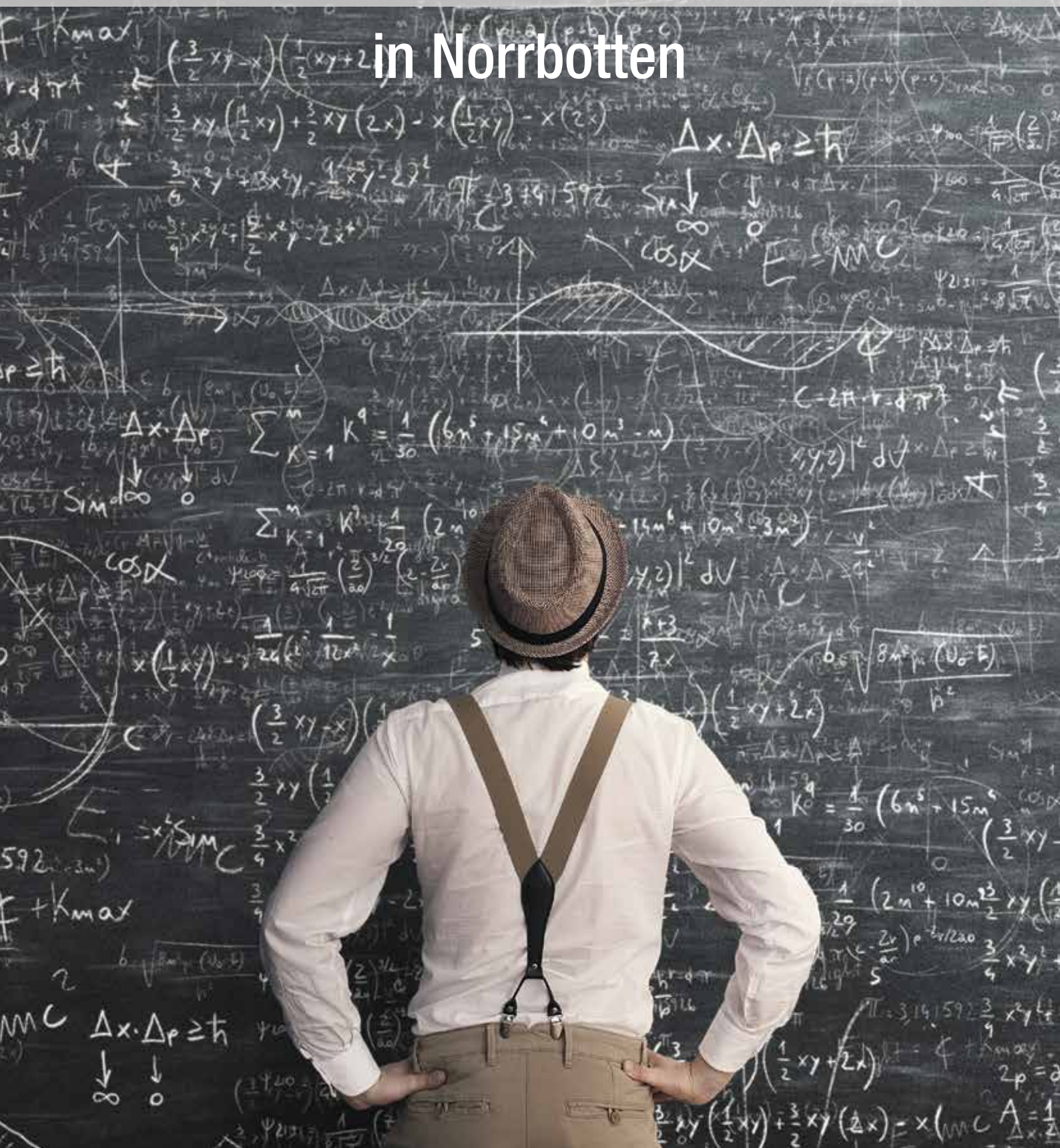
Strategy

SMART SPECIALISATION

in Norrbotten



Norrbotten is to be a permanent
world fair for a sustainable and
innovative future

CHEMINS DE FER PARIS-LYON-MÉDITERRANÉE
EXPOSITION UNIVERSELLE
1889
DE PARIS
INAUGURATION DE L'EXPOSITION
BILLETS D'ALLER & RETOUR
1re, 2e et 3e Classe
25 % DE RÉDUCTION
Délivrés du 1er au 15 Mai 1889
POUR PARIS
PAR TOUTES LES GARES DU RÉSEAU
VALIDITÉ
Jusqu'à 200 kilom... 4 Jours
De 201 à 300 — ... 6 —
De 301 à 400 kilom. 8 Jours
De 401 à 500 — 10 —
Au-dessus de 500 kilom...... 12 Jours
Y COMPRIS LE JOUR DU DÉPART
LES BILLETS D'ALLER ET RETOUR SONT REÇUS
DANS
Tous les Trains (Express & Rapides compris)
AU MÊME TITRE QUE LES BILLETS A PLEIN TARIF
FRANCHISE DE 30 Kos DE BAGAGES

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Summary

In order to achieve conditions in which we can reach the vision of the smart specialisation strategy, the most crucial aspect is to influence and improve conditions in a number of areas. The below figure is a summary of open innovation, strategic opportunities, smart specialisation, and smart differentiation. Measures in smart specialisation should aim to create products and services for a market, or to implement them in an operation by focussing on one or more areas and working within these to develop one or more of the strategic opportunities that have been identified.

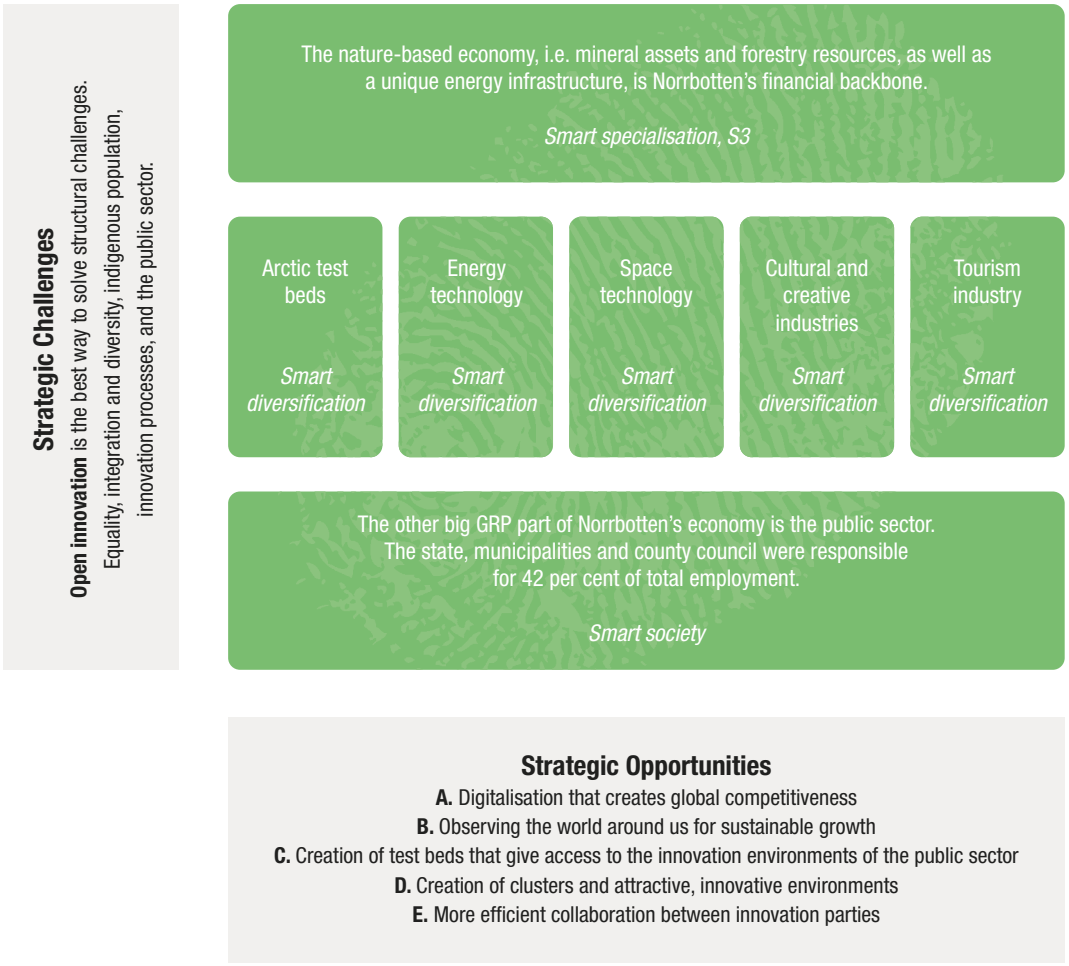

Figure 1: Summary of Norrbotten's smart specialisation.

Norrbotten is to work with the tool of smart specialisation. This means that we should build new industries based on the strengths and competitive advantages that we already have, while daring to take risks and trying things previously untried.

The spaces between the focus areas symbolise the interfaces. 'Interface' is a method that can be used for the purpose of strengthening the region's focus areas. There is a potential for future innovations if you promote meetings within and

between industries and different types of businesses, organisations and competence areas, and between regions and countries. Interfaces can also contribute to increased equality if traditionally gender-divided industries meet. Projects that contribute to interfaces within and between focus areas will be prioritised by parties working in accordance with the strategy.

Introduction

Region Norrbotten is responsible for regional development in Norrbotten. Extensive work with developing Norrbotten's smart specialisation strategy has taken place. Norrbotten has chosen to work according to the smart specialisation method, which means smart ways to actively, efficiently and dynamically promote unexpected meetings between our nature-based economy with its matching infrastructure, our Arctic conditions, and other related areas. Together, they can create a more varied business structure while reaching the vision and goals that we have set.

Norrbotten is Sweden's biggest county, and comprises 25 per cent of the country's surface area. With Norrbotten's geographic location in Arctic Europe, and with borders with both Finland and Norway, transborder collaboration has developed. Norrbotten, with its geographic location in the middle of Arctic Europe, has a long tradition of collaborating across borders. Together, the regions in the area have good opportunities to collaborate more to create better conditions for sustainable growth. Global interest in the Arctic affords Norrbotten the opportunity to position itself as a competitive Arctic region. Arctic competence could be described as the ability to create sustainable growth and development in areas with a cold climate, vast distances, and a sensitive environment. The region's development is driven by people's new ideas, ways of working, and solutions to Arctic challenges.

Norrbotten is an innovative region. We are to continue to encourage and promote this, both through investments in research, innovations and entrepreneurship, and through being braver than other regions. We are world leaders in strong, nature-based industries, while our cultural and creative industries are growing quickly. There are many exciting, sustainable and transborder business opportunities, and we must dare to take risks and understand that not all investments will be profitable. We can't be scared to fail – we should be scared not to try. In order to get something you've never had, you have to try things you've never done.

Successful innovation work is characterised by clear leadership, a permissive climate, dynamism, a variety of ideas, and businesses that are willing to invest in research. Leadership can be practised by one or more people or organisations. To have an effect on innovation work, it's important to get everyone to stand up for the region, and to work together for the region's development. This does not mean that everyone has to agree on one modus operandi, but involves a range of parallel modi operandi which all involved parties work towards to reach the common goal. It's also important for regional development that all parties that work with the county's development are clear leaders in their respective areas, and that they support the joint regional innovation process.

To create an innovation, one or more people have to dare, want, be able, and get the opportunity to think in new ways. For innovations to appear, the climate around them must thus be permissive. Occasional mistakes have to be accepted, but people must also be allowed to succeed – regardless of gender, ethnic origin, religion or other belief, functional impairment, sexual orientation or age.

Reading Instructions

The strategy begins with a chapter that summarises all the main components it comprises. To create a powerful strategy, a good understanding of both history and the current situation is required, so these subjects are dealt with in the second and third chapters. Then, there is an extensive analysis chapter that also includes a mapping of parties, as well as probable future scenarios that the strategy has taken into consideration.

Finally, there is a detailed report of the structural changes and strategic opportunities that will be required for us to reach the below presented goal for 2030, and an innovation index, specifically adapted for Norrbotten, that gives us the opportunity to follow up the desired changes as we go. The strategy's connection to other programmes is described in appendix 1. There, you can also find an overview of how strategies, programmes and financing are connected from an EU level to a municipal level.

Vision

> Norrbotten is to be a permanent world fair for a sustainable and innovative future.

The visionen requires coaction among the regional parties, and for everyone to come together over strength and focus areas where we – within the county – have unique or especially excellent conditions. This is to form the foundation for ongoing renewal work, and to – in the long term – lead to stronger innovative ability, entrepreneurship, and business growth

We don't know how the future will develop, only that the coming changes are great and complex, which means that no individual party or area has the required know-how or resources. Nobody can find the solutions that are required for Norrbotten to be a pioneer, and to show the world what a sustainable and innovative future can look like by themselves.

The vision also includes the expectation that Norrbotten will be a destination for other regions and parties that want to see now what the future – and an environment where the parties' ability to work together is constantly evolving – will be like. This strategy is to constitute a guidebook for our visitors, and for us, about how to develop Norrbotten in this direction.

Purpose

The county's development is to be based on regional resources through new knowledge in order that more people, organisations and industries develop and contribute to new or better solutions that respond to both current and future needs and demands.

Furthermore, the innovation strategy aims to help focus on Norrbotten's challenges; it's to be used as a more efficient base of public means that support innovation development in the county, and it should be a guide when ideas and projects are prioritised.

It's not about building new institutions that are to deliver innovations, but about flexible support for the developmental directions that are made possible by innovations and transborder collaboration.

Goal

Norrbotten has developed into one of the most innovative regions in the EU[1], and our competitiveness must be said to be considered very good. There are still great challenges that have to be solved in order to ensure Norrbotten's future appeal, however.We consider one of the biggest challenges to be the use of sustainable growth to transform our current competitiveness, keeping it as strong in the future as it is today. In a globalised society with increasing environmental challenges, the hitherto pervasive idea of financial growth will most likely be questioned. According to our assessment, future competitiveness can only be implications. Sustainable growth has three dimensions: a financial, a social, and an environmental one. In Norrbotten, we need to make progress within sustainable growth so that we can meet today's needs without compromising the needs of future generations. Therefore, the county is to develop into one of the country's most attractive regions.

> To secure sustainable development that guarantees future competitiveness in Norrbotten.

Delimitations

Smart specialisation supports the implementation of the EU's cohesion policy, and relevant national strategies.

Smart Specialisation the Norrbotten Way

Smart specialisation is a model for the specialisation of development activities that is to contribute to financial development and adaptability[2]. It's not about traditional industry support, but about supporting concrete activities that can contribute to benefits, renewal, development, and synergies in several areas. The starting point of smart specialisation is that it's necessary to perform a basic evaluation of the region's strengths and weaknesses, and that the process has to be run in close proximity to regional stakeholders. The goal is a regional coming together behind the areas that have the biggest potential for sustainable innovations, entrepreneurship and growth.

The purpose of smart specialisation is to promote smart diversification[3], starting from clear niches, in order to stimulate the development of new specialisations and knowledge areas. Economy revitalisation through knowledge dissemination between related operations is termed related variety[4]. Related variety has been noted by researchers as a driving force for regional development of established industries and knowledge areas[5, 6]. Centrally, therefore, the task becomes to support innovation and development activities related to industries that are connected to other operations in the region[7]. It is within and between these regionally anchored areas that the potential for related variety is the greatest.

1 Regional Innovation Scoreboard 2017; http://ec.europa.eu/docsroom/documents/23881.

2 European Commission (2014). National/Regional Innovation Strategies for Smart Specialisation (RIS3)

3 Norrbotten's main advantages can be found in its mineral assets, forestry resources, and capacity for renewable energy. Nature-based economy is Norrbotten's smart specialisation area, which means that Norrbotten has a high degree of specialisation. In order to increase diversification of the economy, we have to use the existing strengths in mineral assets, forestry and renewable energy, as well as added value and technology that are connected thereto in order to create new business and employmnet opportunities.

