

SOCIAL AND ECONOMIC RESILIENCE

in the Bothnian Arc Cross-Border Region

By Alberto Giacometti, Jukka Teräs and Heikki Aalto

NORDREGIO REPORT 2019:11

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*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.*

Social and Economic Resilience in the Bothnian Arc Cross-Border Region

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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.

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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

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Foreword

Nordregio, on behalf of the Nordic Council of Ministers Committee of the Civil Servants for Regional Affairs, is the secretariat for the Nordic thematic group for innovative and resilient regions 2017-2020. During this program, the Nordic thematic group has focused on expanding knowledge and identifying policy-relevant solutions to the challenges that Nordic regions face when it comes to resilience, smart specialisation and digitalisation. Nordregio prepared the resilience study of the Bothnian Arc area in 2018 with the title "Social and Economic Resilience Study in the Bothnian Arc".

The aim of the study was to find some answers to two main questions: First, what global and local risks and long-term challenges is the Bothnian Arc cross-border area exposed to? And second, how can societies and economies in this area anticipate and respond to challenges to ensure resilient long-term development paths?

This report provides a background overview on resilience and the methodology applied. Moreover, the report provides a snapshot of resilience situation in the Bothnian Arc. The data and information gathered was collected by interviewing local people both in Swedish and Finnish sides.

As part of the process, a highly interesting workshop was held in Tornio, Finland, just next to the border with Sweden, in early 2019. Key actors in the region participated and engaged actively in a discussion about resilience in the Bothnian Arc. In addition to discussing the two research questions, the participants tried to identify how cross-border cooperation can strengthen resilience in the region. The fruitful discussion resulted in a collection of different types of risks and long-term challenges as well as resilience drivers in the region.

This study points out some of the local challenges and risks in the Bothnian Arc. Importantly, it shows some of the global threats that all regions are vulnerable to. The report gives us an excellent picture of the current situation in Bothnian Arc and tools to anticipate the possible crises.



Heikki Aalto
CEO of Bothnian Arc Association

1. Summary

What global and local risks and long-term challenges is the Bothnian Arc cross-border area exposed to? And how can societies and economies in this area anticipate and respond to them to ensure resilient long-term development paths? Answering these questions was the challenge of Nordregio together with the Bothnian Arc association on behalf of the Nordic Thematic Group on Innovative and Resilient regions, set by the Nordic Council of Ministers from 2017 to 2020. For this purpose, an exploratory study was conducted in a participative manner in 2018-2019, including key experts from across the region to provide input on challenges and potential threats as well as factors driving resilience in the Bothnian Arc cross-border area.

The Bothnian Arc is a cross-border area that extends from the Swedish city of Skellefteå to Kokkola in Finland, along the coastal territories surrounding in a horse-shoe shape the Gulf of Bothnia. Despite the peripheral location, the area counts with two relatively large middle-size cities, namely Oulu in Finland, and Luleå in Sweden. The cross-border region is rich in natural resources and has a long tradition of large-scale extractive, manufacturing and processing industries. Mining, metalworks, forestry, paper and pulp, chemical industries as well as the iconic Nokia mobile phones are some of the key examples of the industrial legacy in the region. Moreover, the cross-border region has played a historical role in technological development, from undertaking the first wireless phone call, to the development of 4G and 5G internet technologies as well as leading the automation and digitalisation of traditional industries. Despite the favourable business conditions, the region struggles with urbanisation and centralisation forces that drain population from already low-density areas. In addition to low birth rate, distance to cultural amenities of the capital regions and Europe, and the rather tough weather conditions, this makes it difficult to attract new talented labour force.

This study has revealed many interesting findings. A number of major risks were identified as well as day-to-day challenges in the Bothnian Arc area. In some cases, risks have a low probability, such as major industrial accidents, but their impact could be enormous. Industrial accidents could threaten the liveability of the area, the natural environment and overall economy of the region. Other types of risks are more recurrent despite that they remain unpredictable, such as sharp fluctuations in the prices of commodities and raw materials. Instead, other challenges are more predictable but have a more gradual and long-term effect on the region, such as demographic pressures, low attractiveness and peripherality.

Additionally, this study identifies several factors driving regional resilience in the Bothnian Arc. One of the most important factors is the collaborative and hands on culture that often leads to quick responses upon unwanted developments. This positive attitude is present within institutional actors, private companies, universities and the citizens at large, which also translates in a rapid and pragmatic approach when taking onboard new opportunities. Collaboration across the Finnish-Swedish border and regions is highly dynamic, which is not only motivated by policy, but through the complementarity of the labour markets. Other key factors include the strong innovation systems surrounding universities and industries, the vast availability of natural resources, safety and cohesive society, and attractive nature.

This study points out some of the local challenges and risks in the Bothnian Arc, but most of all it shows some of the global threats that all regions, without exception, are vulnerable to. The intention is to highlight the importance of awareness of global trends in terms of technology, politics and climate, in order to adapt to change and shape region's development paths accordingly.

2. Resilience: background

Regional resilience refers to regions' ability to withstand uncertainty and disturbances coming from outside and inside the community. Uncertainty in local societies and economies arises from the continuous exposure to *shocks*, *risks* and *stress* (Martin et al. 2016) (See key concepts in Infobox 1).

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 papers¹. The policy attention given to resilience might be a response to some of the most pressing societal, economic and environmental issues of today. For instance, the ability of a societies to recover from natural disasters, and market instability led by geopolitical shifts, and to anticipate global trends in technology and society that may put local industries, jobs and communities at risk. The EU Commission has pointed out that profound transformations emerging from globalisation and digitalisation are expected to have an enormous impact on employment structures, industrial sectors, business models, the economy and society at large (EU Commission, 2017).

The effects of global transformations, and major economic shocks, however, are largely asymmetric and uneven across territories. The inner characteristics and *adaptive capacities* of regions play an important role on how capable they are in both anticipating and responding to shocks and stress. For this reason, the EU Commission has emphasised the need to help citizens, organisations and regions to adapt to these transformations (EU Commission, 2017). Likewise, our extended study on regional resilience across the Nordic countries has revealed the substantial role of human agency, networks in effectively conducting the necessary transformations upon major disturbances (Giacometti & Teräs, 2019). Yet, citizens' possibility and willingness to become active and self-organise depends on the trust levels amongst them, and towards public institutions and the awareness of the present risks (ibid.).

¹ See Giacometti & Teräs (2019) for an extensive theoretical and empirical study in the Nordic countries. Publication: doi.org/10.30689/R2019:2.1403-2503

INFOBOX 1: Key concepts

Regional resilience: the ability of a region to cope with global and local disturbances and recover from shocks and stress.

Shocks: abrupt events with negative or positive impacts on the whole region and its parts.

Risks: the probability of shocks to occur. **Stress or stressor:** long-term trends and factors that weaken regions and their actors.

Slow-burn: Long-term deterioration of a region and its key structures resulting from accumulated stress and struggle to cope with transformation and restructuration.

Risk Landscape: a collection of risks, stressors, and past shocks identified in a region.

Adaptive capacity: regions' ability to flexibly rearrange its economic, social and institutional structures upon shocks and stress.

Sources: based on Martin, 2012; Muštra et al, 2016; OECD 2014; Pendall et al, 2010

What are regions at risk of?

Resilience thinking is about anticipating and reacting to risks, shocks and stress. However, this is a challenging task, since regions are affected by global, national and local developments, which are to a large extent unpredictable, at least in terms of timing and intensity. Economic turmoil at national and regional levels might originate from outside, such as technological innovations, geopolitical shifts, or housing crises that spread to other countries. Likewise, turmoil can also originate locally, for instance in the case of closure or relocation of key firms or through local decision-making processes (Sensier et al., 2016).

Table 1: Types of risks/shocks and stressors.

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

Source: *Giacometti & Teräs (2019)*.

Moreover, economic shocks at the local level can be symptomatic of long-term struggles in coping with accumulated stress and restructuration. In this light, it is worth distinguishing between **shocks and 'slow burns'**. Shocks are events that are abrupt, disruptive and discrete, and may come as singular occurrences or as a series of shocks to a region (Pendall et al., 2010). In contrast, slow burns describe the gradual deterioration of regions and the struggle for their key institutions and actors to cope with transformation and restructuration (ibid.). Slow burns weaken regions' potential and deepen the vulnerability of their actors eventually leading to major shocks (OECD, 2014).

