsafn/Peningastefnuneftnd/Fundargerdir-2017/Fundargerdir_peningastefnuneftndar_november_2017.pdf)

The Icelandic Central Bank. (2017). Monetary policy based on inflation target: Experience in Iceland from 2001 and Changes following the financial crisis. Retrived 4. September 2018 from: [https://www.sedlabanki.is/library/Skraarsafn/Serit/Serit\\_nr\\_%2011.pdf](https://www.sedlabanki.is/library/Skraarsafn/Serit/Serit_nr_%2011.pdf)

The Icelandic Central Bank. (2011). Foreign exchange reserves. Retrieved 15. September 2018 from: <https://www.sedlabanki.is/um-sedlabanka-islands/gjaldeyrisfordi/>

The Icelandic Regional Development Institute (2018). Review of the bill on fishing fees released by the Employment Committee of the Icelandic Parliament. Retrived 26. October 2018 from: <https://www.althingi.is/altext/erindi/149/149-176.pdf> Althingi (The Icelandic Parliament). (2017–2018). Parliamentary resolution regarding tunnel to Vestmannaeyjar. Retrieved 18. September 2018 from: <https://www.althingi.is/altext/147/s/0133.html>

The Icelandic Regional Development Institute. (2016). Retrieved 12. April 2018 from: [https://www.byggdastofnun.is/static/files/Skyrslur/atvinnutekjur\\_2008-2015.pdf](https://www.byggdastofnun.is/static/files/Skyrslur/atvinnutekjur_2008-2015.pdf)



## Interviews Vestmannaeyjar:

**\*Note:** The order of the interview list does not correspond to the numbering used in the text

- Ásgeir Jónsson, adjunct at the University of Reykjavik, programme administrator Marine Bio Innovation and manager of the diploma programme in Vestmannaeyjar.
- Arnar Sigurmundsson, former director of the contingency fund in Vestmannaeyjar and former member of the town council.
- Elliði Vignisson, major in Vestmannaeyjar at the time of the interview.
- Eyþór Harðarson, fishery manager at Ísfélagið Vestmannaeyjum.
- Hrafn Sævaldsson, innovation and development manager at the Knowledge Centre in Vestmannaeyjar.
- Páll Marvin Jónsson, director of the Knowledge Centre in Vestmannaeyjar.
- Páll Scheving, factory manager at Ísfélagið Vestmannaeyjum.