4 This means that basic industry in the shape of mining, forestry and paper industries, and energy production are now complemented. The significance of a development based on 'related variety' was confirmed as early as in the 1990s through contributions by researchers such as Ron Boschma, Björn Asheim, etc. operations that, in different ways, are related to the region's traditional industry and competence.

5 Asheim, Boschma, och Cooke (2011). Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. Regional Studies, 45:7, 893-904.

6 Boschma, Heimeriks och Balland (2014). Scientific knowledge dynamics and relatedness in biotech cities. Research Policy 43.1: 107-114.

7 McCann och Ortega-Argilés (2013). Smart Specialization, Regional Growth and Applications to European Union Cohesion Policy. Regional Studies.

Smart specialisation should not be seen solely as a strategy for implementing regional projects. The method should also be used to influence regional and national policy, and to facilitate participation in other Europe-driven programmes such as the regional fund programmes (ERUF)[8], Interreg[9], ESF[10], EJFLU[11], Cosme[12], Kolarctic[13] and Horizon 2020[14], which stipulate that if a region has a smart specialisation strategy, its parties may apply for research and innovation funding from these programmes.

The smart specialisation strategy is to be a tool for sustainable and inclusive development and growth in Norrbotten. The goal is to ensure future competitiveness in Norrbotten. The strategy should be of interest to all key Norrbotten parties working with innovation in the county's appointed specialisation areas, as well as to parties in Sweden, Europe and the world.

The design of a regional strategy does, however, have to use the region's conditions for developing competitiveness as a starting point. In its overview guide to smart specialisation, the European Commission describes the work in the following steps[15]:

1. Analysis of the region's strengths with a special focus on regional assets, European and international competitiveness, and links to other markets.
2. Anchoring and participation from both a market and a customer perspective. In addition to traditional triple helix[16] work, society and customers should also be able to get involved so we can get as broad a view as possible, either through direct influence and participation, or indirectly, through interest organisation representation.
3. Formulation of an overall vision for the region.
4. Identification of the areas that are to be prioritised through matching a top-down perspective with a bottom-up perspective.
5. Plans for implementation. The strategy is implemented through action plans, in which it's important to leave space for experimentation.
6. Plan for learning and follow-up in order to follow up how well the goals of the strategy are reached. One example of modus operandi are so-called peer reviews – a particular type of extreme scrutiny – where regions are matched with each other.

REGION NORRBOTTEN'S INTERPRETATION OF SMART SPECIALISATION

"Smart specialisation means smart ways to actively, efficiently and dynamically promote unexpected meetings between our nature-based economy with its matching infrastructure, our Arctic conditions, and other related areas. Together, they can create a more varied business structure for a sustainable and innovative future."

8 European Regional Development Fund.

9 European collaboration across national borders.

10 European Social Fund.

11 European Agricultural Fund for Rural Development.

12 Competitiveness of Enterprises and Small and Medium-Sized Enterprises

13 Kolarctic Cross Border Cooperation 2014-2020.

14 The EU's framework programme for research and innovation.

15 European Commission (2012) Guide to Research and Innovation Strategies for Smart Specialisation.

16 Triple helix is a collaboration model between different parties such as trade and industry, society, and academia. There are other models too, such as quatro helix and multi helix models. We have chosen to call our models collaboration models, as they concern collaboration between different parties in order to achieve a higher value together, and not about whether there are three or four or more different parties working together.

Process and Analysis Method

The task of developing a regional research and innovation strategy for smart specialisation was given to Norrbotten's County Administrative Board in 2015. On the 1st of January 2017, the task was taken over by Region Norrbotten as a result of a parliamentary decision in November of 2016 which meant that responsibility for regional development was be transferred from Norrbotten's County Administrative Board to Region Norrbotten on the 1st of January 2017.

Work with the innovation strategy begun in connection with the start of Regional Renewal[17] which is a collaboration project between Region Norrbotten, Norrbotten's County Administrative Board, and the Luleå University of Technology that aims to increase knowledge of Norrbotten's conditions and needs, with the purpose of strengthening the county's conditions when it comes to important regional growth and development issues.

n the work with identifying Norrbotten's focus areas[18], which is the foundation for this strategy, the process and method have largely been in line with the European Commission's guide to strategies for smart specialisation which was presented above[19]. A gender analysis[20] of Norrbotten's previous innovation strategy 2012 – 2020 was also conducted – in order to further strengthen the strategy's equality integration.

What Are Innovations?

Innovations are developments or implementations of new or improved solutions that respond to needs and demands in everyday life and the world around us. Innovations create value for society, businesses and individuals; value that comes from the benefits and utilisation of ideas. It is thus important to form a broad perspective in working with innovations in order to involve women as well as men, and various organisations and businesses. Value creation that is based on research and development is important, but many innovations appear continuously in businesses, the public sector, and other organisations. Work with innovations is always associated with risks – not all investments will be profitable. At the same time, risks must be taken for progress to be possible[21].

There are also social innovations that contribute to meeting societal challenges, and research in working life, health, equality and integration, for instance. A large number of social innovations are realised by voluntary, public and private parties. These are innovations that contribute to improved quality of life and welfare in the region. Innovations often appear in the interface between the private, public and voluntary sectors. Value comes from the implementation, use and dissemination of an innovation. The value that is created can be financial, social, and/or environmental. Innovation is about new or better solutions that create value for society, businesses and individuals. The area includes plans and measures to develop and strengthen the innovation and renewal power of Swedish businesses in many societal areas[22].

Radical or Incremental Innovations

Innovations can have varying degrees of newsworthiness. Some are 'new to the world' – comprehensive or radical innovations based on innovation impact and completely new solutions – while others are new to the region or the business,

17 https://www.norrbotten.se/sv/Utveckling-och-tillvaxt/Regional-utveckling-och-framtid/Ett-dynamiskt-naringsliv/Regional-fornyelse/

18 OECD's Territorial Reviews Northern Sparsely Populated Areas (2017), and Regional Renewal, which is a collaboration project between Region Norrbotten, Norrbotten's County Administrative Board and the Luleå University of Technology that aims to increase knowledge of Norrbotten's conditions. https://www.norrbotten.se/sv/Utveckling-och-tillvaxt/Regional-utveckling-och-framtid/Ett-dynamiskt-naringsliv/Regional-fornyelse/

19 European Commission (2012). Guide to Research and Innovation Strategies for Smart Specialisation

20 Lindberg, Malin. Genusanalys av Norrbottens innovationsstrategi, Luleå tekniska universitet.

21 See also http://www.regeringen.se/sb/d/14440/a/201291

22 See also https://www.regeringen.se/regeringens-politik/innovation

but don't have the same technological impact or newsworthiness. The latter are called incremental or cumulative innovations.

In Sweden, the former type of innovation has been valued, while people have often looked down on innovations that are based on copying other people's solutions. From a developmental perspective, however, both these types of innovations create value for businesses and society, and form a basis for developing competitiveness, profitability, improved societal service for citizens, and new jobs in businesses and the public sector alike. The two types of innovation are based on different forms of developmental logic, and require different kinds of resources and supportive structures. Radical innovations benefit from being developed in denser and more knowledge-intensive environments with good access to venture capital – environments that can often be found close to universities and research institutes. Innovations with lower knowledge content that are based on copying, however, benefit from being developed in more sparse environments[23]. In order for the region to develop, we need both types.

In Norrbotten, like in other regions, most innovations are improvements and developments of existing goods and services, and they are normally produced by businesses that are already established in the region (sector A in the figure below). Here, you'll find continuous product development that takes place both in basic industry and in other enterprises, and that includes both new products, services, and ways of organising production and operations[24]. Sometimes, this development work leads to innovations with a high level of newsworthiness, however (sector C). New businesses that develop goods and services that are completely new to the world (sector D) do exist in the region, but are more an exception than a rule. The majority of new businesses offer the market goods and services that are already established, and that have a low degree of actual newsworthiness (sector B)[25].

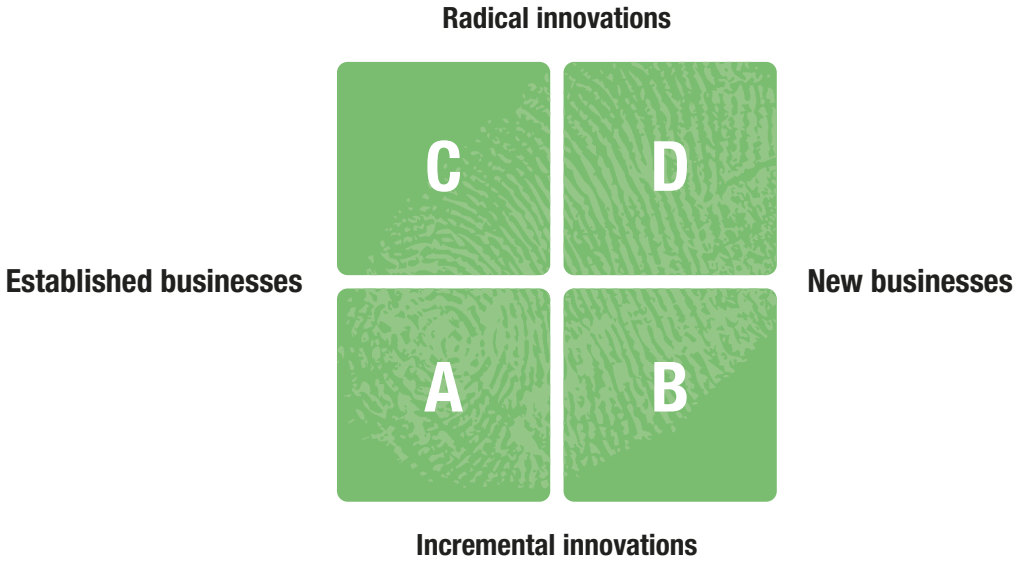

Figure 2: A playing field for analysing the businesses in the innovation system.

23 Cooke, P. & Leydesdorff, L. (2004), Regional Development in the Knowledge-Based Economy: the construction of advantage, Journal of Technology Transfer, 31: 5-15

24 A clear trend in industry right now is to develop offers that include both products and services.

25 Norrbotten County's Innovation Strategy 2013 – 2020.

If you choose instead to focus on the supportive parties that operate in the field, as illustrated by the above figure, you'll find that they – in part – have different target groups and ambitions. Research and development organisations such as universities and research institutes, alongside many technology brokerage organisations, have the ambition to develop completely new and radical innovative solutions, but work with commission-based research and development that includes more incremental innovations just as often. The venture capital industry includes parties that like to see innovative investments but that also depend on balancing their books, and so like to invest in profitable projects with calculable risks. Some organisations for new entrepreneurs focus on serving individuals with new entrepreneurial ambitions regardless of the innovative impact of the business idea, while other organisations have the explicit business idea to only work with innovative ideas with a great export potential. All together, a number of innovation-supportive parties, such as Almi, Arctic Business Incubator Ltd, and Coompanion, and businesses and entrepreneurs form a multifaceted, regional innovation system. Many ideas get stuck in what is generally referred to as 'the valley of death'[26] – i.e. the product and service development steps that concern more expensive prototypes, first market attempts or initial market establishment – however, as financing opportunities are lacking.

To see which development routes and strategies are possible, we'll start from the playing field in the figure on the previous page. The conclusion is as follows::

- Future regional innovations are certain to continue to be mostly incremental innovations developed by existing businesses (sector A in the figure). It is crucial that supportive parties working in the regional innovation system contribute to this by delivering the required competence.
- It is just as crucial to also support opportunities to develop more radical innovations in the shape of new technologies, new functional products – combinations of goods and services packaged as long-term, sustainable ways to meet market or customer needs, new experiences in the tourism industry, etc. These types of innovations benefit from collaboration in the so-called knowledge triangle.
- Even if the majority of new businesses focus on providing markets, goods and services with a low degree of innovative content (i.e. operating in sector B), new businesses generally constitute an important component in the regional innovation system, and contribute to a more attractive region with their employment opportunities and supply of goods and services.
- Businesses need support with specific measures, activities and programmes to avoid ending up in 'the valley of death'.

The Public Sector in the Innovation System

The public sector also plays an important role in the innovation system, but the term is still relatively new and undeveloped in this sector. Currently, there is no coverall description of the differences between the public and private sectors when it comes to innovativeness. The public sector's different roles in the innovation system are described below.

The Regional Policy System

The municipalities in Norrbotten are parties and stakeholders in the regional policy system, and participate in the shaping of the region's strategies. As co-financers, the municipalities support innovation investments and projects. Normally, innovation investment issues are dealt with by the Municipal Management Administration in dialogue with political leaders and concerned administrations and/or municipal companies.

26 'The valley of death' – the initial, critical period in the life of a new business when the costs for development are significantly greater than the income. https://www.nyteknik.se/startup/33-listan/sa-overlever-ditt-foretag-dodens-dal-6395551

Knowledge Development and Dissemination

The municipalities are education parties and seedbeds that provide universities and trade and industry with competence. Municipal education produces future students, researchers, innovators, employees and business leaders. Active collaboration with universities, trade and industry, and research organisations creates interest, involvement and networks that stimulate and facilitate future recruitment. Education departments, adult education operations, support for new entrepreneurs, young entrepreneurship investments, and incubators/science parks are examples of municipal operations that help with knowledge development.

Innovation Investments – Development of New Solutions, Goods and Services

The municipalities can have several different roles in specific innovation investments. In many cases, the municipality has a development-supporting role, acting alongside other parties to stimulate the process from idea to commercial product. These kinds of investments are often made via enterprise departments or various types of development companies. In other cases, the municipality has a role as a market party that needs to develop new societal services. Different types of horizontal expert functions such as management, governance, communication, economy, digitalisation, and staff departments can constitute possible target groups for innovation investments in the public sector. Different types of innovation support work and projects can currently be found in municipal organisations, where focus shifts between operationally internal innovations and innovations with a view to commercialise. These types of investments are normally financed by municipal means in combination with external means.

Another part of the municipalities' innovation support work is providing attractive environments for innovation. Direct needs such as physical locations with associated infrastructure are part of this support, but more indirect influencing factors such as residential environments, societal services, brokerage and networking are also important success factors that the municipalities can contribute.

In order to facilitate and increase understanding between parties and stakeholders in the region's innovation support systems, the innovation term needs to be translated and described in relation to the public sector's different roles and societal tasks. We need to ask ourselves what types of innovations might be found in the public sector, but not in the private sector. The public sector should weigh a number of values against each other in order to fulfil its mission. In their book 'Administrative Policy,' writers Pettersson and Söderlund point to the tension between the rule of law, democracy, and the efficiency of the public sector. They note that these three cornerstones, which are supposed to support each other, are in actual fact incompatible[27]. If you are doing something in the public sector, you can't do it as efficiently as possible, as you constantly have to consider the rule of law and democracy. Thus, there is always a conflict in the system. An employee who exercises public authority may experience that innovativeness contradicts the requirement for rule of law.

The political system creates conditions for the innovation system on a local, regional, and national level, and – to an extent – on an international level.

Civil Society

Civil society was launched in Sweden at the beginning of the 90s, partly as a definition of a particular societal sector in addition to state, trade and industry, and households, and partly as an independent arena for participatory democracy processes[28]. The most formalised term for such collaboration is certain specific forms of organisations as non-profit

27 Pettersson, O. & Söderlund, D. (1993), Förvaltningspolitik. Stockholm

28 SOU 1999:84, Wijkström & af Malmborg 2005.

organisations, trusts benefitting the public, and registered religious bodies. A joint term for these is idea-based organisations or civil-societal organisations. Economic associations, social enterprises and cooperative operations, such as user, staff and consumer cooperatives, tend to be included as well, while they can also be considered to be part of trade and industry. Stock companies with special profit distribution limits are sometimes included[29]. Lately, so-called work integration social enterprises, which are run with the purpose of creating financial gains while facilitating work training and employment opportunities for people who struggle to gain or keep employment, have garnered a lot of attention[30]. Within the area of social innovation, the main focus is on finding innovative solutions to societal problems that are relevant to a lot of people. This does not necessarily mean that the innovations lack impact, but that isn't the primary goal.

The terms idea-based and non-profit indicate that civil society is not just seen as a separate organisation in addition to the state and trade and industry, but that it is considered to be based on driving forces that are neither political nor commercial. Idea-based refers to operations that are run based on a particular ideology, belief or vision, and that are independent of the state and (traditional) trade and industry[31].