Table 1 provides a detailed account of a wide range of risks identified as affecting regional economic and social resilience. In this case, 'risks' and 'shocks' refer to the same negative events and their consequences. The difference is that risk implies probability, and shock the event itself (OECD, 2014). Stressors, rather, refer to long-term trends that weaken the potential of a region on the long-term and increase the vulnerability of its key structures and actors (ibid.). Table 1 organises the identified risks according to an OECD (2014) categorisation, including: 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. Additionally, the category '**stressors**' was added to distinguish non-abrupt negative developments².

² For a more detailed description of risks see: Giacometti & Teräs (2019): doi.org/10.30689/R2019:2.1403-2503

What factors contribute to 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 often with an explicit focus on communities, individuals and networks (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.** Individuals are organised in complex and interconnected networks, which collectively compose the regional social structures and economies (Bristow & Healy, 2014, p.928). Therefore, strengthening resilience is possible by public, social and commercial actors working together, and by utilising all available resources (Ibid.).

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 genera-

tions 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 and context dependent.** For instance, both individualistic and collectivistic values can influence resilience positively. Individualistic values may promote entrepreneurial spirit while collectivistic values may enable the pooling of resources (Huggins & Thompson, 2015).

In the Nordic countries, the welfare state and governance systems, with its strong public institutions and participative decision-making processes, can be argued to provide strong basis for resilience. This model is often praised for its gains in societal trust, which may have key implications for resilience. According to Gylfason et al. (2010), the strong state and financial institutions in the Nordic countries make it possible to rapidly introduce stabilising measures during recessions, thereby softening the blow for households and firms and the economy as a whole. Arguably, this model could be said to serve positively other challenges such as **preparing for carbon-neutrality, and the automation of the labour market.** The trust placed on public institutions becomes a clear advantage when driving societal change.

Furthermore, this study explores more case-based factors contributing to regional resilience in the Bothnian Arc cross-border region.

3. Methodology

This project used a methodology based on the 'Guidelines for Resilience Systems Analysis' developed by the OECD (2014). The RSA builds on risk management approaches and was originally designed to provide the public administration with a tool to assess the level of resilience of a community, and for integrating resilience thinking into policies, strategies and planning processes. The RSA guidelines use a 'systems-thinking' approach; it designates the system, in this case the region or a community, as the unit of analysis instead of the risk. Systems-thinking makes it possible to gain a comprehensive understanding of: 1) 'the system' (the region) and 2) its different parts ('of who?' what actors, what institutions?), 3) what risks threaten each of the system's parts, and the connections between different risks (Figure 1). Systems-thinking brings also 4) a temporal perspective (what 'timeframe?'), which helps drawing parallels between past events and actions with present developments and potential future shocks.

This methodology is explained in more detail in the in-depth study preceding this publication under the title of "Regional Economic and Social Resilience: An Exploratory In-Depth Study in the Nordic Countries" (Giacometti & Teräs, 2019). Building on that previous work, this study applies new tools to investigate regional resilience in the Bothnian Arc Region.

Gathering literature and empirical evidence: Desk-research, interviews and workshop

This study combined desk-research with field-work to gather theoretical and empirical evidence. The theoretical discussion was published in the preceding study: "Regional Economic and Social Resilience: An Exploratory In-Depth Study in the Nordic Countries" (Giacometti & Teräs, 2019). That publication also provided a ground of empirical evidence on Norrbotten and Northern Ostrobothnia regions which are partly covered by the Bothnian Arc cross-border region.

Interviews were conducted to key stakeholders from national, regional and local administrations, cross-border organisations, academics and private actors. The workshop gathered experts from across the Bothnian Arc cross-border region



Figure 1: Dimensions of the scoping question for a resilience systems analysis. Source: OECD, 2014

to provide their impressions on existing and potential risks to the economy and society. Participants were also asked to provide indications to factors strengthening regional resilience, and particularly on a cross-border context.

Analysis

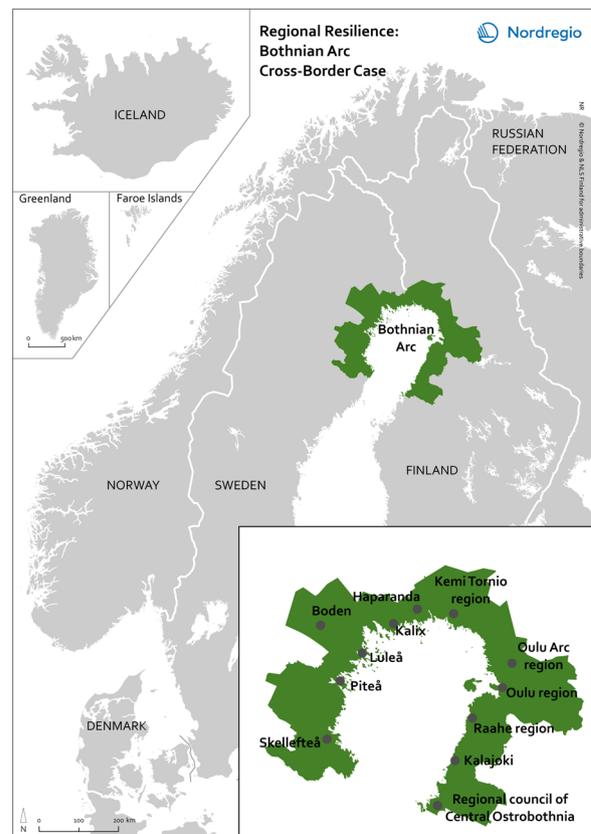
A qualitative approach was utilised to study what are the major challenges of the Bothnian arc municipalities, and how can they adapt to and respond to change. Particular attention was put to understand how the cross-border interface matter in the regions' resilience. Far from providing a full autopsy of the Bothnian Arc risk landscape and possible resilience drivers, this study and workshop aimed at initiating a discussion amongst key actors in the region on how to build a more resilient cross-border region. The results based on the workshop do not measure the probability that identified risks may actually occur. However, the results may contribute with a snapshot of relevant threats to the regional resilience, 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 strengthened proactively.

4. Bothnian Arc case study region

The Bothnian Arc is a cross-border area that extends from the Swedish city of Skellefteå to Kokkola in Finland, along the coastal territories surrounding the Gulf of Bothnia. The area does not correspond to traditional administrative boundaries, but is defined by the local authorities that are members of the Bothnian Arc collaboration. The members on the Swedish side include the municipalities of Haparanda, Kalix, Luleå, Boden, Piteå and Skellefteå. On the Finnish side, members include the sub-regional areas of Kemi-Tornio, Oulu Arc, Oulu, Raahе, Kalajoki and the regional council of Central Ostrobothnia (See Map 1). The area is relatively large and is home to some 710.00 inhabitants (Berlina 2018).

The Bothnian Arc is a multicultural region as it is home to Sápmi, Finnish and Swedish communities living across the borders. Natural resources have represented the main economic base for the region for centuries. Mineral resources and forestry, particularly, have boosted the economy of since the nineteenth century, which attracted large numbers of settlers from southern regions. Besides mineral and lumber, the vast availability of hydric resources, has permitted a surplus in the production of hydropower, which is necessary for the large processing industries present in the regions including steel, pulp and paper and chemical industries. The region is also rich in human resources with many competent professionals, particularly in technical fields and with strong innovation systems surrounding Oulu University and Luleå Technical University. The high-tech industry is well established in the region, being home to numerous globally important innovations in the telephone and internet technologies and iconic companies such as Nokia and Ericsson. Today the tech industry has adapted to the rapidly changing demands in the market and the tech industry has undergone a transition from manufacturing to IT services and developing technology. Developments in other sectors, such as tourism, services and higher education, offer interesting growth potential.