## References Rogaland case:

- Bjørnland, H. and Thorsrud, L.A. (2015) Hva skjer når oljeprisene faller? Samfunnsøkonomen 2015:2, pp. 22-29, Available in Norwegian: [https://www.bi.edu/contentassets/fbf9e4deca584c898b960e8c25359927/2015\\_samfunnsokonomien2\\_2015.pdf](https://www.bi.edu/contentassets/fbf9e4deca584c898b960e8c25359927/2015_samfunnsokonomien2_2015.pdf) (accessed: June 2018)
- Bjørnland and Thorsrud (2013) Ringvirkninger: Norsk økonomi og olje, CME Working papers 7/2013, available in Norwegian: <https://brage.bibsys.no/xmlui/handle/11250/2366310> (accessed: June 2018)
- Blomgren, A. Quale, C., Austnes-Underhaug, R., Harstad, A.M, Fjose, S., Wifstad, K., Mellbye, C., Amble, I.B., Nyvold, C.E., Steffensen, T., Viggen, J.R, Iglebæk, F., Arnesen, T. and Hagen, S.E (2015) Industribyggerne 2015: En kartlegging av ansatte i norske petroleumsrelaterte virksomheter, med et særskilt fokus på leverandørbedriftenes ansatte relatert til eksport. Rapport IRIS - 2015/031, available in Norwegian: <http://www.iris.no/publications/414551636/2015-031> (Accessed: June 2018)
- Cappelen, Å., Eika, T., and Prestmo, J.B. (2014) Virkninger på norsk økonomi av et kraftig fall i oljeprisen, Økonomisk Analyser 3/2014, SSB. Available: <https://www.ssb.no/>
- nasjonalregnskap-og-konjunkturer/artikler-og-publikasjoner/\_attachment/180823?\_ts=14662dc53a8 (Accessed: Oct 2018)
- Dagens Næringsliv (2017) Flere vil bygge om rigger til oppdrett, available in Norwegian: <https://www.dn.no/havbruk/fiskeridirektoratet/dag-meling/trond-ferkingstad/flere-vil-bygge-om-rigger-til-oppdrett/2-1-79588> (accessed: Nov 2018)
- Davis, S.J. and Haltiwagner, J. (2001) Sectoral job creation and destruction responses to oil price changes, Journal of Monetary Economics 48: pp. 465–512
- Ekeland, A. (2012) Sysselsatte i Petroleumsnæringene og relaterte næringer 2012, available in Norwegian: [https://www.ssb.no/arbeid-og-lonn/artikler-og-publikasjoner/\\_attachment/169678?\\_ts=144fdb2f258](https://www.ssb.no/arbeid-og-lonn/artikler-og-publikasjoner/_attachment/169678?_ts=144fdb2f258) (accessed: June 2018)
- Equinor (2018) About our name, available: <https://www.equinor.com/en/about-us/about-our-name-change.html> (accessed: Aug 2018)
- Forbundet Kysten (n.d.) Hermetikkens vekst og fall, available in Norwegian: <https://www.kysten.no/hermetikkens-vekst-og-fall> (Accessed: March 2018)
- Forbes (2015) Memories of Houston, The Last Oil Plunge and \$10 Crude, Available: <https://www.forbes.com/sites/danielfisher/2015/01/06/memories-of-houston-the-last-oil-plunge-and-10-crude/#2ddf3d833533>
- Forbes (2018a) America's Path to Energy Independence: The Shale Revolution, available: <https://www.forbes.com/sites/simonlack/2018/06/04/americas-path-to-energy-independence-the-shale-revolution/#61ee4e917554> (accessed: Oct 2018)
- Forbes (2018b) Shale Gas Revolution Is Just Getting Started, available: <https://www.forbes.com/sites/williampentland/2018/07/07/shale-gas-revolution-is-just-getting-started/#559d42ab7c11> (Accessed: Oct 2018)
- Forskning.no (2016a) Forskere advarer mot statlig styring etter oljen, available in Norwegian: <https://forskning.no/2016/05/styrer-politikerne-forskningen-mye-i-stavanger> (accessed: Oct 2018)
- Forskning.no (2016b) Burde sett krisen komme, available in Norwegian: <https://forskning.no/olje-og-gass-om-forskning-samfunn-naeringsliv-okonomi/2016/05/burde-sett-krisen-komme> (Accessed: Oct 2018)