Non-profit operations can either be completely free from profits, or create profits that are used for non-profit purposes. Few organisations are completely non-profit in the sense that they don't have any financial turnover whatsoever. Non-profit operations actually turn over significant sums every year, and contribute to municipalities' and the state's tax income through purchases, sales, paying wages, etc. Operations that are run as economic associations especially generate financial turnover and profits, but often reinvest them in the operation instead of distributing profits to its owners, as a matter of principle. Through their operations, non-profit and idea-based operations contribute to what is normally called the socio-economy, in which public benefit or member benefit is placed ahead of any interest in profits, and where operations are run independently of the state and trade and industry[32].

Based on the above approaches, civil society can be seen as a societal sphere that is, in part, characterised by certain forms of organisation (non-profit organisations, economic associations, trusts benefitting the public, registered religious bodies, etc.), and in part by visions and practices (idea-based and non-profit)[33]. At the same time, warnings have been issued that the term civil society creates an illusion of a cohesive sector, when it is actually made up of a number of different organisations, agendas and strategies that don't necessarily have anything in common other than not being part of the state or trade and industry[34].

Creating Sustainable Development for the Region

Welfare development is increasingly dependent on there being an ability to deliver and utilise innovations. Mobility and change, positive or negative, happen quickly. Innovation leads to growth, which leads to welfare – a development taking place at the cost of regions or countries that are needed in areas like climate change, which is one of the greatest challenges of our time. At the same time, environment, climate and energy challenges can be driving forces for technology, goods and service development in all industries. Society must be able to utilise the growth potential of a growing global demand for green and resource-efficient solutions in a better way.

29 Lilja & Åberg 2012, SOU 2016:13.

30 http://sofisam.se/vad-ar-sociala-foretag.html

31 SOU 1999:84, SOU 2016:13, Överenskommelsen 2010.

32 Gawell m.fl. 2009, Proposition 2009/10:55, SOU 1999:84, Överenskommelsen 2009, 2016.

33 Lilja & Åberg 2012.

34 Överenskommelsen 2010.

One of the prerequisites for developing innovation environments is that research is strengthened, which increases opportunities for the development of strategically vital areas for trade and industry and the public sector, and that research results are turned into goods and services, which, in turn, are realised, commercialised, or benefit citizens. To achieve this, goals and strategies need to be developed based on a transborder and trans-sector collaboration.

One way of doing this is to improve the quality of education, strengthen research measures, promote innovation and knowledge transfer, utilise information and communication technology fully, and ensure that innovative ideas can be turned into new goods, services and employment opportunities in technology and natural science as well as in social science, the humanities, and art.

Challenges in the shape of competence supply and digitalisation, for instance, will remain for a long time. Innovation is the key to the changes that will contribute to a sustainable development that is able to meet these challenges. The purpose is to create a resilient region, i.e. building a society with the ability to quickly overcome and recover from difficulties. It's largely about developing robust functions and processes that can form a basis for the creation of a strong region[35].

Requirements for building a resilient region:

- A strong regional innovation system.
- Conditions for creating a learning region.
- Modern and productive infrastructure.
- Educated and creative citizens.
- Access to investments and capital.
- A diversified financial base that is not dependent on any one industry.

35 There is also a connection to resilience in Nassim Nicholas Taleb's term 'antifragile'. Taleb introduces his book as follows: 'Some things benefit from shocks; they thrive and grow when exposed to volatility, randomness, disorder, and stressors, and love adventure, risk, and uncertainty. Yet, in spite of the ubiquity of the phenomenon, there is no word for the exact opposite of fragile. Let us call it antifragile. Antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the antifragile gets better.' The bottom line of Taleb's book is that everything can fall into three categories: the fragile, the robust, and the antifragile. The fragile state is marked by being negatively affected by disturbances. The robust is that which is not affected by disturbances, and the antifragile is that which grows stronger and more creative with each challenge..

Development in Norrbotten During a Transformational Century

Norrbotten's industrial development can be divided into two phases; a first phase extending from the end of the 19th century up to the 1960s, and a second phase stretching from the 1960s and into our time. The first phase was initially characterised by great investments into the most modern technology of the time in the areas of railway, mining, military operations, and – last but not least – energy. To put it in more concrete terms; the construction of the Iron Ore Line (the Luleå – Gällivare section was completed in 1888, and the Gällivare – Kiruna – Riksgränsen stretch was opened in 1903), large-scale ore mining in both Malmberget and Kiruna, the construction of Boden Fortress (begun in 1901), and finally the construction of Porjus power station (opened in 1915). Add investments in sawmills and facilities such as Karlshäll's wood sanding plant in Luleå, and the sulphate pulp factory in Karlsborg outside Kalix[36]. n image of teeming activity was blazoned across the country in newspaper articles and books, and epithets such as 'an America within Sweden's borders,' 'land of the future,' and 'land of the sleeping millions' abounded in the often lyrical stories of what was going on up north. In conjunction with high birth rates and a strong decrease in child mortality rates, the industrial investments contributed to the region having the quickest population growth in the country long into the 20th century[37].

Investments were expected to initiate strong industrial development in the region, not least because of the fact that it was – at the time of the construction of the power plant in Porjus – impossible to transfer electricity over longer distances. The long transfer restrictions were both technical and financial in character, and meant that industries that wanted to use electricity had to choose a locale close to a power plant. The furthest transfer planned for the Porjus power plant was to the Norrbotten coast. For this reason, the fact that the Porjus power plant – Sweden's second biggest power plant at the time – was going to be a veritable Norrbotten magnet for industries appeared indisputable at the time[38]. So, were the high expectations of these investments' effect on Norrbotten's future business and society met? The answer is both yes and no.

It's yes insofar as the investments that were made led to the emergence of large employers in a number of places in the region; employers that directly and indirectly provided – and in some cases still provide – employment to many thousands of people. It's also yes insofar as the investments led or contributed to the establishment of many important secondary industries, such as the Swedish State Railways' workshops in Boden, Luleå and Kiruna, as well as companies like Kiruna Truck and Norrbotten's Iron Works (NJA). It's yes again as these investments built the foundation for the growth and development of towns like Kiruna, Boden, Gällivare and Luleå. But it's also no, since no more significant industrial undergrowth appeared beneath the big companies until the mid-1900s. As late as in 1950, no more than 20.0 per cent of those employed were in the mining and industry sectors. The same figure for the country was 32.6 per cent[39].

The region's own inherent power hadn't been developed enough to utilise the opportunities that the externally governed investments in modern technology had offered. Nor was the region attractive enough to encourage external parties to

36 Hansson, S., 1994, 1998 and 1999.

37 Sörlin, S, 1988 och Norrbotten framåt 2015.

38 Hansson, S., 1994.

39 BD 80. Länsutredning för Norrbottens län.

invest in anything other than raw materials. The explanations for this are many, and the people of Norrbotten can recognise them even in our time. Thus, they also become a confirmation of history living on in new generations, and show that those living in the county would be wise to familiarise themselves with their historical heritage. By learning our strengths and weaknesses, we should increase our chances in fighting and utilising them respectively.

One weakness was shortcomings in the oh-so important area of communications, which is crucial for all types of development. Road connections were lacking, and when it came to seafaring, there could be six month-long stoppages. High freight prices on the railway were also part of the problem, especially the so-called value tariff, with high transport costs for added value products and more valuable goods. It is obvious that this had a damaging effect on Norrbotten businesses' ability to compete with industries that were more centrally located in relation to the markets[40].

Lacking communications and an extremely weak industrial tradition meant that it was very difficult to get local trade and industry going. There was a clear weakness in the knowledge area, in the deficiencies of the school system and associated shortcomings in terms of vocational training and technological and commercial speciality training[41]. A further aggravating circumstance was the lack of capital, which in turn meant that the county grew dependent on external capital owners. In addition, many people owning resources in the north lived in southern or central Sweden, and paid tax there. A further difficulty was the distance to bigger markets which made it hard to determine what demand looked like. It was an obstacle to getting up-to-date news, and made it nigh on impossible to establish new networks or to enter existing networks whose advantages could aid development.

There is no doubt that this is an extremely significant phase of Norrbotten's history. With the emergence of the big employers in basic industries, an industrial structure was established, which came to characterise the region's social and industrial life, and thus also what could be called people's mental map, all the way to our time. The industrial structure that was established came to be extremely focussed on export, very sensitive to market fluctuations, and consisted mainly of businesses that manufactured products with little added value. The businesses that came to be the central nodes of this structure became extremely dominant in the towns where they were built[42].

The Second Phase – Stagnating Population Development and Troubling Unemployment but Many Concurrent Positives

One of the things that happened in the 1960s was that the number of people employed in agriculture and forestry continued to decrease from just over 30,000 in 1950 to just over 9,000 in 1970, and that industry was faced with demands for more rational and less labour-intensive manufacturing processes. For Norrbotten, this meant that the number of people employed in the industry sector decreased by 2,000 in 1960 – 1965 alone. Add to this a decrease in the construction and facilities sector of just over 1,000 jobs. The consequence was a great wave of people leaving the county. In the 1960s, the number of people lost to moving was around 30,000. Another repercussion was steeply rising unemployment. It was in this context that the state's localisation support was conceived in July 1965. The support would primarily go to the northern support area which included all of Norrbotten County. As a result of the state's localisation support, and other regional policy measures, it is estimated that the region was afforded around 4,900 employment opportunities from 1965 to 1974[43].

The thing that characterises the image of the 1970s more than anything else is Steelworks 80. This was a project that, when everything was completed, was to increase the number of people employed at ironworks by 2,300. It was believed that Luleå would see a strong population increase, and that the population in 1985 would be 96,500 people, an increase of 30,000 people. Two and a half years after parliament approved the project on the 28th of May 1974, it was

40 Norrlandskommitténs principbetänkande. Norrländska utvecklingslinjer. Första delen. SOU 1949:1.

41 See Hansson, S., 1994 and 1999, and Malm, G., 1963, for instance.

42 See Liljenäs, I., 1986, for instance.

43 Länsprogram 1974 och BD 80. Länsutredning för Norrbottens län.

cancelled. Formally, the cancellation decision came on the 20th of October 1976 from a unanimous NJA committee. The county's dream of salvation was lost at a point when the County Administrative Board saw a need for 16,000 new employment opportunities to reach a balanced development[44].

Instead of thousands of new employment opportunities, the county saw the mining, steel manufacturing, and forestry industries experience their deepest dips of the post-war era. The business structure, established in the strong investment years around the turn of the 19th/20th century, and very sensitive to market fluctuations, now showed how vulnerable it was. The recession hit hard with great unemployment as a consequence.

The sector that had the most positive development during this time was the service sector, with an increase in the number of employees from 38,800 in 1975 to 52,300 in 1980. The lion's share of the increase definitely came from the public sector, where the number of employees rose by 11,000. In total, that meant that 33 per cent of the region's labour force was working in the public sector in 1980. The share of people working in mines and industry in the same year was 22 per cent, which was a decrease of 3 per cent compared to 1975[45]. In spite of increased employment in the service sector, however, unemployment was high at the beginning of the 1980s, and the difficult situation the county found itself in led the government to put forward a bill including proposed measures to strengthen employment in Norrbotten County to parliament on the 3rd of March 1983. The proposed measures were estimated to cost 4,000 million SEK[46].

It is fair to say that the difficulties that the county ended up with were largely connected to structural problems that were established as early as at the turn of the 19th/20th century. Norrbotten's production structure was still heavily anchored in heavy raw materials-based industry characterised by a low degree of added value, and great sensitivity to market fluctuations. County Programme 80 noted that the dependency on the big basic businesses had been an obstacle to the county's development. Strong criticism was aimed at State Company Ltd for not having developed the degree of added value at their facilities in the county.

Disadvantages Turned into Advantages

Global development in the last decades of the 20th century has been characterised by an accentuation of previously noticeable tendencies, with globalisation, a new international division of labour, a changed role for nation states, and deregulations as the most prominent features. All under strong influence from developments in the area of information and communication technology. For Norrbotten, this has meant, among other things, exposure to increased competition, but also increased need for self-sufficiency. In the 1985-2002 period, the county lost around 24,000 employment opportunities. Hard-line rationalisations in basic industry as well as cutbacks in defence spending are important explanations for this decrease.

Following the crises, and influenced by new political realities, a strong desire to deal with problems more actively on a local level has successively grown, though so far with relatively meek results. Dependency on individual, dominant businesses is still great, even if it has decreased in towns like Luleå, Kiruna and Gällivare. The public sector is still very significant for employment in the county. In the year 2000, the state, municipalities and the county council provided 42 per cent of total employment. The national average figure was 31 per cent. Now, the public sector is something of a crisis-stricken industry, and requirements to save and cut back are constantly recurring. It's a situation that constitutes a difficult balancing act between the need to reduce costs and maintaining high quality in operations such as schools, health care, and other care.

44 Hansson, S., 1987.

45 Fakta om Norrbotten 1975 och 1980.

46 Utveckling i Norrbotten. Regeringens proposition 1982/83:120.

How these issues are handled becomes particularly important as towns with reduced services also become less attractive. It's now important for municipalities to look at their reputation when it comes to aspects as varied as attractive homes, multifaceted culture, good schools, and interesting and meaningful leisure activities, etc.[47].

All this must not be allowed to cloud the fact that there are also many positive and hopeful parts in Norrbotten's trade and industry, however. Investments in the ice hotel in Jukkasjärvi, Treehotel in Harads, and the growing interest in different types of testing operations for the car industry have given us the insight that geographical location and a harsh climate don't necessarily have to constitute obstacles to positive developments in the long term. Businesses such as LIKO, Polar Bread, Älvsby Homes, Grönlund's Organ Factory, and Ferruform are inspiring examples of successful businesses being built in the county. Another new and very interesting event, appearing in this later phase, is the development that has led Kiruna to have a prominent role in international space research and space operations. Nor must we forget that traditional, big businesses like LKAB and SSAB have gone through significant changes in a positive direction in the final stages of the 20th century. LKAB rose out of the biggest crisis in its history in the mid-1980s, and has developed into a high-tech business that now adds value to its products on a completely different level than before, when the ore was only crushed before being sold..

A further positive is that there is, since 1971, access to higher education and research in the county. This has led to a strong increase in the number of highly educated people, and a flow of knowledge that has generated both new businesses and more competitive businesses. From a county perspective, it is satisfying that the people of Norrbotten have taken a considerable step up in the table of how large a share of the population begin studies at university before the age of 25. At the end of the 1980s, Norrbotten was in the bottom part, on place 17 out of 21. Now, Norrbotten is in 11th place. 19.2 per cent of young people under 25 went on to higher studies in 1987, while 40.4 per cent did so in 2001[48].

Seen over the long period we've looked at, it is undoubtably the case that the county has contributed to the development that Sweden has seen since the end of the 19th century, which places Sweden in the category of nations that have had the strongest growth in the world from 1870 to 1970. Contributions have come from the forest, ore, and hydropower. That the development has led to great gains for the county is indisputable. The exploitation of the county's natural resources has, in different ways, provided important contributions to the welfare Norrbotten enjoys today[49].

47 Nilsson, J-E, 1998.

48 Luleå University of Technology. Press release 01-03-2002.

49 Hansson, S., 2002.

Current Situation

Geography and Population

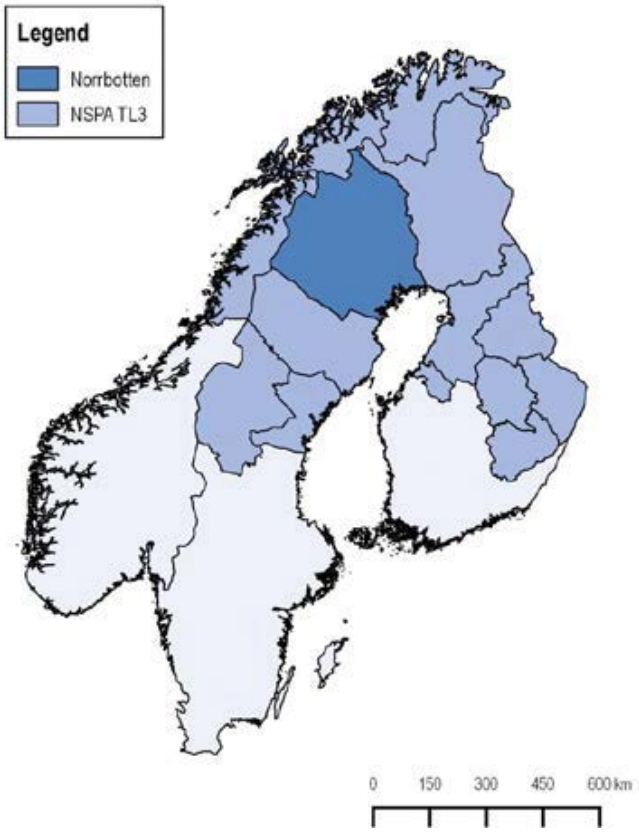

Figure 3: Norrbotten, placement in the NSPA. Source: OECD study NSPA.