The level of development varies significantly across the Bothnian Arc area. Urbanisation, demographic decline and few creative jobs are some key challenges in many parts of the region. However, not all parts of the region are affected by



Map 1: Bothnian Arc case-study region.
Source: Eeva Turunen, Nordregio

these issues in the same way. The distribution of opportunities is rather asymmetric also within the Bothnian Arc. Most of the region is dependent on traditional industries. Metalworking and mining are important industries with a large SSAB steel factory in Luleå and other firms in Kemi-Tornio, Raahе and Skellefteå. Paper and pulp mills and forestry such as Stora Enso are located in Kemi-Tornio and others in Kalix and Piteå. Chemical industries are present in Central Bothnian and Piteå. Primary production (agriculture and dairy production) is present in areas such as the Oulu Arc (Oulunkaari) and Central Bothnia in Finland and Haparanda, Kalix and Boden in Sweden. However, the larger cities, namely Oulu and Luleå, concentrate dynamic business environments around the high-tech sector and to some extent around the creative industries. Together with the leading educational institutions, Oulu University and Luleå Technical University, these cities have developed highly innovative systems.

Cross-border collaboration

The region has a long-standing history of collaboration across actors and borders. Aside from cultural and linguistic differences, the regions have many things in common, and their labour markets and industries are largely complementary. The extensive collaboration in terms of strategy, infrastructure and service provision is to be outlined, as well as the presence of a 'soft border', meaning that there are no customs, or border controls. The ESPON report by Berlina (2018) on 'Cross-border Public Services (CPS) in the Bothnian Arc', maps a long list of joint initiatives between municipalities across the Finnish-Swedish border. This ranges from the joint Haparanda-Tornio Elementary school, language school, tourist offices, and sewage system for the twin cities, to wider range initiatives such as the Nordic Mining School offered by the University of Oulu together with Luleå Technical University.

The Bothnian Arc Association is the main governance body in the cross-border area dealing with strategic development and facilitating regional cooperation. Other cross-border initiatives that overlap with the Bothnian Arc area, include:

- **Haparanda-Tornio cooperation:** between the twin cities of Tornio, in Finland and Haparanda in Sweden, which are located at either side of the countries' border and facing the northernmost point of the Gulf of Bothnia. According to Berlina (2018), there are over 10 cross-border public services and other forms of agreements between the twin cities of Haparanda and Tornio since the 1970s, particularly in connection with education, healthcare and spatial planning.
- **Provincia Bothniensis Association:** is also a joint initiative between the cities of Haparanda and Tornio which coordinate action at a political level (Berlina 2018).
- **Torne River Valley cooperation:** brings together the 21 municipalities located along the Finnish-Swedish border. The cooperation focuses on cross-border labour mobility and business interactions (Nauwelaers et al 2013).
- **North Calotte Council:** funded mainly by the Nordic Council of Ministers and gathers regional development authorities and representatives of business associations across the northernmost regions of Finland, Sweden and Norway. The main

focus is to promote business development, nature protection, mobility and remove barriers for cross-border interactions.

Moreover, the EU-supported macro-regions, including the Barents Euro-Arctic Region, the Baltic Sea Region, and the Northern Periphery area, also play a role for the development and cross-border collaboration. These initiatives address issues related to strategic development, transport infrastructure and environmental objectives.

Despite the positive culture for collaboration and the governance structures in place to facilitate such interactions, there are still several challenges for cross-border collaboration. Nauwelaers et al. (2013), point out three main barriers related to the physical, regulatory, and cultural-linguistic characteristics of the regions and countries at either side of the border. Large distances and the insufficient infrastructures and transport connections are some of the physical barriers that make collaboration challenging. Differences in tax regimes and legislations are the key institutional or regulatory barriers as well as the distance from national level decision-making processes. Difficulties with communication as well as the 'social distance' between people are the cultural-linguistic barriers or limitations for collaboration. Moreover, Nauwelaers et al. (2013) points out that there is also a general lack of awareness among people and firms on the existing opportunities and potentials of collaboration across borders. Yet, there are also those who take advantage of the location near the border and the different legislations in Finland and Sweden (ibid.).

Currently, the cross-border collaboration receives financial support from the European Cohesion Policy, such as the Interreg programme. However, this funding is currently being put at risk due to budgetary cuts, and most likely will be further reduced after Britain's divorce from the EU. Nevertheless, joint efforts across borders are considered crucial, among other reasons, to reach a critical mass for delivering basic public services as well as to reach a sizable labour market and boost competitiveness. This is however challenging due to the large distances and low population density and distance to national decision-making processes.

5. Workshop

Nordregio and the Bothnian Arc Association organised a workshop in Tornio, Finland in early 2019 gathering experts from the Bothnian Arc region (from both Finland and Sweden). The aim of the workshop was to facilitate a discussion to identify: 1) threats (risks and stress), 2) factors that support regional resilience, and: 3) the relevance of cross-border collaboration in strengthening resilience in both sides of the border.

The workshop consisted of a round of presentations introducing the results of the precedent study, and context of the Bothnian Arc region, followed by three interconnected workshop sessions to discuss and identify:

- what risks, threats and long-term challenges can be identified in the Bothnian Arc?
- what are the drivers of resilience in the Bothnian Arc?
- how can cross-border cooperation strengthen resilience in the Bothnian Arc?

In line with OECD guidelines, this exercise adopted a multi-hazard approach to uncovering the risk landscape of the Bothnian Arc region. This includes a combination of geopolitical, economic, and natural and environmental risks and stressors with potentially negative effects on the long-term.

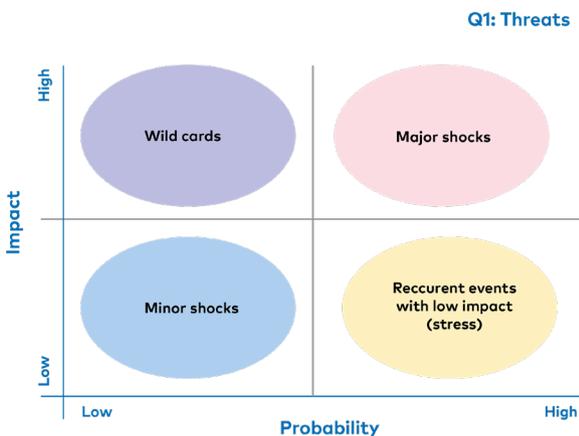


Figure 2: Workshop poster used to identify regions' risk landscapes. Developed by the authors.

To guide this process, two different graphs were designed to stimulate the discussion and gather information. The first graph was designed to help identifying the risk landscape of the region (see figure 2). It consisted of two axes: the horizontal axis indicated the probability of risks (from low to high), while the vertical axis indicated the degree of impact of risks in the case they materialise (from low to high). These axes formed four quadrants that helped distinguish between **1) wild cards**: not very likely but highly damaging shocks; **2) major shocks**: highly likely and highly damaging events; **3) minor shocks**: not very likely and not too damaging events; and **4) Recurrent events with low impact**, mostly resulting from long-term stress.

The second graph was designed to help identifying all possible resilience drivers in the Bothnian Arc region (see figure 3). The graph consisted of two **columns** to distinguish factors that contribute to **1) Anticipate**, and **2) React** to shocks and challenges. Additionally, the graph consisted of two **rows** to distinguish factors that may constitute **1) Preconditions** or the basis for resilience, and **2) Actions/Attitudes** that help handling situations in a more ad-hoc way.

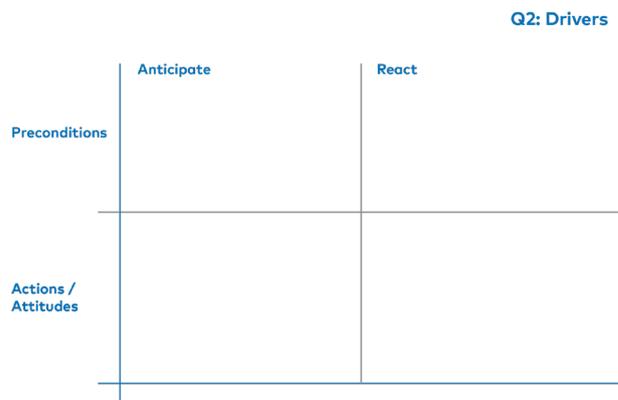


Figure 3: Workshop poster used to identify regions' resilience drivers. Developed by the authors.