- Forskning.no (2005) Silda som forsvant, available in Norwegian: <https://forskning.no/hav-og-fiske-fisk-biologisk-mangfold/2008/02/silda-som-forsvant> (accessed: 15th Oct 2018)
- Fortune (2015) As oil prices tank, where did OPEC go wrong? Available: <http://fortune.com/2015/03/08/as-oil-prices-tank-where-did-opec-go-wrong/> (accessed: April 2018)
- Greater Stavanger (2018) Strategisk Næringsutvikling 2018-2025. Pdf version available in Norwegian: <https://greaterstavanger.com/Om-oss/Aktuelt/Strategisk-naeringsplan-2018-2025-Felles-innsats-for-en-styrket-region> (accessed: May 2018)
- Greater Stavanger (2015) Om regionen, available in Norwegian: <https://greaterstavanger.com/Regionen/Om-regionen> (accessed: May 2018)
- Herrera, A. M., & Karaki, M. B. (2015). The effects of oil price shocks on job reallocation. *Journal of Economic Dynamics and control*, 61, 95-113.
- Innovation Norway (2016) Rekordhøy etablererstøtte i Rogaland i 2015, available in Norwegian: <https://www.ntbinfo.no/pressemelding/rekordhoy-etablererstotte-i-rogaland-i-2015?publisherId=89989&releaseId=10206503>
- Innovation Norway (2015) Virkningen av lav oljepris på norsk økonomi, Innovasjonsbloggen, available in Norwegian: (<https://innovasjonsbloggen.com/2015/06/18/virkningen-av-lav-oljepris-pa-norsk-okonomi/>) (accessed: May 2018)
- Kartverket (2018) Kommunesammenslåingar i Rogaland, available in Norwegian: <https://www.kartverket.no/Om-Kartverket/Stavanger/kommunesamanslaingar-i-rogaland/> (accessed: Nov 2018)
- Mazzucato, M. (2013) *The Entrepreneurial Lion: Debunking Public vs Private Sector Myths*, Anthem Press: London
- NAV Rogaland (2017) Arbeidsløysa er som forventa høg i starten av året for Rogaland, Press Release, Available in Norwegian: <https://www.nav.no/no/Lokalt/Rogaland/Pressemeldinger/arbeidsl%C3%B8ysa-er-som-forventa-h%C3%B8g-i-starten-av-%C3%A5ret-for-rogaland>
- [NAV] Norwegian Labour and Welfare Administration Rogaland (2017) HLO90. Helt Ledige. Fylke. 2018-2017, available: <https://www.nav.no/no/NAV+og+samfunn/Statistikk/Arbeidssøkere+og+stillinger+statistikk/Helt+ledige> (Accessed: Oct 2018)
- NHO Rogaland (n.d.) Næringslivet i Rogaland, available: <https://www.nho.no/Om-NHO/Regionforeninger/NHO-Rogaland/Naringslivet-i-Rogaland/>
- Nordic Edge (2018) Smart City Innovation Cluster: Our ambitions, available: <https://www.nordicedgecluster.org/post/stavanger-based-arena-smart-city-cluster> (Accessed: May 2018)
- Norges Bank Investment Management (2018) Investements, available: <https://www.nbim.no/no/investeringene/> (accessed: Oct 2018)
- Nysnø (n.d.) Dette er Nysnø, available: <https://www.nysnoinvest.no/no/dette-er-nysno/> (accessed: Oct 2018)
- [NRK] Norsk Rikskringkasting (2018) Sverdrup-kontrakt sikrer jobben til Maria, available in Norwegian: <https://www.nrk.no/rogaland/aibel-far-sverdrup-kontrakt-verdt-atte-milliarder-1.13992680> (accessed: May 2018)
- Regjeringen.no (2016) Revidert Nasjonalbudsjett, Available in Norwegian: <https://www.regjeringen.no/contentassets/94d2e052d80c48b1a59e093ded80d324/no/pdfs/stm201520160002000dddpdfs.pdf>
- Regjeringen.no (2018) Retningslinjer for bruk av oljepenger (Handlingsregelen), available: [https://www.regjeringen.no/no/tema/okonomi-og-budsjett/norsk\\_okonomi/bruk-av-oljepenger-/retningslinjer-for-bruk-av-oljepenger-ha/id450468/](https://www.regjeringen.no/no/tema/okonomi-og-budsjett/norsk_okonomi/bruk-av-oljepenger-/retningslinjer-for-bruk-av-oljepenger-ha/id450468/)
- Regjeringen.no (2018) Nye Fylker, available in Norwegian: <https://www.regjeringen.no/no/tema/kommuner-og-regioner/kommunereform/regionreform/nye-fylker/id2548426/> (accessed: September 2018)
- Regjeringen.no (2018) The Government Pension Fund, available: <https://www.regjeringen.no/en/topics/the-economy/the-government-pension-fund/id1441/> (Accessed: Nov 2018)
- Regjeringen.no (2018) Governance Model, available: <https://www.regjeringen.no/en/topics/the-economy/the-government-pension-fund/governance-model-for-the-government-pens/id699573/> (Accessed: Nov 2018)
- [RFG] Rogaland Fylkeskommune (2017) Rogaland: Regionale Utviklingstrekk, available in Norwegian: <http://www.rogfk.no/content/download/68408/1528794/file/Regionale%20utviklingstrekk%202017%20WEB.pdf>

Rogaland Statistikk (2018) Folketall, available: <https://www.rogalandstatistikk.no/statistikk/66b4764b-52b7-49db-8a40-06c438df5d17> (accessed: Oct 15th 2018)

Roxel (2018) Jackup Conversion to Ocean Fish Farming, available: <http://roxel.no/aqua/jackup-conversion-to-ocean-fish-farm/> (Accessed: Nov 2018)

Roxel (2018) Smarte Samfunn, available in Norwegian: <http://roxel.no/infra/smarte-samfunn/> (accessed: Nov 2018)

Stavanger Aftenblad (2017) Slik vil SR-Bank, Lyse og Smedvig-familien «booste» Stavanger-regionen, available in Norwegian: [https://www.aftenbladet.no/okonomi/i/GVoKJ/Slik-vil-SR-Bank\\_-Lyse-og-Smedvig-familien-booste-Stavanger-regionen](https://www.aftenbladet.no/okonomi/i/GVoKJ/Slik-vil-SR-Bank_-Lyse-og-Smedvig-familien-booste-Stavanger-regionen) (accessed: Oct 2018)