In 2018, Norrbotten had 250,424 inhabitants, which is 2.5 per cent of Sweden's population. 2.5 per cent of the men and 2.4 per cent of the women of Sweden lived in the county at this point in time. The county is geographically large, and with its surface area of 97,257 square kilometres, it's larger than Hungary or Portugal. Norrbotten's population density is 2.6 inhabitants per square kilometre, compared to the national average of 24.2. Over the past ten years up until 2015, the population grew by an average of 0.08 per cent annually, compared to the national average of 0.85 per cent[50].

Around two thirds of the region's population are concentrated to the coastal areas, including the two biggest towns, Luleå and Piteå. Luleå is the region's administrative centre, and the biggest town with 76,088 inhabitants (2015), which is 30 per cent of the region's population. Piteå, the second biggest town, around 55 kilometres from Luleå, has 41,548

50 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas

inhabitants (2015). Luleå and Piteå are the only municipalities that have seen a population growth over the past two decades. Over the ten years leading up to 2015, Luleå grew by 0.45 per cent, almost half the national average at 0.85 per cent, compared to the rest of the region which saw a reduction of (-)0.30 per cent[51].

Historically, the region has been sparsely populated. Sami and Finnish peoples were dispersed throughout the area, and from the 17th century, Swedes moved in from the south. The Sami, Finnish and Swedish cultures are still important parts of social identity in Norrbotten. Luleå and Piteå became municipalities in the 17th century, and developed as port towns for trade vessels transporting minerals and timber. Forestry and mining have always been the region's historical strengths[52].

Today, Norrbotten is responsible for 90 per cent of iron ore production in Europe. Hydropower in the county provides around 13 per cent of the country's power.

Digitalisation

Digitalisation is one of the big transformational forces in Norrbotten, leading to traditional processes being streamlined, and a shift to new, computer-driven businesses with value propositions and business models. Digitalisation of society and the economy has been and is a contributing factor to the increasing pace of globalisation. It's important to note digitalisation's opportunities to reduce the significance of geography. For many companies, it brings great opportunities when it comes to reaching the international market. Some know-how that is relevant to the businesses is not limited by national borders, but is available on a global market.

Digitalisation leads to a structural transformation, the effects of which affects all Swedish regions. Physical products become digital services through 3D printers, and marginal costs for copying and distribution will change and be packaged differently to today[53].

The businesses of tomorrow have to be adaptable and quick on their feet, and it is extremely important that the businesses can work in functional networks with partners, research institutes, and small and large businesses from both their own industry and others. To attract talented employees, businesses must also be seen as creative, meaningful and sustainable, with a focus on both customers and employee value[54]. The public sector will be similarly affected.

Digitalisation of businesses will change their products, and create new business opportunities, but the public sector will also experience pressure to transform. Customers used to request products with simpler functions, but now, they want whole concepts that contain built-in, adaptable functions with more advanced services. In the future, we will see more and more products that connect to other products or services in order to deliver added value to users. If the manufacturing industry is to be able to deal with the increased demand for customer adaption, production has to be flexible and adaptable. Today, businesses need to be able to handle greater variations, with more models and fewer series manufactured in the same production system. With the help of digital solutions, production systems can handle much greater variation when it comes to the design of the product, and varying series sizes. Through increased flexibility and use of digital tools, businesses can manufacture individually adapted products at the same cost that they previously had for mass production of identical products. Flexibility is the key to success when customer requirements increase and become more complex[55]. This means that the businesses have to run their development in an agilt[56] way. That means

51 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas.

52 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas.

53 Anna Breman och Anna Felländer, Diginomics – nya ekonomiska drivkrafter.

54 Svenska företags syn på din digitalisering. En enkät inom Sverige Digitaliserar! Genomförd i samarbete med Roland Berger, Teknikföretagen och Swedish Medtech.

55 Digitaliseringens betydelse för industrins förnyelse. En rapport från Teknikföretagen.

56 Agile means easy to move..

being in continuous conversation with the customer throughout the development process, and includes each incremental delivery being evaluated.

Digitalisation means that increased data storage is a must. According to several reports, the amount of data in the world is growing exponentially. If we estimate the amount of data and consider technological development as it concerns energy usage, the data centre industry will double in size until 2020. A rough estimation is that around 200 new mega data centres will need to be built in Europe between 2014 and 2020[57].

Report *Digitalisation and Business* describes how Norrbotten's trade and industry views digitalisation. The report shows that business leaders spend around 20 hours per week in front of their computer, as well as around five hours per week with their mobile phone with activities other than calling. According to the report, an average of 66 per cent of the employees of the operations can use computers and common software without problems, but at the same time, 33 per cent of the businesses say that they have problems dealing with computers and common software. Eleven per cent of the businesses state that there is nobody within their operations that can use computers and common software[58].

A relatively large proportion of businesses state, according to the report, that they see a potential for innovation and business development in digitalisation. 60 per cent of business leaders said that digitalisation can lead to new or improved goods and services. A slightly smaller number, between 40 and 50 per cent, said that digitalisation could be central to the development of new markets and marketing and sales methods. When it comes to distribution channels and new management and organisational methods, around 30 per cent of businesses could see potential in digitalisation[59].

Business leaders saw the biggest potential in their operations' customer management and relationships with customers. For these, two thirds saw digitalisation as potentially significant. When it came to designing operations' value proposition and production, such as key activities and key resources, too, almost 60 per cent of those asked felt that digitalisation could contribute[60]. There is still a large group of businesses that don't see any opportunities coming from digitalisation.

Competence Supply

Access to labour with the relevant competence is a prerequisite for the development of trade and industry and public operations. Challenges include the need to improve matching between supply and demand of labour, creating inclusive growth for all groups, and meeting demographic developments with an aging population as well as urbanisation. The development could, in the long term, lead to increased lack of labour in certain sectors and regions. In order for operations that are currently run across the region to have conditions under which they can continue to operate, we have to meet this challenge. Quick changes in the labour market with increased requirements for both general and specific competencies also mean that those who have not completed upper secondary school risk struggling more in the labour market[61].

According to the latest prognoses, the number of Europeans aged over 65 will have increased by 25 million people by 2030, which will be a great challenge for authorities, decision makers, businesses and non-profit organisations. Costs for health care in the EU are expected to have increased by an average of one to two per cent of GDP by 2060. At the same time, the European Commission expects that there will be a shortage of two million health care staff in the EU by 2020. In Norrbotten, this trend is already noticeable. Today, 23.2 per cent of the county's population is aged over 65,

57 Strategi för att skapa en världsledande teknikregion i Norrbotten för klimatsmarta effektiva datacenter..

58 Örtqvist Daniel, Digitaliseringen och näringslivet, 2017, Luleå tekniska universitet.

59 Örtqvist Daniel, Digitaliseringen och näringslivet, 2017, Luleå tekniska universitet.

60 Örtqvist Daniel, Digitaliseringen och näringslivet, 2017, Luleå tekniska universitet.

61 Svenska framtidsutmaningar – Slutrapport från regeringens framtidskommission, Ds 2013:19.

a level that EU on the whole is not expected to reach until 2030, and Sweden not until 2050. In 40 years, no less than 30 per cent of the EU's population is expected to be over 65, but it's a reality that many smaller municipalities in Norrbotten are already experiencing[62].

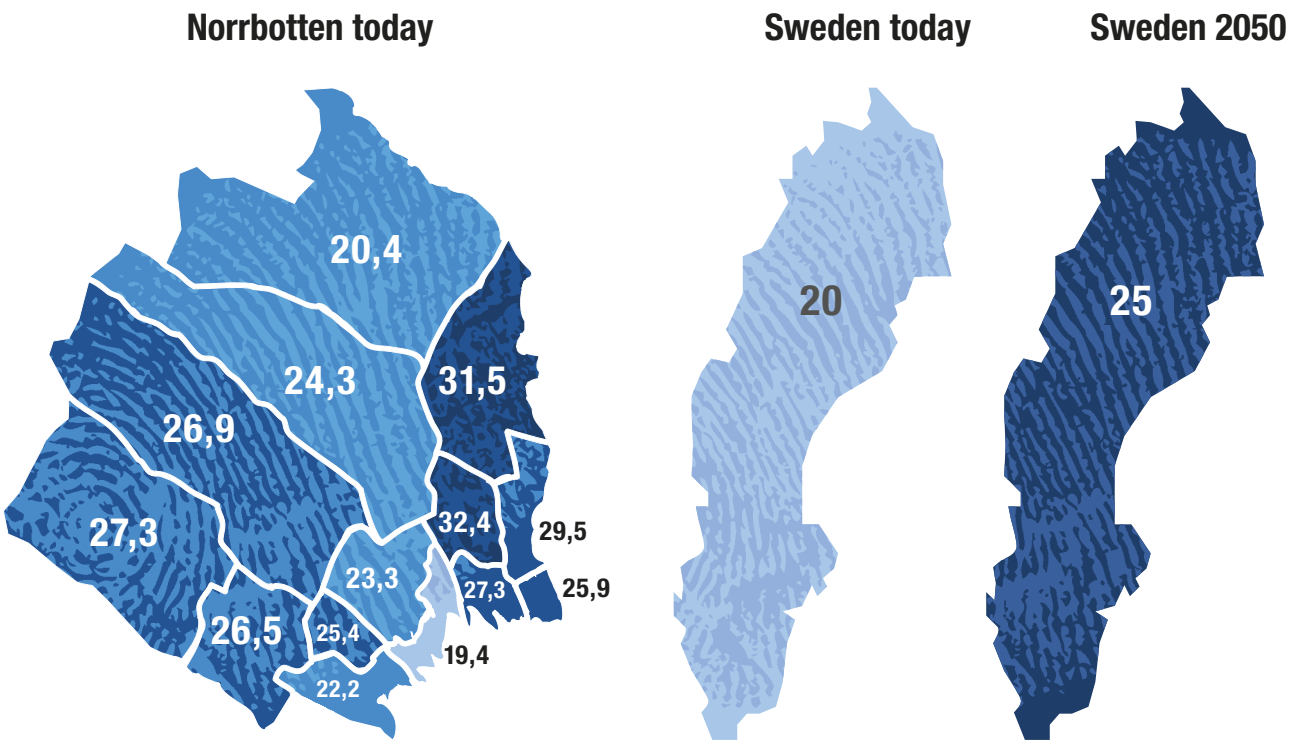

Figure 4: Proportion of elderly people in the population, over 65, today and in 2050.

Norrbotten and many other Swedish counties face a large-scale generational shift in the labour market. More than a third of the county's employed labour force in 2010 are expected to have retired by 2025, while the share of people who are able to work is expected to decrease. With limited access to labour, it will be increasingly important that those who enter the labour market have the competence that is in demand. Measures to utilise the labour resources that are now outside the labour market for different reasons are also required. To meet the demand for labour, we will probably need more people to move in, if development continues as it has in the early 21st century. The figure below shows how retirements in the county are expected to be distributed across different industries until 2025, based on an expected retirement age of 65[63].

62 Svenska framtidsutmaningar – Slutrapport från regeringens framtidskommission, Ds 2013:19.

63 Ejdemo Thomas och Parding Karolina (2018) Kompetensförsörjningsanalys Norrbotten - med sikte på 2030: rekryteringsbehov, rekryteringsproblem och lösningsförslag, Luleå tekniska universitet.

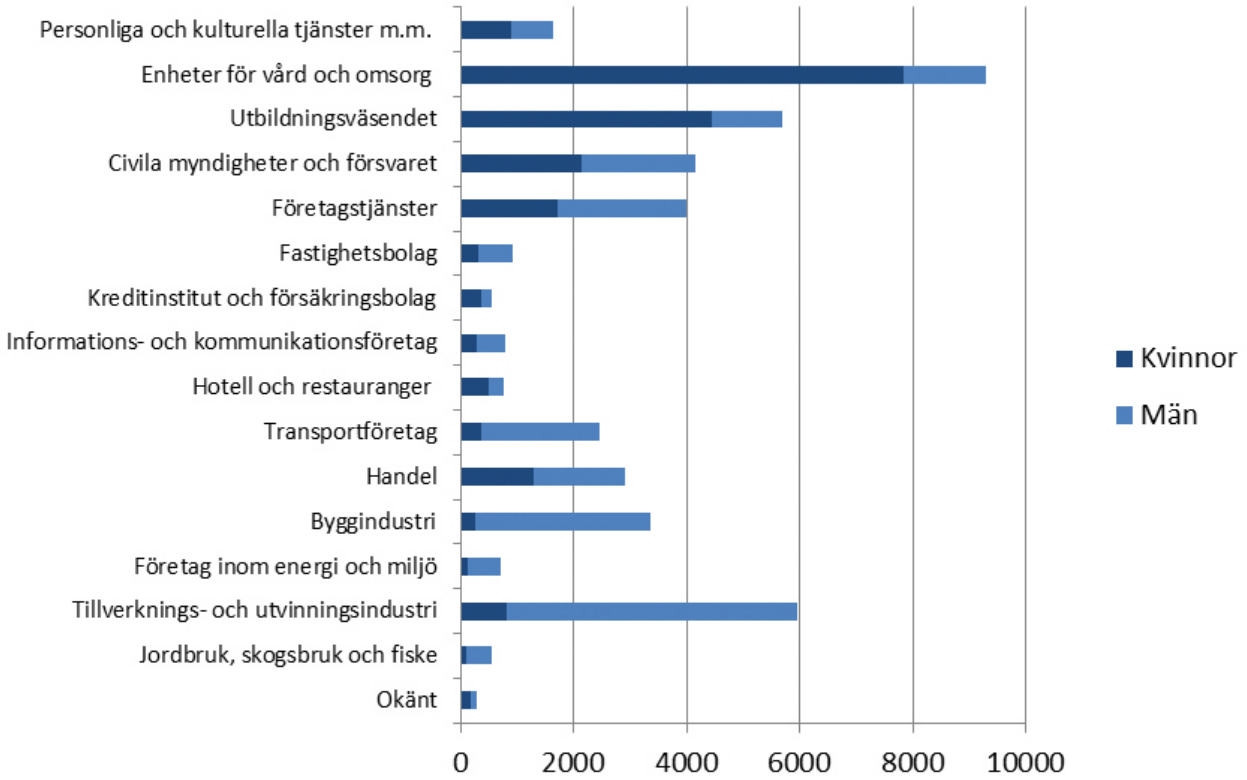

Figure 5: Expected retirements per industry, 2010 to 2030.

To shine a light on the recruitment challenges facing Norrbotten, the report includes calculations of expected retirements as a share of employees per respective industry in 2015. This is illustrated in the figure above. Industries with high levels of retirement are:

- Health care and other care – 42 per cent
- education – 49 per cent
- civil authorities and the armed forces – 43 per cent
- manufacture and quarrying – 39 per cent[64].

In some industries, around 40 per cent or more of those who were employed in 2010 are expected to have retired by 2025, which means that even if employment were to go down somewhat during this period, there would still be an extensive generational shift, requiring a functional competence supply in order to avoid recruitment problems. The recruitment requirement shows how many employments are expected to take place until 2025. The collective recruitment requirement until 2025 is shown in the figure below[65].