6. Analysis and findings

The workshop and additional empirical study and deskwork resulted in a number of interesting results. These are by no means comprehensive or distinguished in detail across the Bothnian Arc territory but provide some leads into the key issues relevant for resilience in the cross-border region.

I. Response to Research Question 1: What risks is the Bothnian Arc region vulnerable to?

The workshop conducted in Tornio with Finnish and Swedish experts coming from across the Bothnian Arc region resulted in a mapping of risks and challenges they identified as relevant (see Figure 4). These results should be interpreted as 'raw data' collected from the impressions of the workshop participants and cannot be generalised to every part of the Bothnian Arc region. Secondly, based on the interviews, workshop and desk study, a more systematic mapping of the different types of risks and stressors is listed in Table 1, according to the categories introduced in chapter 2.

Workshop in Tornio Results: Risk landscape Bothnian Arc

The **top-left quadrant** in Figure 4 recollects what participants in Tornio identified as '**wild cards**', thus having low probability but high impact. For instance, industrial accidents, nuclear disasters in Russia, and internet and electricity shut-down. The presence of several process and extractive industries in the region gives a certain level of probability for accidents, in which case, the pristine nature and overall liveability of the region would be threatened. Moreover, all such industries, as well as transport and day-to-day work and other activities are evermore depending on stable electricity and internet supply. Despite the measures in place to secure their provision, any natural disaster, human error or even cyber-attack, could represent threat an electricity and internet shut-down.

Wild cards and major threats to the Bothnian Arc region can be endogenous but also dependent on events happening outside the region. The proximity to nuclear powerplants in Russia was described as a risk in the event of major accidents. Moving towards the edges of the top-left quad-

rant, there are other major threats that were ranked higher/lower in probability and/or impact. Food scarcity resulting from major droughts and floods in other parts of the world, was ranked as moderately-probable-and-high-impact. The extremely high and increasing dependency of food imports in the Bothnian Arc region, was said to exacerbate the risk of food scarcity globally. On the **top-right quadrant**, participants placed more probable-and-high-impact exogenous risks, such as oil price shocks, the currently escalating trade war among western and eastern global powers and the instability at the interior of the EU, including the Brexit negotiations.

Other 'major shocks' placed inside the **top-right quadrant**, are commodity price shocks, in the event of sharp fluctuations in the prices of raw material and mineral resources, and the potential closure of major industries, such as the paper-pulp factories.

The **bottom-right quadrant** and bubbles extending towards other quadrants require a more complex interpretation. This quadrant collects a variety of challenges or 'stressors' that are more recurrent and having lower impact (on the immediate term). These include, demographic challenges (urbanisation, ageing populations, low birth rate, low migration), labour market issues (few opportunities especially in low density areas, miss-match of skills, low education), impacts of digitalisation, health problems, weather and infrastructure barriers, as well as attitudes related to cultures, increasing nationalism and individual expectations. All these challenges were indicated to be highly relevant to the long-term development of the region. Therefore, their position in the bottom side of the graph should not be interpreted as less important but as non-shocking long-term stress. On the contrary some of the trends, and accumulated stress have a significant impact and can even lead to major emergencies. For instance, continuous loss of competitiveness, and out-migration can cause the relocation of a major firm, resulting in further unemployment and fewer opportunities, deepening the vulnerability of already stressed communities.

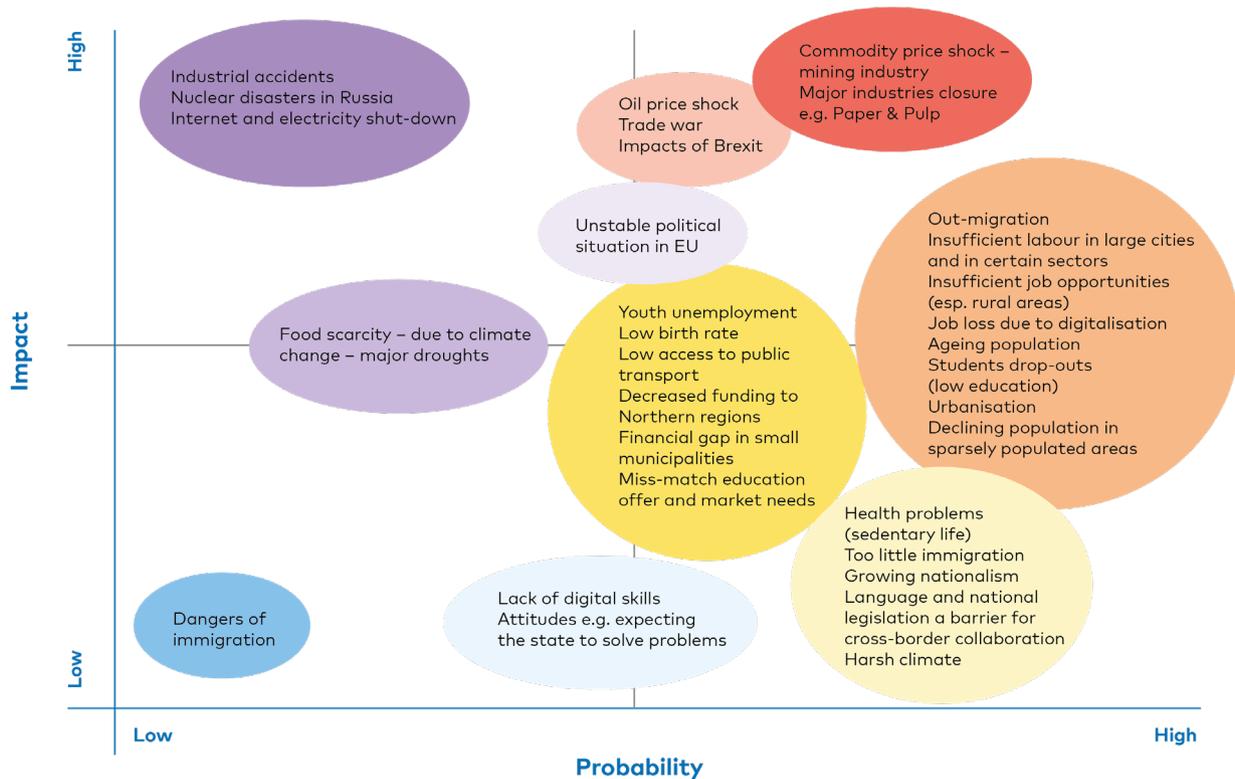


Figure 4: Workshop results - (Raw data) - Risks, and long-term challenges in the Bothnian Arc region.

Finally, the **bottom-left quadrant** collects issues that were considered less probable and having low impact. In this area participants placed potential dangers related to immigration, lack of digital skills, particularly in older generations, and negative attitudes and behaviours. For instance, it was pointed out that newer generations are being less proactive and expect the state to solve their problems. Misconceptions about the quality of education and opportunities at the other side of the border were also lifted as barriers for cross-border integration.

Broader analysis: Risk landscape Bothnian Arc

The Bothnian Arc, as any other region, is exposed to a several types of risks and stressors, that originate both globally and locally. Table 2 shows a mapping of the risks identified in Bothnian Arc region during the workshop and interviews. Risks and stressors never exist in isolation but are interlinked with others and with the overall context in which they exist, but for the of analysis we separate them into different categories. Trends and events occurring globally are not necessarily negative per se. The negative or positive conse-

quences, however, are dependent on the impact of such trends on individual regions according to their inherent characteristics and capacity of adaptation and response. Therefore, the local context is of significant importance when reacting to global developments.

Challenges with low population and attractiveness

The Bothnian Arc, being a peripheral region, has a particularly sensitive demographic situation driven by rural-urban migration, brain drain, ageing population, low birth rates and is exacerbated by the low levels of attractiveness for new people to move in. Despite the pristine nature and landscapes, attracting new people is challenged by the few creative labour opportunities, the distance to the urban amenities and the arctic climate and temperature.