Stavanger Aftenblad (2018) Arbeidsledigheten i Rogaland fortsetter å synke, available in Norwegian: <https://www.aftenbladet.no/lokalt/i/J1yXwR/Arbeidsledigheten-i-Rogaland-fortsetter-a-synke> (Accessed: Sept 2018)

Teknisk Ukeblad (2017) mot forlenget OPEC-kutt for å styrke oljeprisen, available in Norwegian: <https://www.tu.no/artikler/mot-forlenget-opec-kutt-for-a-styrke-oljeprisen/387802> (Accessed: Aug 2018)

The Economist (1999) The Next Shock? Available: <https://www.economist.com/node/188181>

[EIA] U.S. Energy Information Administration (2018) Europe Brent Spot price FOB, available: <https://www.eia.gov/dnav/pet/hist/rbrteD.htm> (accessed: Nov 2018)

World Bank (2018) What triggered the oil price plunge of 2014-2016 and why it failed to deliver an economic impetus in eight charts by Marc Stocker et al., available: <http://blogs.worldbank.org/developmenttalk/what-triggered-oil-price-plunge-2014-2016-and-why-it-failed-deliver-economic-impetus-eight-charts> (accessed: Nov 2018)

### Interviews Rogaland:

**\*Note:** The order of the interview list does not correspond to the numbering used in the text

- Bjørn Vidar Lerøen, Author
- Elisabeth Faret, Rogaland County Administrative Board
- Frode Berge, Chamber of Commerce in Stavanger
- Kari V Holmefjord, Innovation Norway Rogaland
- Kristin R. Husebø, Greater Stavanger

- Leif Johan Sevland, Offshore Northern Seas (ONS)
- Martin Gjelsvik, International Research Institute of Stavanger (IRIS)
- Riana Steen, BI Stavanger
- Truls Nordahl, The Norwegian Labour and Welfare Administration in Rogaland

### References Norrbotten case:

Chen, Y., Costache, A., Fronze, S., Hille, M., Kahmen, A., Koch, K. (2003). A vulnerability assessment of Norrbotten, Northern Sweden. International Summer School Peyresq, Alpes de Haute-Provence, France. [https://www.pik-potsdam.de/avec/peyresq2003/group\\_reports/sweden\\_case\\_study.pdf](https://www.pik-potsdam.de/avec/peyresq2003/group_reports/sweden_case_study.pdf)

County Council of Norrbotten / Länsstyrelsen i Norrbottens län (2013). Regional Development Strategy for a Sustainable Future in Norrbotten 2020 / Regionalt utvecklingsprogram för hållbar framtid i Norrbotten 2020

OECD (2017), 'Norrbotten, Sweden (Northern Sparsely Populated Area)', in OECD Territorial Reviews: Northern Sparsely Populated Areas, OECD Publishing, Paris, <https://doi.org/10.1787/9789264268234-20-en>.

### Interviews Norrbotten:

**\*Note:** The order of the interview list does not correspond to the numbering used in the text

- Daniel Örtqvist, Professor at Luleå Technical University
- Fredrik Kallioniemi, Director at Hydro66 Data Centre and Senior Advisor, Cloud Consulting Sweden AB
- Kajsa Myrberg, CEO of the Association of Local Authorities
- Kenneth Sjaunja, EU-Coordinator at Norrbotten Region
- Hans Sundvall, Advisor
- Lena Bengten, Planning/Environmental Strategist at Luleå Municipality
- Michael Nilsson, General Business Manager at Centre for Distant-spanning Technology, Luleå Technical University

### References Vejle case:

Green Tech Centre. Invitation till åbning: Resilience House. (2017) Retrieved from: [http://greentechcenter.dk/media/391318/invitation\\_](http://greentechcenter.dk/media/391318/invitation_)