64 Ejdemo Thomas och Parding Karolina (2018) Kompetensförsörjningsanalys Norrbotten - med sikte på 2030: rekryteringsbehov, rekryteringsproblem och lösningsförslag, Luleå tekniska universitet.

65 41 000 anställningar till och med 2025. En studie av rekryteringsbehovet i Norrbottens län, Thomas Ejdemo och Nils-Gustav Lundgren, Luleå tekniska universitet.

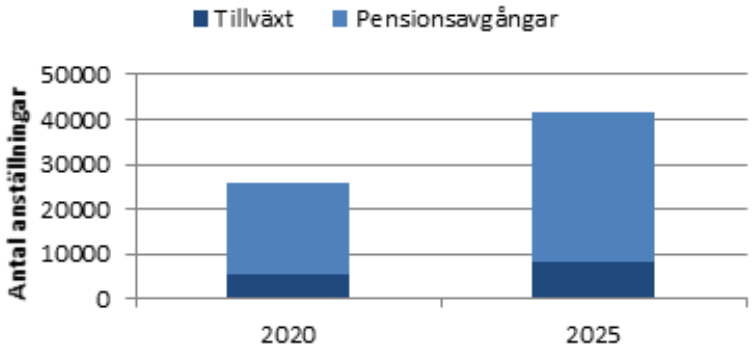

Figure 6: Expected recruitment requirement in Norrbotten until 2030 with a closer look at 2020.

The total recruitment requirement is expected to reach 26,000 employments by 2020, and 41,000 employments by 2025. The recruitment requirement is mostly made up of vacancies resulting from retirements[66]. All industries in Norrbotten are expected to see a recruitment requirement by 2025. The labour market is constantly changing, but one general trend is that the qualification level is increasing, which indicates a shift in competence. New professions may appear during the period, while some of the professions that are part of today's statistics could disappear completely. A further factor of competence supply is accelerating urbanisation – regionally, nationally, within the EU, and globally. It means that an increasing number of elderly people remain in sparsely populated areas, with worsening public and private local services[67].

Climate Change

Climate change is one of humanity's biggest challenges. Global, national, regional and local measures are required to limit greenhouse gas emissions, and adapt society to a changed climate. The overall goal for climate policy, the so-called generational goal, and the UN's 17 sustainable development goals, which Swedish parliament has adopted, require ambitious environmental policy in Sweden on a national, regional and local level. Parliament's ambition is that Sweden should be a leader in work with reaching sustainable development internationally. In connection with the Climate Bill[68] parliament accepted the government's assessments, including the vision that Sweden shouldn't have any net emissions of greenhouse gases in 2045. The ambitious goals for Swedish policy on climate, environment and energy require active and long-term work, not least on a regional and municipal level. This is important for regional growth that is sustainable in the long term..

Measurements show that since the beginning of the 20th century, the average temperature has increased by around 0.9 degrees until today. It's not just the air that is warmer; world oceans are getting warmer, and the world's ice is melting[69]. The atmosphere's carbon dioxide content has increased by over 35 per cent since the mid-1800s. This development has taken place while humanity's use of coal, oil, natural gas, diesel and petrol has successively increased. In the middle of the 19th century, it became common to burn coal to heat up homes and provide industries with energy. Soon thereafter, petrol-driven cars appeared, and we started to heat up homes and buildings using oil. Since then, more and more of us use cars and products made with the help of fossil fuels[70].

66 41 000 anställningar till och med 2025. En studie av rekryteringsbehovet i Norrbottens län, Thomas Ejdemo och Nils-Gustav Lundgren, Luleå tekniska universitet.

67 Lindblad Sverker, Tynelius Ulf, Danell Torbjörn, Pichler Wolfgang och Anderstig Christer SOU 2015:101 Demografins regionala utmaningar, Statskontoret.

68 Prop. 2008/09:162.

69 http://www.naturvardsverket.se/Sa-mar-miljon/Klimat-och-luft/Klimat/

70 ttps://www.naturvardsverket.se/Documents/publikationer/978-91-620-8368-7.pdf


1 INGEN FATTIGDOM
2 INGEN HUNGER
3 GOD HÄLSA OCH VÄLBEFINNANDE
4 GOD UTBILDNING FÖR ALLA
5 JÄMSTÄLLDHET
6 RENT VATTEN OCH SANITET FÖR ALLA
7 HÅLLBAR ENERGI FÖR ALLA
8 ANSTÄNDIGA ARBETSVILLKOR OCH EKONOMISK TILLVÄXT
9 HÅLLBAR INDUSTRI, INNOVATIONER OCH INFRASTRUKTUR
10 MINSKAD OJÄMLIKHET
11 HÅLLBARA STÄDER OCH SAMHÄLLEN
12 HÅLLBAR KONSUMTION OCH PRODUKTION
13 BEKÄMPA KLIMATFÖRÄNDRINGARNA
14 HAV OCH MARINA RESURSER
15 EKOSYSTEM OCH BIOLOGISK MÅNGFALD
16 FREDLIGA OCH INKLUDERANDE SAMHÄLLEN
17 GENOMFÖRANDE OCH PARTNERSKAP
GLOBALA MÅLEN
för hållbar utveckling

In Norrbotten, the industry and energy sectors are responsible for the biggest emissions. The transport sector is increasing its emissions the most, and this applies especially to road transports[71].

Basic industries in the county are very energy-intensive compared to other Swedish industries, and are responsible for no less than 75 per cent of Norrbotten's total energy usage. Households and transports use around nine per cent each, while the service sector, public operations and other services use up a far smaller share; six per cent. Agriculture, forestry and fishing are responsible for a marginal share of the county's energy usage; 0.4 per cent[72].

There are differences between men and women in the energy area. Single women use around 20 per cent less energy than single men. When making generational comparisons, it's clear that the difference between the genders remains among young people. It appears that when men are to save energy, they do so through technical improvements like insulation, changing windows and choice of heating, while women's energy saving measures are behavioural[73, 74].

The Industry of the Future[75] report describes how industry went from a linear economy to a circular one with high levels of recycling at the beginning of the 21st century. An example of this is the paper industry. The degree of recycling in paper packaging is currently 72 per cent, compared to 44 per cent in 1990. The steel industry is estimated to recycle 90 per cent of all steel at present. The vehicle industry reports an even higher degree of recycling. The textile industry has the lowest degree of recycling, but there too, the degree of recycling is around 27 per cent[76]. Demand from customers drives development forward. Seven in ten businesses state that growing environmental demands from customers and end consumers will have a strong influence on the development of the industry[77].

Recycled materials will become increasingly significant for industry. For instance, mining operations in Norrbotten will still be here in 2030, but the ore's area of use will be different. Ore is expensive to quarry and add value to, and can't compete with recycled steel. Newly produced steel has instead become a luxury product, often made especially for specific purposes. Even expensive earth metals are recycled as much as possible. The forestry industry has taken a similar route. Its raw materials are used for a long line of products such as biocomposites, biofuel, textiles and fire-resistant building materials. A considerable share of material research in Sweden is focussed on the ability to extract as much value as possible from old materials so costs can be cut further, and the quality of Swedish products can be increased[78].

In Norrbotten County, greenhouse gas emissions have been reduced somewhat from 1990. The county's heavy industry is responsible for most of the emissions. There are environments in Norrbotten with heightened levels of pollutants, originating from both local and far away sources. Levels of certain substances decrease as a result of legislation. Other substances have become more common in the environment, or remained at the same level. In Norrbotten, four of the environment quality goals set by the County Administrative Board are thought to be almost reached by 2020. The other 13 goals will not be reached by 2020[79], see appendix 4.

71 Klimat- och energistrategi för Norrbottens län.

72 Klimat- och energistrategi för Norrbottens län.

73 Doerr, 1993, Buko, 1995, Schwartau-Schuldt, 1990, Roehr, 2001.

74 Klimat- och energistrategi för Norrbottens län.

75 Framtidens industri, vart vi är på väg och varför, SWERA.

76 Framtidens industri, vart vi är på väg och varför, SWERA.

77 Framtidens industri, vart vi är på väg och varför, SWERA.

78 Framtidens industri, vart vi är på väg och varför, SWERA.

79 https://www.miljomal.se/Miljomalen/Regionala/?t=Lan&l=25

Globalisation

Globalisation means that the significance of national borders is decreasing. Communication, trade, and access to other countries is increasing, and labour markets and economies are increasingly integrated. Globalisation has been ongoing for a long time, but over the past few years, it has picked up speed with digitalisation and quick technological developments. Globalisation contributes to increased world trade, capital flow, movement of people, dissemination of information, knowledge and technologies, as well as deregulation. Global financial competition increases adaptation pressure in the economy. At the same time, capital flows and investments, as well as trade, travel and migration, are growing. There is also more frequent exchange of information and technology[80].

As new international parties appear, the playing field is also changing for the businesses of Norrbotten. Globalisation creates increased accessibility to new imports and export markets, while the content of trade is constantly changing. Since 1993, trade with goods and services, export plus import, has increased from less than 60 per cent to over 100 per cent of GDP. This is a big increase. The fact that trade can actually comprise over 100 per cent of GDP is connected to export and import comprising values of sales, while the gross domestic product describes the total value added in the economy. The tendency for businesses to increasingly use foreign suppliers of input, and to increasingly supply foreign businesses with input is thus an explanation of the strong world trade growth that we have been seeing lately[81].

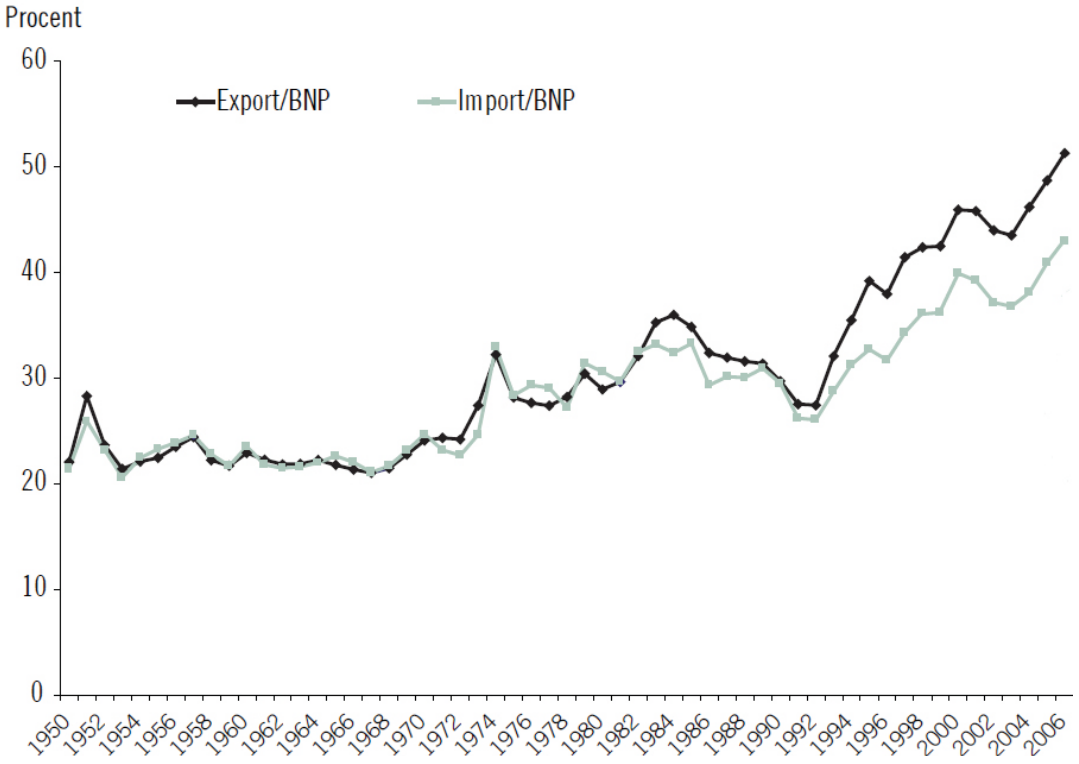

Figure 7: Sweden's export and import, and share of GDP 1950-2006.

The figure above shows development in the post-war era. It shows that there has been a significant increase in exportation since the beginning of the 1990s. In 2007, the exportation of goods constituted over 25 per cent of the world's total economy. To put that into perspective; the same figure in 1950 was only seven per cent, while it was 15 per cent in 1992. So, the world economy is dramatically more dependent on trade today than it was only a couple of decades ago[82].

80 Globaliseringens drivkrafter och samhällsekonomiska konsekvenser, 2008, Karolina Ekholm Stockholms universitet och SNS.

81 Globaliseringens drivkrafter och samhällsekonomiska konsekvenser, 2008, Karolina Ekholm Stockholms universitet och SNS

82 Kommerskollegium, Varför handlar vi med omvärlden?

Norrbotten is responsible for a significant contribution to goods exportation, not least through the rich natural resources in the shape of forest and ore, which also, to some extent, have value added to them in the county. Statistics from the Swedish Ministry for Foreign Affairs show that goods exportation from Norrbotten County in 2011 was almost at 42.7 billion SEK, which was around 3.9 per cent of total goods exportation from Sweden. Norrbotten was thus the sixth biggest export county, as shown in the figure below[83].

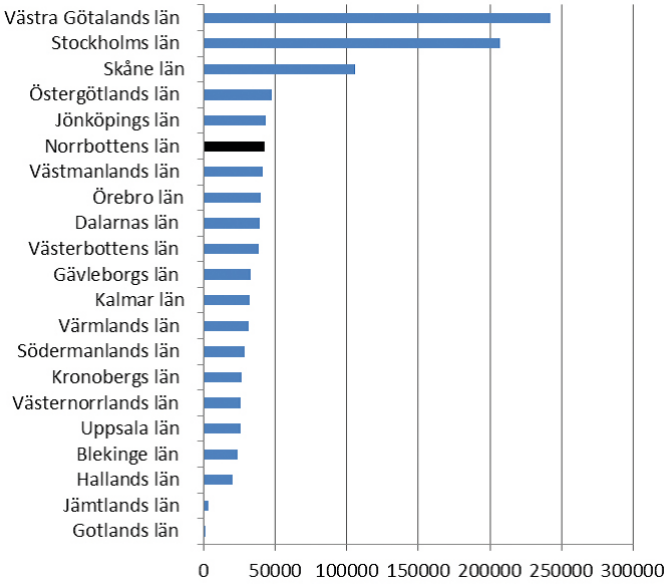

Figure 8: In 2011, Norrbotten was the sixth biggest export county in the country.

The figure below shows that Norrbotten has the highest goods export rate of all the counties.

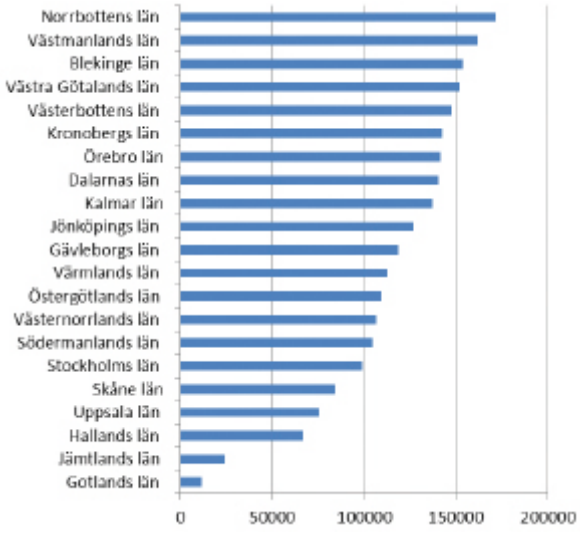

Figure 9: In 2011, Norrbotten had the highest goods export rate in the country, measured by SEK per inhabitant and year.

83 Ejdemo Tomas, Norrbottens roll i samhällsekonomin – En kritisk granskning av indikatorer samt några lärdomar för framtiden.

Compared both to the nation as a whole and to other counties, Norrbotten has a high gross regional product, and a particular emphasis on goods production. Goods production, which is dominated by the capital-intensive processing industry, is highly export-oriented, which explains the high export value[84].

Norrbotten's goods production was responsible for almost 42 per cent of the gross regional product (GRP) in 2011, while goods production in the nation was responsible for only 24 per cent of GDP.