Demographic challenges become significantly more acute with the distance from the coastline and from urban centres (Berlina 2018). Meeting citizens needs and providing services is rather challenging when the population density is low. The situation is quite different in the cities of Oulu and

Table 2: Mapping of the risk, shocks and stressors identified in the Bothnian Arc.

| Types of shocks/risks | Hazard type | Findings |
|-----------------------------|--|--|
| Covariate shocks | Financial | Financial crises – past and future; |
| | Technological | Smartphones introduced in the market, collapse of Nokia, impact on Telia and Ericsson; Automation and digitalisation: impact on jobs and skills; |
| | Commodity price | Oil price shock (impact in the whole economic system); Iron-ore and other minerals; Forest-based products; |
| | Demand-driven | Decline in paper consumption – impact on paper & pulp, and forestry industries; Loss of Russian markets due to economic crisis and sanctions e.g. dairy products from Northern Ostrobothnia; |
| | Policy-induced and regulatory | Regional reforms (in Finland); National legislation distant from the needs of the territories; |
| | Geopolitical | Repercussions of international sanctions on Russia; Brexit vote; EU instability; Trade war, including USA's increasing protectionism; Migration waves resulting from conflicts outside Europe; |
| | Environmental | Industrial Accidents; Nuclear disasters in Russia; Impact of climate change on reindeer herding; Food security and peace; Migration waves resulting from natural disasters outside Europe; |
| Idiosyncratic shocks | Over-dependence on a single or few industries (especially traditional industries); Risk of loss of income-generating activity e.g. Closure of paper & pulp industries; Internet and electricity shut-down; | |
| Seasonal shocks | Climate related - Reindeer herding – changing patterns in winter; | |
| Stressors | Demographic pressures: Ageing population, low birth rate, emigration, urbanisation; Expensive and insufficient means of transportation (especially in low density areas); Insufficient transport offer and infrastructure; Shortage of labour, shortage of specific skills (e.g. digital skills); Challenges with education attainment (early drop-outs) and retraining; Miss-match education offer and market needs; Male-dominated industries; High youth unemployment; Low attractiveness; Unhealthy lifestyles (sedentarism); Attitudes e.g. expecting the state to solve problems; Growing nationalism; Language and national legislation a barrier for cross-border collaboration; Harsh climate; Decreased funding to Northern regions; Financial gap in small municipalities. | |

Luleå, which have experienced continuous population growth for several decades. However, this responds mostly to immigration from other parts of northern Finland and Sweden and not much from southern regions or abroad. Moreover, compared to the general trend of urbanisation, the population growth of these cities is significantly lower, partly due to their peripheral location from national and European perspectives.

There is particular concern for keeping the population along border area and particularly on the Swedish side (Nauwelaers et al 2013). There are many collaboration initiatives for delivering public services that take advantage of the border-region to reach a certain critical mass, such as educational solutions, water management and fire brigades. However, there are challenges with national legislation and decisions made at national levels that hinder such collaboration initiatives. For instance, the educational curricula imposed to schools cross-nationally, is said to neglect the specific needs of a multilingual cross-border region and impede tailored educational programmes.

In relation to the labour market, there are discrepancies between the jobs and the competences available. According to interviews (in Giacometti and Teräs 2019), there are insufficient links between industries and the labour market, which results in a mismatch between the skills available and those needed. Moreover, there is a mismatch between the jobs needed and those wanted by the people themselves. Interviews in Norrbotten, Sweden, point out that issues with the 'employability' of people are having an impact on the competitiveness of the region (ibid.). High salaries in the traditional industries Norrbotten lead to early drop-outs from education, which represents a risk for those people's long-term employability.

Accumulated stress deriving from the demographic and educational challenges are a serious threat to the competitiveness of the region. Stress can result in the loss of economic opportunities or even the relocation of existing firms.

Financial risk

Financial risk emerged mostly in connection to the global crisis in 2008–2010 and the consequences it had on the region. Financial risk was mentioned also in relation to other risks, such as geopolitical risk and commodity price risks, which in turn can lead to financial crises. Decreased funding for Northern regions and municipalities was pointed

out in relation to EU and national budgetary cuts. Lastly, financial resources for businesses were said not all be equally accessible across the region (Giacometti and Teräs, 2019).

Technological risk

'Technological shocks' occur from a process known as 'creative destruction'. This implies a transformation of the economic structure due to the evolution of its industrial base through the emergence of new technologies (Giacometti & Teräs, 2019). The Bothnian Arc region has suffered from technological shocks. Most notoriously with the abrupt downturn of Nokia in the 2010s which had particular damage to Oulu and regional employment. Technological innovations coupled with global competition has an asymmetric effect over territories. Meaning that innovations play for one region's advantage but for others' detriment. Global competition in technological innovations has shaken firms such as Ericsson and Telia, resulting in negative effects in Luleå and surrounding region. Technological innovations are not always abrupt, on the contrary they are normally incremental. Thus, industries need to be up to date with technology to stay competitive and keep their place in the market.

Technological innovation does not occur only within the high-tech sector. For the better and worse, technological innovation has played an important role in other process industries across the Bothnian Arc, such as pulp and paper, steel industries and mining. Reduced consumption of paper for instance has led to market loss to pulp and paper industries. Nevertheless, automation has also allowed such industries to become more competitive on the global markets.

Already before the technological shock to the high-tech sector, there was a shifting trend within the industry towards from ICT manufacturing towards knowledge-based service activities, such as software development. This trend accelerated significantly more after the crash of Nokia and numerous skilled professionals within the sector has lost their jobs, liberating labour to develop new ideas and companies. The ICT sector proved to be extremely dynamic and today the ecosystem around this sector is particularly innovative and forward looking both in Oulu and Luleå. Nevertheless, the technological risk, through global competition in innovation remains a major challenge.

Commodity price risk

The Bothnian Arc's economy is dominantly defined by mining and forestry and processing industries that are one step ahead of the supply chain (i.e. the steel and paper-pulp industries) from primary resources. These resources are denominated commodities as they have little or no value differentiation in relation to their place of origin, but instead, their prices are determined in global exchange markets (Giacometti and Teräs 2019). Commodity prices are therefore dependent on the global supply and demand, and to a large extent to expectations on the performance of economies around the world and trade relations. For this reason, countries and regions that heavily depend on commodity exports, are highly sensitive to general state of the global economy, as well as to geopolitics and speculation. Industries and authorities in the Bothnian Arc, therefore, must expect and be prepared to significant commodity price fluctuations.

The global financial crisis from 2008-2010 has a significant effect on commodity prices globally. The stagnant global economy led to a sharp drop in their global demand. The consequences of this was felt in the Bothnian Arc and surrounding regions due to the low profitability of mineral resources. However, the effects of the crises were not profound for the region due to the short duration of the crisis and preparedness of the mining companies, which accumulate a buffer during periods of high profitability. Down the supply chain, however, companies that provide services to mining industries, were the most affected, as they are less prepared for such crises, and often depend on a single or few clients (Giacometti and Teräs). Another reason for the low impact on the household economy, is that mining and manufacturing industries in the region are highly automated, which reduces the risk of job losses during critical times.

Policy Induced

Policies, regulations and administrative reforms have important effect on regional economies and the organisation and relations between local actors. Ineffective policies, and those lacking a grounded basis on the needs of territories can lead to negative effects on the local economies and a loss of trust from the local actors on the government authorities and institutions.

One of the key worries currently, is the uncertainty arising from the regional reforms discussed in Finland, and the impacts they will have on re-

gional development and provision of healthcare and other key services. Another more general example is the terms of the EU Common Agriculture Policy, which in addition to climate change, weather extremes, unstable costs, have resulted in structural changes within the agricultural sector such as growing unit size, more centralised production and diversification of income sources (Giacometti and Teräs 2019).

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)" (Giacometti and Teräs 2019). The sanctions imposed on Russia by the EU in 2014, led to significant losses from Finnish exports, particularly dairy and beef exports. At a national level in Finland, the sanctions resulted in economic losses of about 400 million euros (ibid.). Despite, the efforts made by the Finnish government to promote domestic food exports and the EU compensatory measures, the financial losses were remarkable.

Another major geopolitical threat at the interior of the EU is the uncertainty arising from the Brexit negotiations and the effect of on the EU Cohesion Policy budgets after Britain is finally divorced from the union. Budgetary cuts are expected for the bordering regions between Sweden and Finland, which is feared to affect the cross-border collaboration. Finally, the current US-led 'trade war' and a more general geopolitical shift towards Asian economies are a source of fear among regional actors in the Bothnian Arc.