- resiliencehouse\_25aug17.pdf
- Jyske Vestkysten. (2017). Væksten i Region Syddanmark matches kun af København. Retrieved from: <https://www.jv.dk/regionalt/Vaeksten-i-Region-Syddanmark-matches-kun-af-Koebenhavn/artikel/2452535>
- Mikonomi.dk. (2018). Arbejdsløsheden er faldet meget i Danmark. Retrieved from: <https://www.mikonomi.dk/blog/2018/04/ny-undersogelse-her-er-der-kommet-flest-arbejdsloese-i-job-siden-finanskrisen>
- Rangvid, J., Grosen, A., Østrup, F., Møgelvang-Hansen, P., Jensen, H. F., Thomsen, J., ... Buchhave Poulsen, B. (2013). Den finansielle krise i Danmark: Årsager, konsekvenser og læring. København : Erhvervs- og Vækstministeriet. Retrieved from: <http://finansdanmark.dk/media/37640/rangvid-rapporten.pdf>
- Resilience Business Cup. Retrieved from: <https://www.rcbusinesscup.com/>
- South Denmark Region. Kontur 2017 Vejle. Retrieved from: <https://detgodeliv.regionsyddanmark.dk/publikation/kontur-2017-vejle/>
- South Denmark Region. Det Gode Liv 2016-2019. Retrieved from: <https://detgodeliv.regionsyddanmark.dk/vaekst-og-udviklingsstrategi/>
- South Denmark Region. Konjunkturer for 3. Kvartal. Retrieved from: <https://detgodeliv.regionsyddanmark.dk/publikation/konjunktur-3-kvartal-2018/>
- South Denmark Region. State of the Region 2017. Retrieved from: <https://detgodeliv.regionsyddanmark.dk/publikation/state-region-2017/>
- SSP Team Vejle. SPOR 18 and Through Fire and Water. Retrieved from: <https://ssp.vejle.dk>
- State of Green. (2017). Resilient solutions to energy, climate and water supply problems to be commercialised in the Danish city of Vejle. Retrieved from: <https://stateofgreen.com/en/partners/state-of-green/news/resilient-solutions-to-energy-climate-and-water-supply-problems-to-be-commercialised-in-the-danish-city-of-vejle/>
- The Triangle Region (Trekantområdet). Retrieved from: <http://www.trekantomraadet.com/>
- Vejle Amts Folkeblad. (2018). Vejles huse vakler stadig efter den hårdsående finanskriser. Retrieved from: <https://vafo.dk/vejle/Vejles-huse-vakler-stadig-efter-den-haardtslaende-finanskriser/artikel/552319>
- Vejle Amts Folkeblad. (2018). Ti år senere: Da krisen skyldede ind over Vejle. Retrieved from: <https://vafo.dk/erhverv/Ti-aar-senere-Da-krisen-skyldede-ind-over-Vejle/artikel/565017>
- Vejle Amts Folkeblad. (2018). Lav ledighed giver problemer for lokale virksomheder. Retrieved from: <https://vafo.dk/erhverv/Lav-ledighed-giver-problemer-for-lokale-virksomheder/artikel/522765>
- Vejle's Resilience Strategy (2016). Retrieved from: [https://www.vejle.dk/media/4823/vejles\\_resilience\\_strategy\\_webquality\\_160316.pdf](https://www.vejle.dk/media/4823/vejles_resilience_strategy_webquality_160316.pdf)
- Vejle Municipality. Vækstbarometer August 2018. Retrieved from: <https://www.vejle.dk/om-kommunen/fakta-om-os/rapporter-og-analyser/erhverv-og-vaekst/>
- Vejle Municipality. Vejle Kommuneplan 2017-2029. Retrieved from: <http://kommuneplan2017.vejle.dk/dk/kommuneplan-2017-2029/>
- Vejle Municipality. (2017). City Council Vision: Byrådets vision: Vejle med Vilje. Retrieved from: <https://www.vejle.dk/om-kommunen/udvikling-med-vilje/byraadets-vision-vejle-med-vilje/>
- 100 Resilient Cities. (2018). Retrieved from: <https://www.100resilientcities.org>

### Interviews Vejle:

**\*Note:** The order of the interview list does not correspond to the numbering used in the text

- Björn Snorri Gudmundsson Bøg, Consultant, Region Syddanmark.
- Jeanette Kristensen, Innovation Consultant, Green Tech Centre.
- Marina Vestergaard Christensen, Business Policy Consultant (Erhvervspolitisk konsulent / Direktionssekretariatet), Vejle Municipality
- Michael Sloth, Technology and Environment Director, Vejle Municipality.
- Michael Koch-Larsen, Adviser/Teamleader, Center for Regional Development, Danske Regioner.
- Ulla Varnerskov, Chief Resilience Officer, Vejle Municipality.







P.O. Box 1658  
SE-111 86 Stockholm, Sweden  
[nordregio@nordregio.org](mailto:nordregio@nordregio.org)  
[www.nordregio.org](http://www.nordregio.org)  
[www.norden.org](http://www.norden.org)

ISBN: 978-91-87295-66-9  
ISSN: 1403-2503  
DOI: [doi.org/10.30689/R2019:2.1403-2503](https://doi.org/10.30689/R2019:2.1403-2503)