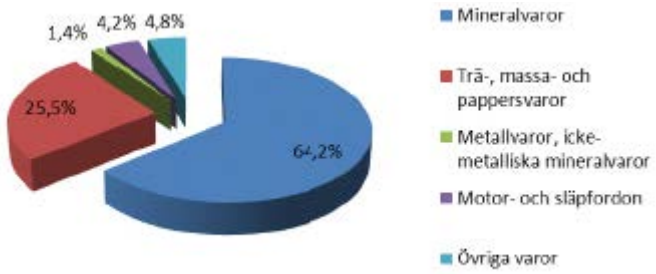

Figure 10: Norrbotten's biggest export products in 2013 (proportion of the county's total goods export).

The above figure shows a significant specialisation on raw materials in Norrbotten. We also note that Norrbotten has significant comparative advantages when it comes to goods production based on forest, ore and hydropower in particular. In the early 2000s, the mining industry in particular has seen good financial development with high ore prices, and as a result of this, the industry has put big investments into Malmfälten[85, 86] in order to increase production capacity. Historically, Norrbotten has been dominated by industries based around raw materials. During economic booms, the county's industries have been highly profitable, thanks to high prices, and big investments have been possible. These periods have been followed by financial downturns when the profitability of the mineral industry, which is sensitive to market fluctuations, has failed, and rationalisations have been necessary[87].

So what are the most important export products from Norrbotten according to the register-calculated trade statistics for each product group? This is shown in the figure above. As expected, it's mineral goods, i.e. the mining industry, which in 2013 was responsible for the biggest share with around 18.7 billion SEK, meaning no less than 64.2 per cent of Norrbotten's goods export value. The second product group that is particularly important is forestry products – i.e. various wood products, as well as pulp and paper products, which, when combined, were responsible for 25.5 per cent of the county's export value in 2013. In addition to these products, metal products and products from the 'motor and trailer vehicles' group were also important parts of the county's exports[88].

How large a share are SMEs responsible for, and what experience do these businesses have of exportation? Around 22 per cent of businesses in Sweden and Norrbotten have experience of exportation according to report Trade and Industry Development in the Northern Programme Area[89, 90]. The report shows that Norrbotten has a low share of SMEs that do not engage in exportation. 78 per cent have no experience of exporting their goods and services to other countries. This shows that SMEs are dependent on the local market as well as basic industry.

84 Ejdemo Tomas, Norrbottens roll i samhällsekonomin – En kritisk granskning av indikatorer samt några lärdomar för framtiden.

85 Ejdemo Tomas, Norrbottens roll i samhällsekonomin – En kritisk granskning av indikatorer samt några lärdomar för framtiden.

86 https://www.di.se/nyheter/nytt-liv-i-konkursad-gruva-i-pajala/

87 Lundgren, 2012.

88 Ejdemo Tomas, Norrbottens roll i samhällsekonomin – En kritisk granskning av indikatorer samt några lärdomar för framtiden.

89 Örtqvist Daniel, Näringslivsutveckling i Nordprogramområdet – En analys av tillväxtambitioner, samverkan och export.

90 According to an analysis of objective data from Swedish businesses, performed over the most recent financial year, these self-reported numbers may be somewhat exaggerated. According to register excerpts from Statistics Sweden, around 11 % of Swedish businesses in the region the investigation covered have experience of exportation from the most recent financial year. It is plausible that the number of exporting businesses that have chosen to respond is overrepresented, and it could also be that the respondents' given answers go back a bit further than the most recent financial year..

Figure 11: Proportion of small and medium-sized enterprises with experience of exportation.

What markets do SMEs have? Out of the businesses that responded to the questionnaire, three quarters have all their sales in Norrbotten. Almost a fifth have their sales in the rest of Sweden. Two to three per cent of the businesses' sales is on markets in the rest of Scandinavia, Europe and the world. Four per cent of the businesses state that they only have markets outside Norrbotten. 54 per cent of the businesses state that some share of their turnover comes from the rest of Sweden. 20 per cent of the businesses state that they have sales in the rest of Scandinavia. 14 per cent state that they have sales in the rest of Europe. Ten per cent of the businesses state that they have sales outside of Europe, see the below figure[91].

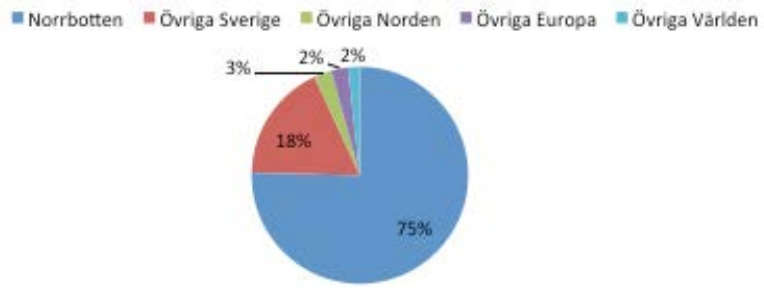

Figure 12: Proportion of small and medium-sized enterprises that have turnovers in different markets.

91 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv – En kartläggning av företagens styrkor, svagheter och utmaningar.

During the financial crisis of 2008 and 2009, there was a financial setback, most felt in 2009, which was followed by a very quick recovery to a new peak, see the below figure.

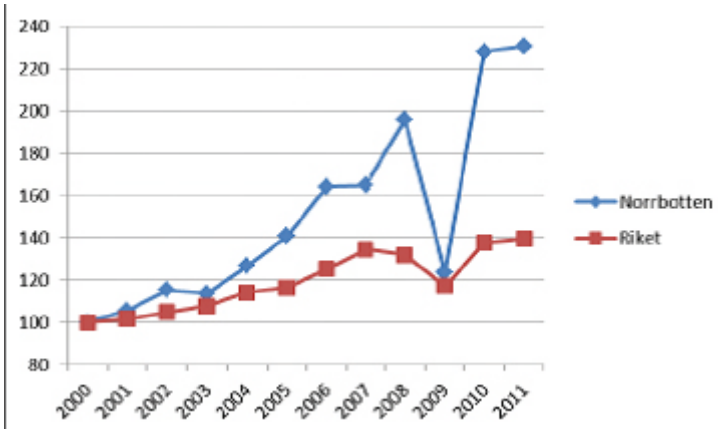

Figure 13: Goods exportation in the county and country in 2011 (million SEK). Source: Swedish Ministry for Foreign Affairs.

The underlying reasons for the big changes to the prices of raw materials can sometimes be found in a combination of income-sensitive demand for minerals, and a short-term supply of these raw materials that is not sensitive to price. Metals are sometimes used in the sectors of the economy that are particularly sensitive to financial changes, such as the car industry, but when demand for metals increases, it takes time before new capacity can be built to meet the higher prices[92].

92 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin - En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

Research and Innovation

The report *Regional Innovation Scoreboard* from the European Commission[93], fshows that Norrbotten and Västerbotten have developed into innovation leaders (see figure below) of a higher level following improvements that have taken place mainly in technical process and goods innovation, and collaborations between the private and public sectors.

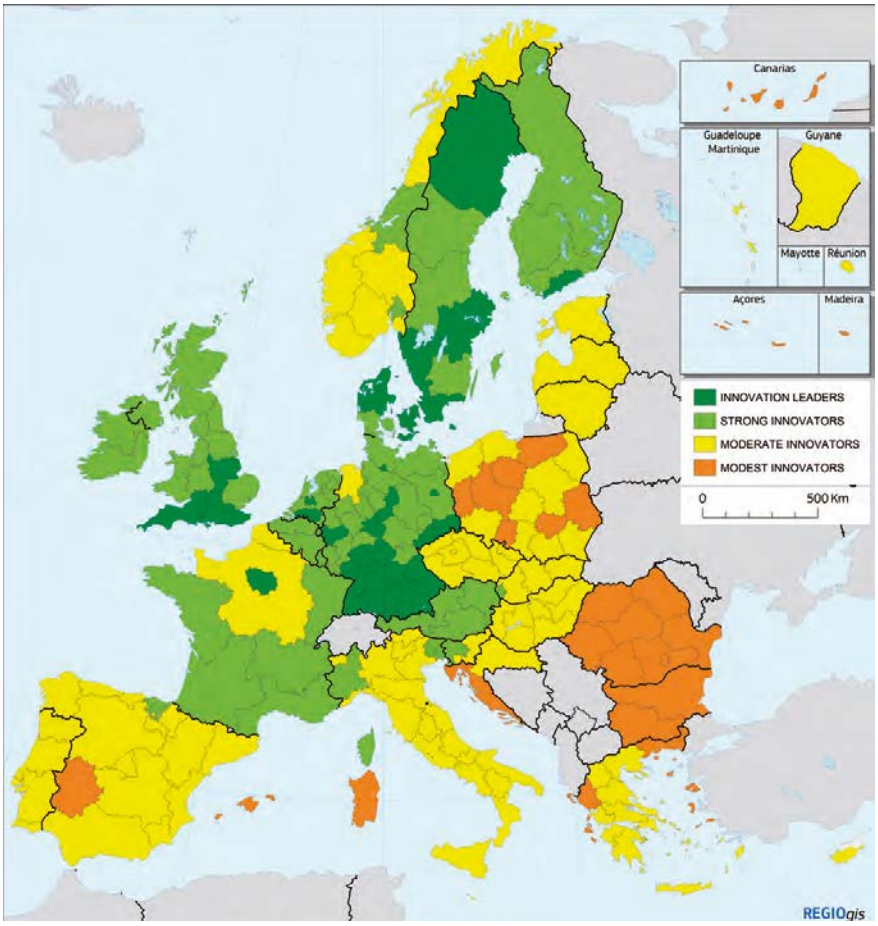

Figure 14: Categorisation of regions according to the Regional Innovation Scoreboard 2016 – innovation index.

In a European comparison, Norrbotten still has improvement opportunities when it comes to businesses' innovation ability, innovation collaboration, and businesses' investment in research and development. The region appears relatively weak in non-technical innovations. It is, however, successful when it comes to collaboration between the private and public sectors, the public sector's investments in research and development, and investments in innovations outside the research and development area[94].

There are strong education, research and innovation environments in Norrbotten. There is also good access to higher education with universities, vocational colleges and active research and development operations in a number of towns close to Norrbotten – Oulu, Tromsø, Skellefteå, Bodø and Rovaniemi[95]. The development of the past few years, with

93 Regional Innovation Scoreboard 2016;
https://publications.europa.eu/en/publication-detail/-/publication/693eaaba-de16-11e6-ad7c-01aa75ed71a1/language-en/format-PDF/source-31233711

94 Regional Innovation Scoreboard 2016;
https://publications.europa.eu/en/publication-detail/-/publication/693eaaba-de16-11e6-ad7c-01aa75ed71a1/language-en/format-PDF/source-31233711

95 University seats are in Oulu and Rovaniemi in Finland, Luleå and Umeå in Sweden, as well as Tromsø and Bodø in Norway. In addition, there is the Sami university, Sámi Allaskuvla/Sámi University College, which is located in Kautokeino in Norway. There are also Sami institutions in many universities in the northern area, such as Tromsø, Bodø, Umeå and Oulu, to mention a few.

several research centres and education institutions, has strengthened the region's competence in research and development. This has resulted in special competencies in areas such as Arctic technology, space technology, and mining and mineral technology. The share of industrial research and development in the region remains low, however. Norrbotten is close to three universities that are on the Shanghai Ranking list, meaning that they are ranked among the best universities in the world. This applies to Umeå, Oulu and Tromsø universities[96].

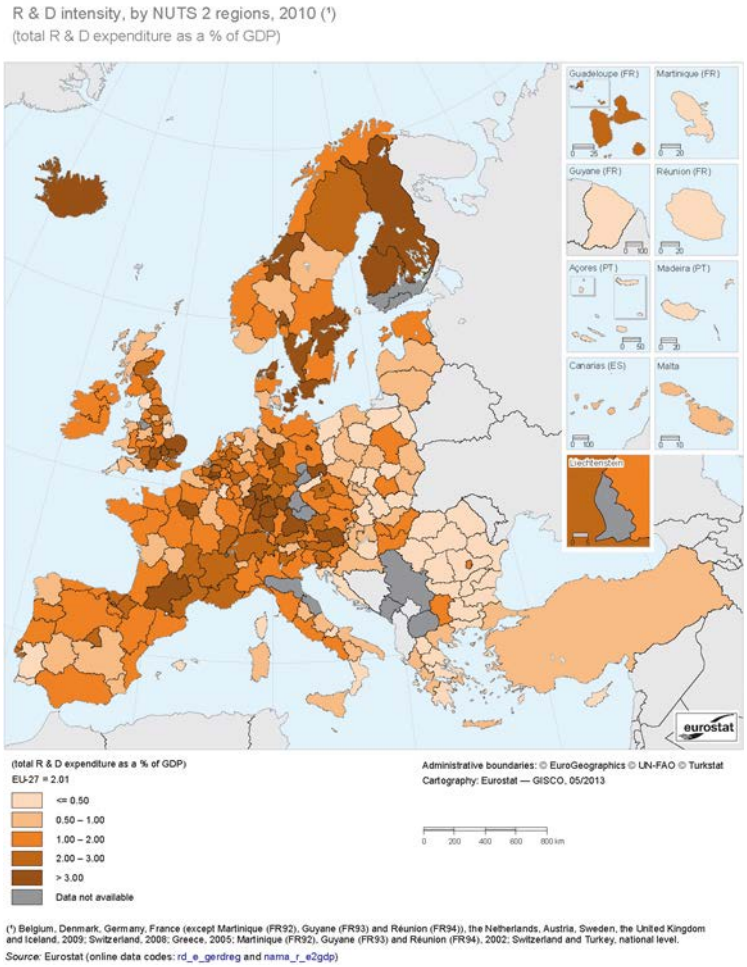

Figure 15: Research and development's share of GRP.

There are a number of small research environments in Norrbotten, many of which have positioned themselves as world leaders in specific areas. As such, they are incredibly significant to the development of the region. The importance of these research environments has to be emphasised on both a Scandinavian and a European level, where they are prone to going unnoticed due to their small size. There is a desire to develop the opportunities for research and development in the sparsely populated north. Experiences from the region show that the research environments are not hampered by being located in small towns far from bigger cities, but that the obstacles come from language, culture, institutional capacity, and the small number of businesses. To more clearly show the importance of research outside the most central regions on an EU level, the sparsely populated north needs to underline the opportunities of focussing on the needs of local industry, and develop the close relationships that make it possible to create innovation in small, dispersed research and development teams[97].

96 http://www.shanghairanking.com/

97 Nordregio, Strong, Specific and Promising, Towards a Vision for the Northern Sparsely Populated Areas in 2020, Erik Gløersen, NORDREGIO REPORT 2009:2.

Much points towards the contexts of education, research, and businesses with an ability to develop and be innovative creating the best conditions for regions' development. Connections between research, society, and trade and industry are central, and tend to – when they work – be described as a collaboration model. But the conditions for achieving such a collaboration model for development are different in different regions. In a dense environment with short distances between people, businesses and academic institutions, businesses and academia can form clusters in which to exchange knowledge, staff, etc. on a daily basis. Employees change jobs often in a dense environment. Sparse environments don't have the same conditions. Here, these clusters must be replaced by remote networks with a lower flow frequency between nodes. But the crucial aspect is that know-how and experience can be exchanged in these conditions too. In the region, the dense and knowledge-intensive environments are mostly concentrated in towns that are close to the region's universities and research institutes. This means that the opportunities for innovation systems are different in different parts of the region, which requires location-independent innovation systems in the region's sparser environments. The transborder approach contributes to improved environments in both cases, even if the conditions are different[98].

A region's innovation capacity can be measured through the region's expenses for research and development. These expenses indicate how strong the region's innovation capacity is.