Socio-economic impact of environmental and ecological resilience

Communities are part of ecosystems, actively affecting its conditions, while being influenced by them at the same time. Economies have flourished without being environmentally resilient, however, it is every time more evident that it is not possible to avoid the effects of the environmental pressures directly and indirectly. Participants to the workshop have pointed out the dangers of natural disasters elsewhere in the world for the Nordic regions. According to participants, the Bothnian Arc region has grown increasingly dependent on food imports, which makes it particularly vulnerable to food scarcity in the event of major floods and droughts in food exporting countries. Besides

food scarcity, such events can also generate large migration flows from into Europe, similar to the exodus observed resulting from conflict and war.

Industrial disasters and pollution are other major dangers that could undermine food production, water availability, and biomaterials extraction and processing as well as to compromise human health and wellbeing. Workshop participants in Tornio have warned of such dangers given that the region hosts a number of large processing and manufacturing industries, but also due to the proximity to Russian nuclear powerplants.

Moreover, climatic change is having direct consequences on reindeer herding, as the reindeer struggle to find food during the winter season (Giacometti and Teräs 2019). As an inherent part of the Sápmi cultural identity and economy, changing climate represents a major threat. In Sweden, reindeer herders are changing the herding patterns moving closer to coastal areas which has generated some tension with residents and land-owners (ibid.).

Furthermore, altering landscapes through deforestation, mineral exploitation, and climate change can affect the region's cultural, recreational and tourism value.

Demand driven risk

Demand driven risks are generally connected to other risks, such as technological innovation, financial crises, geopolitics and regulations. The decreased demand for paper, for instance, responds to an increased used of digital devices. Moreover, geopolitics and sanctions are often resulting in market loss, as well as financial crises and currency devaluations in key markets. Likewise, technology and geopolitics can also lead to increased demand. For instance, the increasing trade and e-shopping has led to a growing demand of cardboard.

II. Response to Research Question 2: What are the drivers of resilience in The Bothnian Arc?

This study raised a number of factors that contribute to the adaptive capacity and resilience of the Bothnian Arc region. These can be distinguished between conditions and actions that 1) prevent or help anticipate unwanted developments and strengthen regions' key structures; and 2) help respond to disturbances and help adapt organisational structures accordingly. During the workshop in Tornio, Swedish and Finnish experts identified a list of factors they considered relevant (See Figure 5).

| | Anticipate | React |
|---------------------|--|--|
| Preconditions | <ul style="list-style-type: none"> Living costs (low outside large cities e.g. housing) Skilled labour (e.g. digital skills) Competitive industries Excellent universities & research High levels of trust High quality life Low pollution Attractive nature Safety (low crime) Good Logistics Enormous potential for tourism Place-based advantages for industries (e.g. climate and hydro-power) | <ul style="list-style-type: none"> Highly cooperative society / institutions Increasing interest in the Arctic Region High business attractiveness Dynamic cross-border labour mobility Cross-border collaboration in delivering public services |
| Actions / Attitudes | <ul style="list-style-type: none"> Growing awareness on the role of local/regional authorities in addressing global challenges Agreements between FI & SE on cross-border collaboration (e.g. in health care) help to reach a critical mass Developing circular economy Improving logistics/transport infrastructures Increasing attractiveness and tourism | <ul style="list-style-type: none"> Hands-on/problem-solving people Forerunner in digitalisation Digital technologies expanding accessibility to health care and education; and improving communications/competitiveness High investment in R&D International business activities Strong collaboration between university, students and business |

Figure 5: Workshop results - (Raw data) - Resilience drivers in the Bothnian Arc region

Workshop in Tornio Results: Resilience drivers in the Bothnian Arc

On the left column in Figure 5, a number of pre-conditions and attitudes or actions were identified by participants as being basic conditions (pre-conditions) for anticipating disturbances and major shocks. These vary from physical capital, to human capital, social capital, natural capital as well as concrete actions leading to improve the situation in the Bothnian Arc. Skilled labour, competitive industries, safety, natural resources and infrastructure were some of the pre-conditions considered important for anticipation. Whereas, a growing awareness of the existing risks and challenges, increasing cross-border collaboration, developing the circular economy, improving infrastructures and boosting attractiveness appeared as key attitudes and actions for anticipating negative developments.

Instead, on the right column of Figure 5, participants identified preconditions and attitudes and actions that were considered more relevant for reacting upon disturbances and shocks. Pre-conditions included the collaborative society and institutions, a dynamic labour mobility, and an increased cross-border coordination. In contrast, the hands-on and problem-solving attitudes, R&D investment, dynamic business environment, close collaboration between regional actors, and leading regions in the digitalisation revolution, including the digitalisation of public services, appeared as more important for reacting upon challenges.

Broader analysis: Resilience drivers in the Bothnian Arc

The cross-border region represents an important asset for the regions in both the Finnish and Swedish sides. The industrial structure is to a large extent similar at either side of the border. The supply chains, as well as the skills available and labour markets are said to be complementary. This is not only the case for traditional industries such as forestry and factory work but also for the tech industries, research and university positions. The 'soft-border' and collaboration agreements between municipalities and various authorities of Swedish and Finnish sides help reaching the critical mass needed for delivering public services. Together, the small populations of both sides of the border add to a more representative number for the provision of water management infrastructures, rescue teams, fire brigades and other services. Moreover,

a number of key features of resilience were identified in this study. These are described as follows:

Monitoring – generating awareness

Monitoring industries' needs, labour markets, technology trends, climate change and other trends is the first step to being prepared. While this may seem obvious, it is often undone, and local actors often ignore the relevance of global trends. Nevertheless, the region of Northern Ostrobothnia offers an excellent example of how monitoring can be done and how it can lead to evidence based decision-making and delivering structural change. The regional council of Northern Ostrobothnia in collaboration with the local authorities, elaborated a status study on the challenges and opportunities identified in the region including global trends and technologies. A special focus was placed on individual industries trends, needs and associated risks. This effort fed into a sound strategy for structural change (*äkillisen rakennemuutoksen suunnitelma*), which was requested by the Ministry of Economic Affairs and Employment. The strategy was then useful for justifying the need for funding from the 'Regional Innovation and Experimenting' (AIKO) fund. (Giacometti and Teräs 2019).

The County of Norrbotten in Sweden has also initiated a process of monitoring in preparation for the new regional strategy. To do so, Norrbotten has used scenario analyses and forecasting considering different kinds of trends (Giacometti and Teräs 2019). In line with resilience thinking the county has identified a number of risks related to its core industries, mining, forestry and ICT, but also opportunities in tourism and other potential developments.

Besides trends related to industries directly, it is essential to monitor trust levels amongst citizens, education levels, urbanisation, migration and climate change. Changes in the social structure are generally slow but have a direct effect on economic performance and play a major role in reacting to emergencies. The element of surprise is essential in resilience thinking, which means that regardless the level of awareness and anticipation, public institutions cannot be expected to be ready to cope with unpredicted events. Therefore, citizen awareness is extremely important in making the society an active agent of change. Direct relations between people and close collaboration appear to be an important way of lifting awareness in the Bothnian Arc region, but also a way to involve all actors and boost individual actions.

Hands-on culture

'Hand-on culture' is generally the phrase used to describe the proactive attitudes people have in the Bothnian Arc region towards day-to-day challenges. Having to cope with harsh weather conditions and remoteness as well as the strong engineering legacy from processing industries are some of the explanations given for the deeply rooted hands-on culture. This appears to play a role within the formal institutions and informally through different networks. Business relations and collaboration between public institutions, research and firms are highly dynamic. This applies not only to solve problems but also to take opportunities. Norrbotten, for instance appears as one of the most innovative regions in Europe, which is very much explained by the close collaboration between university and firms, but also by the entrepreneurial culture and readiness to jump into new ideas. Similarly, in times of trouble actors are quickly activated to find solutions.