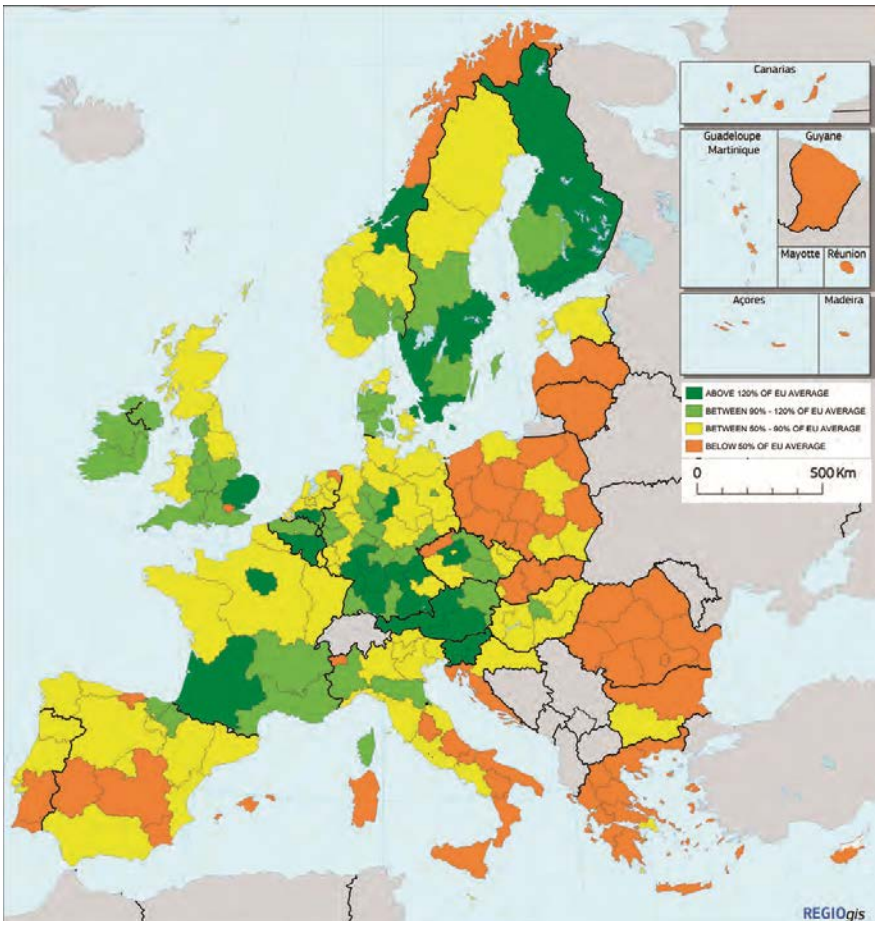

Figure 16: Businesses' investment in R&D in percentage of GRP.

The above figure shows each region's expenses for research and development. For Norrbotten and Västerbotten, the figure is 2.0-3.0 per cent. The EU average is 2.03 per cent[99].

98 Rapport: På väg mot ett gränsöverskridande innovationssystem i Nord, Kontigo 2012.

99 http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Science_and_technology_statistics_at_regional_level#Research_and_development_intensity

Sami Research

There is no unequivocal definition of what Sami research is. Like other research, its goal is to bring forth knowledge for recognition and insight, thus building a foundation for reaching human, cultural, societal and financial goals, both locally and globally. The research has an inherent value, a cultural function, and it should also contribute to increased knowledge and competence in society[100].

There is a special challenge in Sami society not being restricted to one country, since Sápmi stretches across four countries; Sweden, Finland, Norway and Russia. Sami people also participate in international networks and forums in collaboration with other indigenous peoples, for instance. The Sami also have an interest in working internationally, towards institutions such as the UN, the EU, and various forums such as the Barents Cooperation[101].

The most important institutions for Sami research are the university in Tromsø, and the Sami University/Nordic Sami Institute in Norway. These institutions have been crucial for the construction of an environment that has brought forth knowledge of Sami culture, history and community. Sami research is also being carried out at small institutions or at small institutions where it constitutes a smaller part of operations, such as at Sami museums and at universities. Since the situation is such, it's important that these environments are connected in bigger networks to benefit from each other's competence across subjects, institutions and national borders[102].

Businesses in Norrbotten

Over 90 per cent of all businesses in Norrbotten have fewer than ten employees. There are similar figures in northern Finland and northern Norway. Medium-sized businesses with between 50 and 250 employees that have the resources to compete on bigger markets and internationally, however, are underrepresented.

GEOGRAPHICAL AREA	EMPLOYER SIZE	NUMBER	PER CENT (%)
THE TWO SWEDISH COUNTIES	0–9	69 962	94,1
	10–49	3 593	4,8
	50–	771	1,1
	Total	**74 326**	**100**
THE THREE FINNISH PROVINCES	1–9	36 305	92,8
	10–49	2 443	6,2
	50–	368	1
	Total	**39 116**	**100**
THE THREE NORWEGIAN COUNTIES	0–9	39 195	88,3
	10–49	4 516	10,2
	50–	663	1,5
	Total	**44 374**	**100**

Table 1: Number of employers by size – data from Sweden and Norway from 2012, data from Finland from 2011[103].

100 Områdesbeskrivning och SWOT-analys av Interreg Nords programområde.

101 Områdesbeskrivning och SWOT-analys av Interreg Nords programområde. .

102 Forskningsrådet, Norge, Program for samisk forskning 2007-2017.

103 Örtqvist Daniel, Näringslivsutveckling i Nordprogramområdet En analys av tillväxtambitioner, samverkan och export.

Goods and Service Production

In 2011, Norrbotten was responsible for around 5.1 per cent of the country's collective goods production, and on a county level, only the three city counties had higher levels of goods production. The county had, by far, the highest level of goods production measured as SEK per inhabitant; no less than 56 per cent higher than number two, Kronoberg County. Goods production's high share of GRP (42 per cent) indicates significant specialisation, but also says something about a regional economy that is sensitive to market fluctuations, which is abundantly clear from the below figure[104].

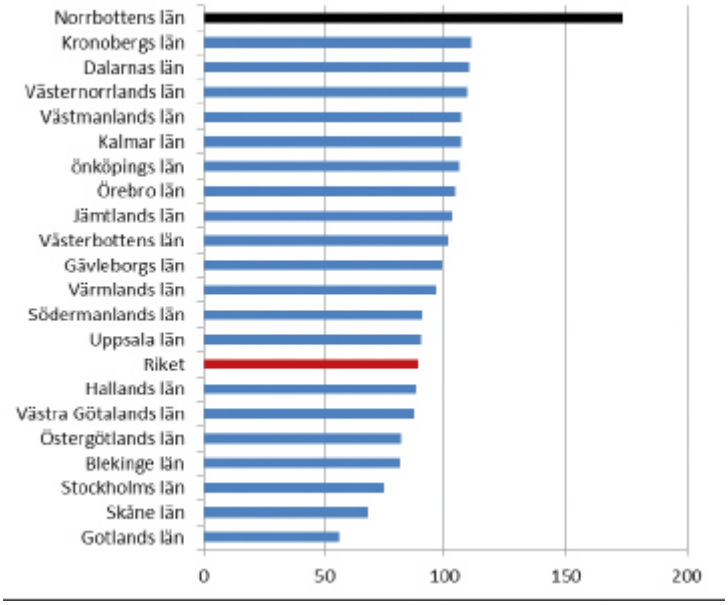

Figure 17: Employment development in goods production (index, year 2000 = 100). Source: Statistics Sweden.

In Norrbotten, manufacturing and quarrying contributed almost 29 per cent of the gross regional product in 2011, which is largely connected to a high demand for the products of mining. Compare that with the year 2000, when the economic situation was different, and manufacturing and quarrying were responsible for just under 17 per cent of the gross regional product, which once again shows that the county is relatively sensitive to the developments of the mineral market. Even if the above numbers indicate that the county's employment isn't particularly dependent on the mining industry, this is in part misleading, as a large part of the industry's employment effects are indirect. For instance, much of LKAB's work is performed by external contractors and consultants[105].

104 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin – En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

105 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin - En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

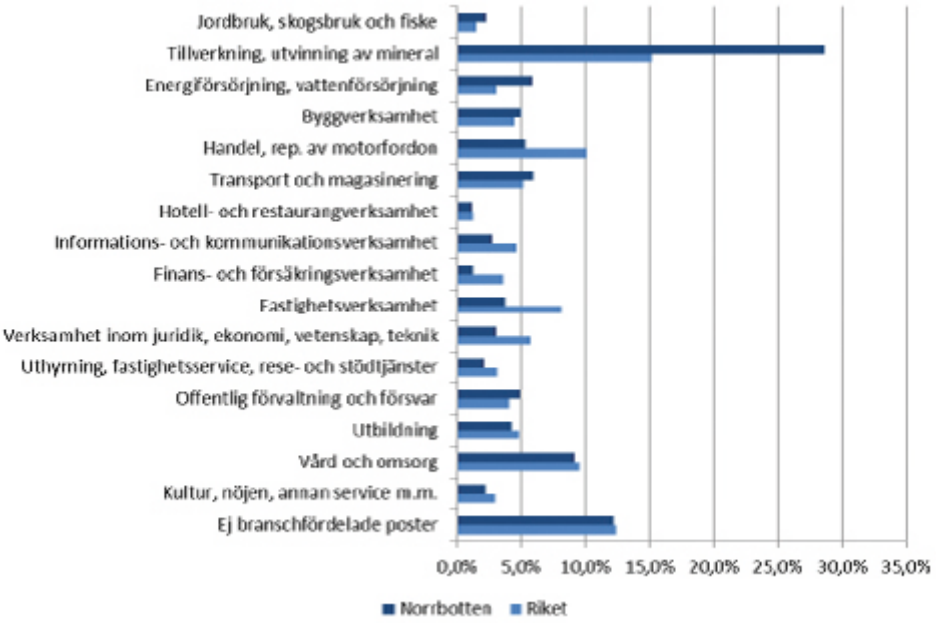

Figure 18: GRP development per industry in Norrbotten (running prices, million SEK). Source: Statistics Sweden.

The single biggest contribution to Norrbotten's GRP comes, as has been mentioned before, from the manufacturing and quarrying industries, which are shown together here due to confidentiality regulations that prevent the mining industry from being shown separately, see the figure below. If manufacture, quarrying and energy supply are removed, the GRP reduction in 2009 is significantly less dramatic.

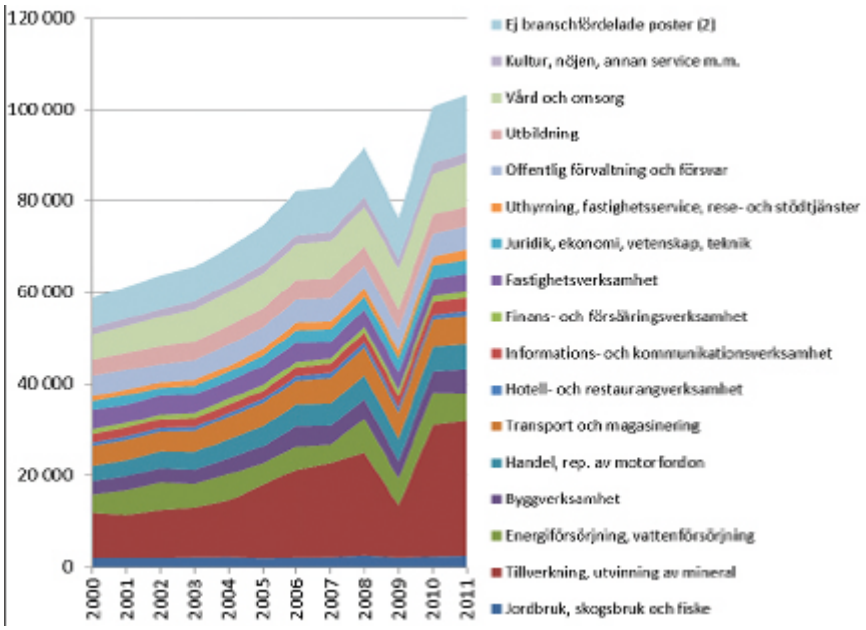

Figure 19: Share of gross regional product per industry (NACE 2007) (GDP for the country) 2011. Source: Statistics Sweden.

The county's collective contribution to GDP was three per cent in 2011. On an industry level, the biggest contributions came from manufacture and quarrying as well as energy supply, which was responsible for almost six per cent of the country's total added value. So, the biggest contributions to GDP seem to come from the quarrying of, and the adding of value to, the county's natural resources, mainly in the shape of wood, ore and hydropower.

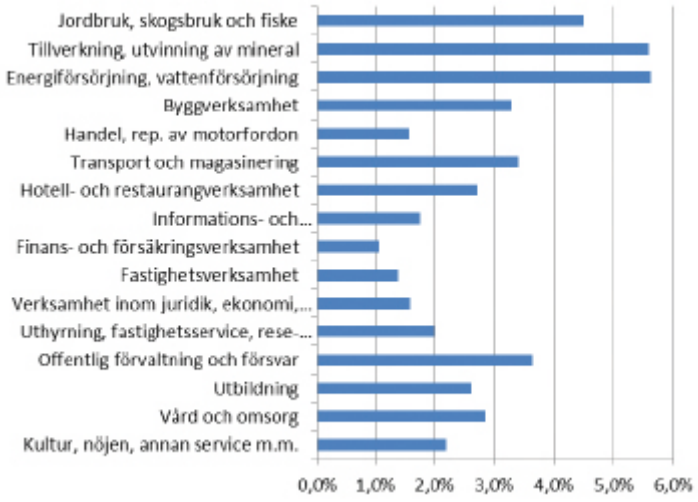

Figure 20: Norrbotten's share of the country's value added per industry (NACE 2007) Source: Statistics Sweden.

Belief in basic industry is also clearly visible in the investments made by the industry, see the figure below. In the 2011–2013 period, the country's biggest industrial investments were made in Norrbotten, with an annual average of just over eight billion SEK. The average for the country is a total of 52.1 billion, which means that in 2011–2013, around 15 per cent of the industry's investments in Sweden were made in Norrbotten. Relating the industry's investments to the number of inhabitants, that's 32,290 SEK per inhabitant in Norrbotten, around 2.7 times as high as for number two in this ranking, Gävleborg County, which is also a county with a lot of heavy industry. It is important to remember, however, that the industry structure is different in the two counties, which explains why sudden changes to investment behaviour takes place in some regions, without being followed by comparable changes in other counties. In practice, a small number of businesses supply the big investments in Norrbotten, and they follow a financial cycle that doesn't necessarily coincide with the financial situation for other types of industries[106].

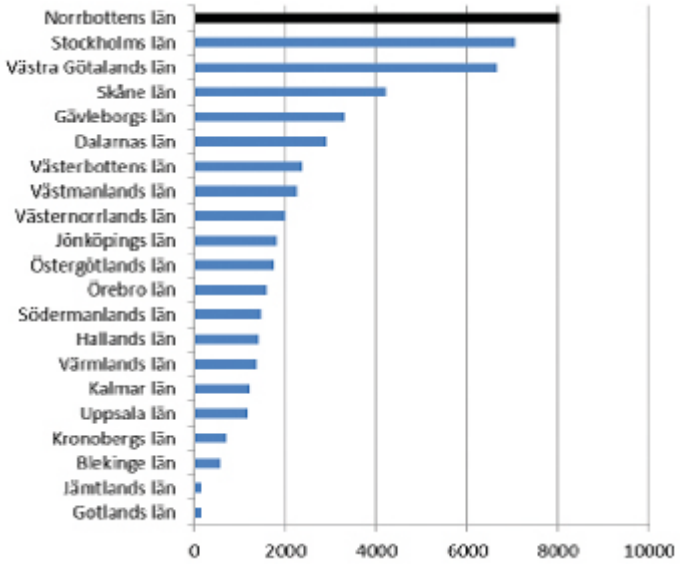

Figure 21: The industry's investments (million SEK), annual average for the 2011–2013 period.

106 See Jonsson och Svendsberget (2010) för en djupare analys av industrins investeringar i Norrlandslänen.

Thanks to mining and forestry, Norrbotten's economy has a strong base in natural resources. Mining in particular is crucial to the region's financial development. Public operations are also important to the region, in part due to its aging population. Another important characteristic of the economy is the relative lack of specialisation in manufacturing and the service sector compared to other regions in northern Sweden. Like in other Swedish regions, the public sector plays an important role in the economy. In Norrbotten's case, the number of people employed in the public sector has decreased since 2004. Many publicly employed people have moved to private employers, such as the mining sector. Growth in the mining sector has significantly affected the regional economy, but the direct effects on employment have been limited. Since 2000, mining has been vital to general financial growth. The consequences of growth in mining can also be seen in other sectors[107].