In Northern Ostrobothnia, the response from the authorities to create a task-force after the sharp downturn of Nokia was remarkable, but also the response of engineers who lost their jobs and Nokia itself. Many engineers chose not to leave the region but to develop their own business ideas and start-ups, despite the significant reduction in salary levels. Nokia, in turn proved also to be loyal and problem-solving by giving away patents and support to engineers who wanted to start their own companies. The hands-on culture has shown to be a crucial condition for long-term resilience, where despite the rich resources and industries, the region also struggles with depopulation and peripherality. Grabbing new opportunities as they come, and handling problems proactively has been the way to stay afloat.

Highly innovative and entrepreneurial region

Innovation and entrepreneurship is crucial for generating adaptability in regions. Industrial discovery and experimentation are ways in which businesses as well as public institutions keep up with trends and new demands in society and international markets. The Bothnian Arc area is extremely innovative with high rankings on the overall regional innovation scoreboards (EU Commission). Luleå Technical University, Oulu University and Oulu University of Applied Sciences are at the heart of the innovation systems in the region, which work in

strong synergy with a mix network of traditional and new technological industries and start-ups. The universities and the innovation systems as a whole have attracted many young people into the region, although mostly into the two largest cities of Oulu and Luleå. Students, researchers and professors from around the region and from abroad have brought dynamism into the urban life and economy of the two cities. The universities in addition to incubators and other business support mechanisms are important enablers for start-ups and partnerships to develop.

Innovation in the region is not exclusively connected with the high-tech industry. Traditional industries are highly innovative as well and often highly automated. Firms in the region are large research funders, working closely with the universities to find new markets, products and organisational solutions. This strong innovation profile in combination with the collaborative relations between business and research has made it possible for the region to overcome difficulties related to technological development and global competition. When it comes to public services, the technology developed in the region is an added value to explore more efficient ways to service the rather widespread population along a vast territory. Namely, digital services such as e-education, e-health and generally e-state are highly on the agenda for the regions and municipalities around the Bothnian Arc.

Turning weaknesses into opportunities

Turning weakness and challenges into opportunities is a smart way to take advantage of unpredictable developments and turbulent economic situations. Cold weather, darkness and peripherality is by far one of the biggest challenges for attracting people into the region. However, these conditions have also been flipped into competitive advantages with an increasingly popular 'winter tourism' niche and with industries that benefit from such conditions. Lapland region in Finland has particularly experienced a significant increase in tourism over the last years and to a certain extent other areas around Bothnian Arc. Cold weather in combination with reliable supply of hydropower was the key reason for Facebook to establish its first data centres outside the USA in Luleå, as they save significant resources in cooling down the servers. This in turn has inspired other companies to build

data centres in the area. Coldness and remoteness are also an ideal condition for testing car performance, e.g. breaks, batteries, without revealing new models to their competitors.

'Creative destruction' – Innovation system

Shocks and disturbances are not just negative, and on the contrary, there is much to be gained from disturbance and destruction. Shocks are catalysts of change, encourage reorganisation of institutional structures and industrial composition. This in turn often leads to tackling unsustainable practices and establishing new working cultures, strengthening social bonds and/or open business opportunities. Ultimately, major shocks can lead to re-direct and shape a region's development path towards a more resilient one.

In this sense, creative destruction refers to the process of abolishing the old to replace it with something better.

In Northern Ostrobothnia, the destruction of the telephone industry, in combination with innovation and promptly allocated policy measures has not only led to a quick recovery but to the 're-invention' of the technological sector (Simonen et al 2016). The post-Nokia era in the high-tech sector in Oulu is much healthier and more dynamic. "Today there are approximately 650 high-tech companies whose need for competent employees is even stronger than it was before the structural change" (Giacometti and Teräs 2019). In the eventuality of a new technological shock in the IT sector, the impact would be significantly different due to the diversification of the industry into many more firms, and services offered.

Continuous adaptation and entrepreneurial discovery, experimentation, flexible education programmes are some ways to induce change to minimise the negative effects of creative destruction.

Support mechanisms – functioning institutions

Generally speaking there are well functioning institutions and good support systems in terms of finance and research that set a good basis and enable economic development and dynamism in the region. Closeness between people and strong networks are additional conditions that allow companies to thrive. The trust levels on institutions are rather high, despite there is a general feeling that national level decision-making (both in Sweden

and Finland) is too far from the region. Financial capital, such as grants, and credit appears to be rather accessible for companies and start-ups. There are incubators connected to the universities where companies can receive support with documentation and planning the business trajectories. The universities themselves work as engines for generating an entrepreneurial environment.

Good governance

Close collaboration between regional actors, and small distances between people are key factors in bringing decision-making close to the people. Both in the Finnish side as in the Swedish, there is a high degree of participation in the local planning and regional strategic work. The strategic work realised by regional councils and municipalities are worth highlighting as important mechanisms for generating preparedness. Planning processes, and programming periods are essential to generate awareness of risks and opportunities which are the basis for designing support mechanisms that regions and national institutions need to deliver for securing functioning societies and competitive economies. The status report leading to the regional strategy in Northern Ostrobothnia, is evidence of that.

Following the financial crisis of 2008, regional councils in Finland worked on strategic planning and regional development strategy in close collaboration with national authorities and ELY-centres (state level agencies responsible for economic development, transport and the environment), as well as with local authorities and universities. The Finnish government implemented a project to boost employment and competitiveness in the regions and identify mechanisms to support structural changes (e.g. äkillinen rakennemuutos, ÄRM) (Giacometti and Teräs 2019). In addition, the Finnish government launched a funding programme in 2015 for 'Regional Innovation and Experimenting' (AIKO), to support regions with anticipated structural change. For this purpose, Northern Ostrobothnia realised a detailed status report on local authorities' economic and employment structure. It covered an extensive analysis of the existing structures and the national and global trends surrounding each economic sector. This preparatory work helped identify risks connected to specific sectors and their level of preparedness upon potential shocks. The report resulted in an action

plan for different authorities and institutions indicating how will they react in case of an abrupt structural change (Giacometti and Teräs 2019).

The case of Northern Ostrobothnia shows quite a good degree of vertical coordination across governance levels despite the large distance to Helsinki. Generally speaking however, the distance to national decision-making is mentioned to play in disfavour to the region. Norrbotten County has not so far created a thorough investigation of their risk landscape as in Northern Ostrobothnia, however an attempt of that has been conducted in preparation for the new regional strategy. However, the municipalities in Norrbotten have created an association of local authorities: 'Norrbotten Kommuner' (NK), to coordinate actions and increase their influence at regional and national level politics. By having six members of the board of NK sitting in the parliament in Stockholm and through the North Sweden office in Brussels, the organisation has been able to bring local authorities' interests closer to decisions made at the national government and the EU. (Giacometti and Teräs 2019)

Spreading risk through diversification and related variety

Spreading the risk through diversification is perhaps the most logical way to cope with disturbances. Putting all eggs in one basket, in the sense of depending too much on one or few industries, can have devastating effects if that industry gets in trouble. There are however, different ways to spread the risk.

■ **Diversification of the industrial base:** implies generating new economic activities. This is perhaps the most challenging way of diversification, but extremely important in the long run. Investing in entrepreneurship, R&D, and scaling up start-ups are some of the main ways of promoting industrial diversification. Business promotion is also used to attract foreign investors, for instance the Facebook data centre built in Luleå. Another way, which is less common today is by governments' decisions to create public companies, i.e. more common today companies that produce and deliver public services, such as powerplants, waste management or sewage. The Finnish government, for instance, took the decision of building a nuclear powerplant in Pyhäjoki.

■ **Related variety:** implies diversification within industries by expanding their value chains. This often happens through collaboration between industries. For instance, paper and pulp processing industries have expanded their supply chain by producing other derivatives from the same raw material such as chemicals and biofuels. The high-tech sectors, and particularly in Oulu are much healthier today with a firm composition of SMEs providing numerous services, compared to the previous overdependency on a single company, Nokia. The mining industries in Norrbotten and Northern Ostrobothnia have also led to the development of technologies that can be used outside the industry, such as ventilation systems, sensors and tunnelling machines. The mines have also been excellent environments for testing drones, 4G and 5G internet technologies, crop husbandry and particle physics research.

■ **Market diversification:** implies exploring new markets and clients, which is crucial in the event of losing clients or a whole market. This is possible for instance do to substantial variations in currencies' exchange rates, or through political decisions: protectionism and sanctions. Dairy farmers in Northern Ostrobothnia were forced to explore new markets after the EU-led sanctions on Russia were implemented. Similarly, in Norrbotten, suppliers to the mining industries were encouraged to find additional clients outside of the region to spread the risk after the global financial crisis in 2008.

■ **Diversification of jobs:** Create jobs in various industries and the public sector is a key way to spread the risk. Generating new economic activities and new industries is a long-term challenge, however, job diversification can be done even without establishing highly profitable industries. For instance, hospitality and cultural amenities may not generate significant resources for the region but can absorb a substantial share of the employment. While the Bothnian Arc region is still heavily dependent on traditional industries, a large share of the jobs are not directly related to such industries. This is even more the case in larger towns, particularly Luleå and Oulu, which are moving from industrial to service-oriented economies. In Luleå, for instance, basic industry is no longer the biggest employer, while Luleå Technical University and the public sector have become major employers.

Close collaboration between industries is a good way to promote innovation and related variety, as well as in attracting new related companies that benefit from clustering around good business environments and suppliers. This is true even with completely different industries. For instance, the traditional industries around the Bothnian Arc area have enormously benefited from collaborating with the high-tech industry in developing new digital solutions that improve their competitiveness. Similarly, the overall competitiveness of the regions have the potential to increase with the use of digital technologies in the delivery of public services i.e. e-health and e-education.

Redundancy – duplication of key infrastructures and services

Redundancy, as the duplication or provision of alternative solutions for the same purpose has proved to be essential in minimising risk of failure. For instance, several energy sources is of enormous importance for securing the electricity provision to processing industries, which have to work without interruption 24 hours every day of the year. In the case of Luleå area, the 'triple redundancy' of electricity sources has proved to be a competitive advantage and an attractive condition for other large industries and data centres to establish operations in the region (Giacometti and Teräs 2019). Redundancy is also essential when it comes to the delivery of basic services and transport alternatives.

Capacity to respond through self-organisation and citizen solidarity

The capacity to respond to shocks and challenges does not necessarily imply strength or rigidity. On the contrary Responding to difficulties demands flexibility and adaptation. For instance, by "shaping 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" (Giacometti and Teräs 2019). One excellent example of flexible reorganisation is through the task force called the 'Tar Group' created in Oulu after the technological shock suffered by Nokia. The task force consisted of different public authorities with support of the university and Nokia to address structural change.

The response of the society at large is indispensable when coping with challenging situations and major shocks. The closeness among people, the loyalty, hands-on attitude, and a strong sense of community and belonging have shown to be of enormous importance in coping with difficult situation in the past in the Bothnian Ar. The mechanisms of response designed by the public institutions are never enough, especially during unpredictable and shocking events. Thus, the need for a proactive and engaged citizenship. However, for the citizens to act proactively, there is a need for raising awareness about the risks, as well as to generate solidarity and cohesion among people.

7. Conclusions

The Bothnian Arc region is an interesting case on which to study regional resilience and particularly from a cross-border perspective. Despite of the peripheral location, the Bothnian Arc region have shown a high capacity of adaptation and resilience. The substantial industrial heritage in the region rooted in the mining, forestry, metalworking and other traditional industries, has provided the basis for new industries to develop over time. The strong engineering background coupled with the hands-on attitudes and entrepreneurial capacity of people in the region led to the development of the high-tech industry and partly transition into a more knowledge economy where research and innovation play a driving role. The crush of Nokia in Oulu represents an iconic example for resilience research, however, issues such as the acute demographic pressures are equally and perhaps more concerning for the population in the Bothnian Arc region.

The long history of collaboration between municipalities and regions across the Finnish and Swedish borders represents a huge asset for these regions. Aside from the social relations across borders, the soft-border enables labour mobility and expansion of the supply chains which are to a large extent complementary. Considering the low population density in the area, collaboration between municipalities and other intuitions at either side of the border allow the accumulation of critical mass for authorities to expand the accessibility of public services and boost the competitiveness of the region.

What is most valuable of this study is that it collected experiences and perceptions from experts across the Bothnian Arc region. Participants came from different places and backgrounds, from policy and public administration at different levels of government to academia. This group provided with a rich amount of input that allowed identifying the most pressing risks and concerns in the re-

gion, as well as some of the strengths and factors driving resilience. What was particularly unique compared to previous studies in other regions, was this groups concerns of long-term and global issues: such as food scarcity, global trade-war, and nuclear accidents in Russia. Moreover, participants were greatly aware of their most pressing issues in the long run, which are depopulation in most areas and particularly remote ones, ageing population and low attractiveness.

Despite these major challenges, the region remains incredibly competitive with high innovation, highly proactive citizens and authorities, and the entrepreneurial spirit that retains emerging opportunities. Natural resources are finite and therefore it is necessary to invest in creating other economic activities that can last in the long run. Regardless of the high dependency on commodity exports and process industries, authorities in the region have been aware of the risks attached to an economic structure dependent on such industries. For this reason, investing in education, generating skills and boosting innovation appears to be the right approach towards attracting opportunities and enhancing the adaptive capacity of the region and its key actors. However, there are also less optimistic voices who point out the neglect of the remote areas by national and regional authorities, and the insufficient action and preparedness upon climate change and major environmental degradation.

Ultimately, long-term resilience is not defined by the ability of the region to resist shocks and disturbances but on their capacity of adaptation and mobilising change. In this case, actors in the Bothnian Arc region have proved highly adaptable and hands-on when it comes to address challenges. Now the biggest challenge remains to boost attractiveness to the region to revert the negative demographic trend.

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Appendix 1

Interviews: list of contributing organisations

- Association of Local Authorities in Norrbotten region (CEO)
- Bothnian Arc Association (CEO)
- Centre for Distant-spanning Technology, Luleå Technical University (General Business Manager)
- Centre for Economic Development, Transport and the Environment in Northern Ostrobothnia (Head of the rural unit)
- City of Oulu (Development manager)
- City of Oulu (Research manager)
- Council of Oulu Region (Head of Development)
- Cloud Consulting Sweden AB (Senior Advisor)
- Hydro66 Data Centre (Director)
- Luleå Technical University (Professor)
- Luleå Municipality (Planning/Environmental Strategist)
- Ministry of Economic Affairs and Employment in Finland.
- Norrbotten Region (EU-Coordinator)
- Oulu Business School, University of Oulu (Professor of Economics)
- Oulu Business School, University of Oulu (Professor of Economics – 2)
- Oulu University (Research Director)

Workshop Participants, Tornio, February 26, 2019

- Barents Regional Committee (Håkan Wiklund; coordinator Barents Regional Committee; position at County Administrative Board of Norrbotten)
- Bothnian Arc Association (Heikki Aalto, CEO)
- Bothnian Arc Association (Tuula Parsiala-Teittinen, Administrator)
- City of Haparanda (Ali Ababneh, Child Protection and Organizations Development Consultant)
- City of Luleå (Natalia Golubeva, International affairs coordinator)
- City of Luleå (Lena Bengtén, Planning/Environmental Strategist)
- City of Luleå (Jan Unga, Social Strategist)
- City of Oulu (Piia Rantala-Korhonen, Director, advisor to the Mayor, MA)
- City of Oulu (Heikki Keränen)
- City of Raahе (Hannele Meskus, Manager)
- City of Tornio (Timo Nousiainen, Mayor)
- City of Tornio (Katariina Huikari, Project manager)
- County Administrative Board of Norrbotten (Tina Nilsson)
- Development Centre of Sea Lapland (Markku Hukkanen, Manager)
- Kalix Municipality (Reinhold Andefors, Politician)
- Nordregio (Jukka Teräs, Senior Research Fellow)
- Nordregio (Alberto Giacometti, Research Fellow)
- Oulu Business School, University of Oulu (Jaakko Simonen, Professor of Economics)
- Provincia Bothniensis (Birgitta Tamminen, Cross-border development specialist)
- Regional council of Lapland, North Calotte Council (Nordkalotträdet) (Paula Mikkola, Secretary general)



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