Looking at the region's GDP per capita in 2012, it was 44,826 USD, which is 9.7 per cent above the national average of 42,082 USD, and significantly higher than the OECD average at 35,812, and the NSPA area average at 37,205. Between 1995 and 2012, the region experienced strong growth, and went from 4.9 per cent below the country's GDP per capita to 9.7 per cent over. The increase in growth pace after 2003 was due to rising prices of mineral raw materials, especially iron ore. Between 1999 and 2012, the GDP growth average was 2.9 per cent, which is significantly higher than the national average of 2.1 per cent. Over the mentioned period, productivity growth has been the strongest driving force behind financial development. During this time, Norrbotten performed better than the national average when it comes to productivity and employment growth[108].

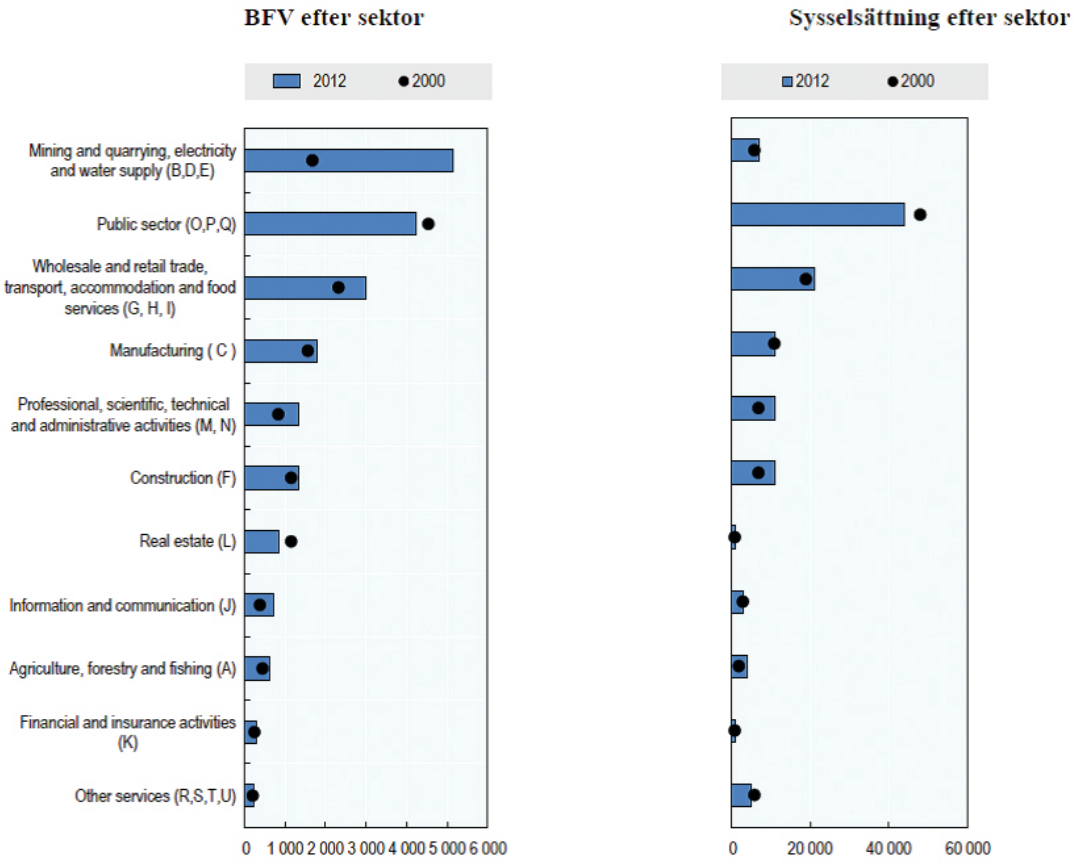

Figure 22: Gross value added (GVA) per capita. Source: OECD's (2017) Territorial Reviews: Northern Sparsely Populated Areas.

107 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas.

108 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas.

The figure on the previous page shows investments in different industries and their effects to the left, and effects of the investment on employment in the industry on the right.

When it comes to employment, goods production is also comparatively significant in Norrbotten. In 2011, this sector was responsible for around 28 per cent of employment in the county, while the equivalent share nationally was around 24 per cent in the same year. While employment in goods production has decreased nationally in the 2000s, it has increased in Norrbotten, by just over 20 per cent in the 2000 – 2011 period, see the above figure. Compared to GRP from goods production, employment reduction in connection with the financial crisis of 2008 – 2009 was relatively small. Employment in Norrbotten went down somewhat, but less so than it did nationally. In addition, recovery was quick, while employment in goods production nationally was still lower in 2011 than at the beginning of the 2000s[109].

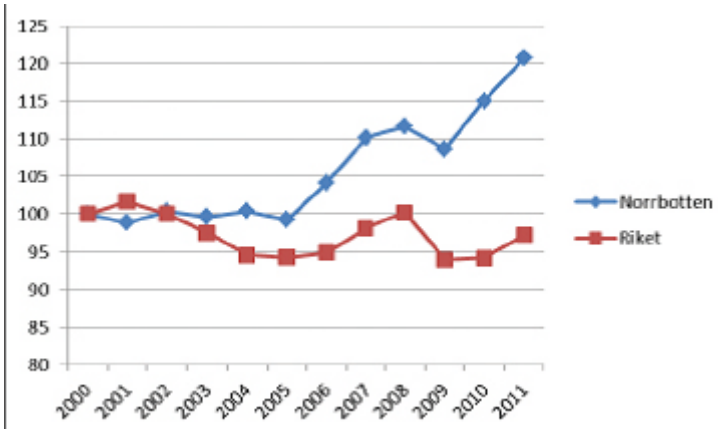

Figure 23: Goods production per capita and county in 2011, thousand SEK. Source: Statistics Sweden.

Norrbotten appears to be a successful producer of goods, especially as measured per inhabitant, but service production doesn't seem to be as significant, compared to the rest of the country. The collective value of trade and industry's service production in Norrbotten was 26.7 billion SEK in 2011, which is the equivalent of around 26 per cent of the gross regional product, while service production nationally was responsible for around 45 per cent of GDP. The three city counties were responsible for almost 68 per cent of the country's collective service production in trade and industry. 14 counties had higher service production than Norrbotten in 2011, and measured per inhabitant, Norrbotten is in 13th place, as shown by the figure below[110].

109 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin - En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

110 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin - En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

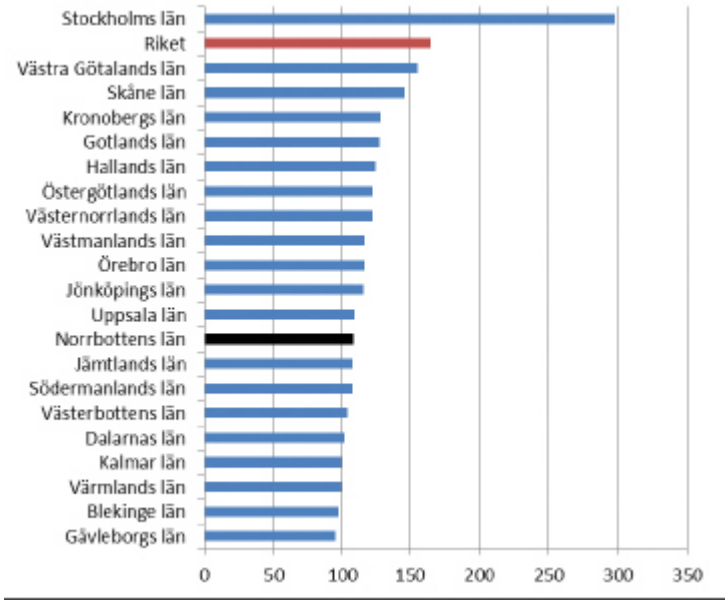

Figure 24: Service production per capita and county in 2011, thousand SEK. Source: Statistics Sweden.

The development of service production's added value since the year 2000 compared to the country is shown in the figure below. The development in Norrbotten trails behind somewhat, but from 2002 to 2006, the growth pace is basically identical to the national one, before trailing behind once again. This coincides with great growth in the added value and employment of goods production, which picks up in earnest around 2006. A possible explanation for these results could be that the raw materials and investment boom of the 2000s had pulled so many of the region's resources that the growth pace of service production suffered somewhat due to increased wage levels and competition for labour. This is, however, partly counteracted by the mining expansion requiring more services[111].

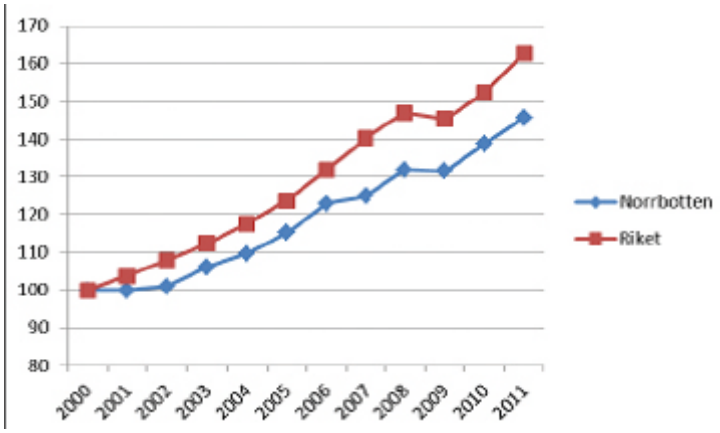

Figure 25: Value development in service production (index, year 2000 = 100). Source: Statistics Sweden.

Private trade and industry was responsible for around 32 per cent of total employment in Norrbotten in 2011, while the equivalent share nationally was 46 per cent. So, there is a significant difference between the country and Norrbotten, and we'll give a more detailed image of what industries are primarily involved later on. When it comes to employment development in the service industries, the county is more similar to the country, as shown in the figure below. We can see that employment in the service sector increased faster than it did nationally in 2006 and 2007. In the same time

111 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin - En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

period, a number of new retail establishments came to Norrbotten; the Storheden area in Luleå continued to expand, and the IKEA shop in Haparanda opened in 2006, but the part of the service sector that grew quicker in the county than in the country during these years was mainly various finance and business services[112].

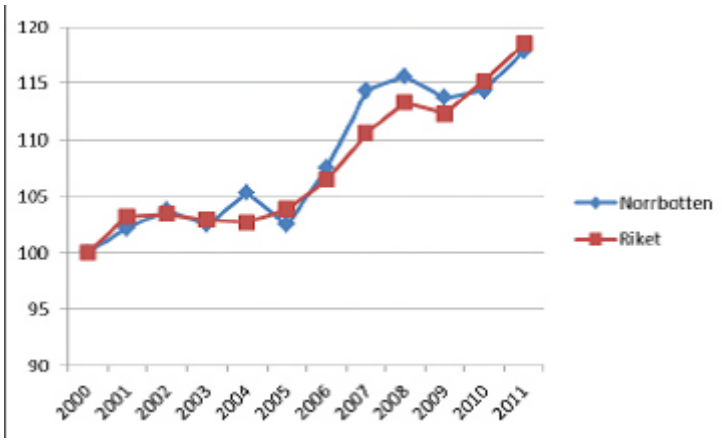

Figure 26: Employment development in service production (index, year 2000 = 100). Source: Statistics Sweden.

Gender Distribution in Businesses

The *Growth Conditions for Norrbotten's Trade and Industry*[113] report shows that there are great imbalances in gender distribution among the employees of businesses. Only 39 per cent of the businesses have 20-80 per cent female employees. This means that women are only a fifth of the employees in over 60 per cent of the businesses.

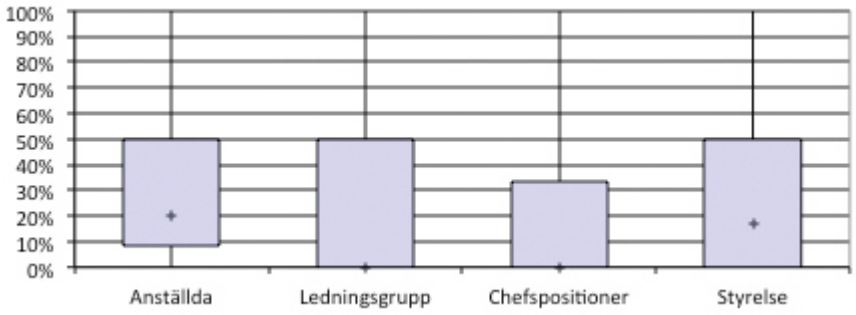

Figure 27: Proportion of women in SMEs.

In a direct comparison, we note similar imbalances in the businesses' management groups and in the share of employed managers. 57 per cent of the businesses have no women in the management group, and 66 per cent of the businesses have no employed female manager, see figure above[114].

Half of the entrepreneurs have upper secondary school competence, i.e. no more than twelve years of education (see figure below). A quarter have more than 15 years of total education. Around half the entrepreneurs have more than twelve years' experience of working as business leaders. 25 per cent have more than 24 years' experience as business

112 Ejdemo, T., Söderholm, P., & Ylinenpää, H. (2014). Norrbottens roll i samhällsekonomin - En kritisk granskning av indikatorer samt några lärdomar för framtiden. Luleå: Länsstyrelsen i Norrbotten.

113 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv - En kartläggning av företagens styrkor, svagheter och utmaningar.

114 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv - En kartläggning av företagens styrkor, svagheter och utmaningar.

leaders, and one person reports no less than 47 years of experience as a business leader. Half of the business leaders state that they have more than 14 years' experience from other professional roles[115].

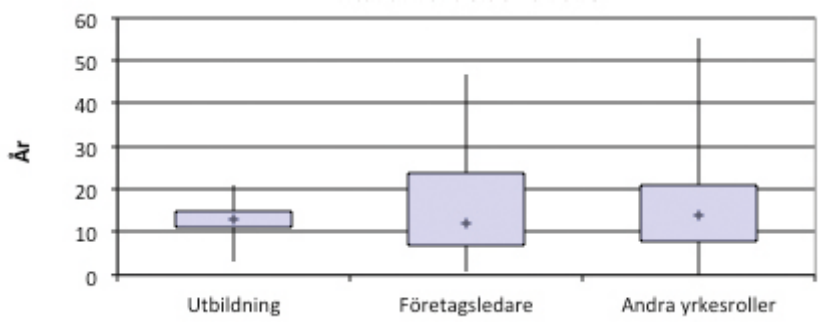

Figure 28: Business leaders' experience (number of years distributed over roles).

What products do the businesses offer their customers, looking at it from an industry life cycle perspective? Businesses can offer products or services that are new and innovative, familiar and widely used, or old and out of date. The study on which the report is based asked – with the purpose of understanding the businesses' range of products and services – how big a share of the businesses' sales comprises products or services in the following life cycle phases.

1. **Introduction phase**
   a. Products and services are not familiar to many potential users, and a more extensive demand for these products or services has just started to grow.
2. **Growth phase**
   a. Total demand for products or services is growing by less than 10 per cent annually for the entire industry..
3. **Maturity phase**
   a. Products or services are familiar to most of the potential users, and demand for these products or services is relatively stable across the whole industry.
4. **Decline phase**
   a. Total demand for products and services is decreasing at a more or less steady pace across the whole industry[116].

The businesses' distribution across the life cycle phases is shown below. 50 per cent of the businesses have no products or services that are in the introduction phase. 50 per cent of the businesses have no products or services that are in the decline phase. A majority of the products on offer is in the maturity phase. In general, Norrbotten's businesses follow an average distribution of turnover over industry life phases, compared to the country's businesses. In most industries and contexts, products in the maturity phase are responsible for most of the turnover. Therefore, a greater proportion of the products on offer is represented in the maturity phase too. At the same time, it's worth noting that the investigation shows great variations among the businesses that have responded to the questionnaire. Some businesses have large proportions of their products in the introduction phase, while others have large proportions of their products in a decline phase, see the below figure[117].

115 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv - En kartläggning av företagens styrkor, svagheter och utmaningar.

116 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv - En kartläggning av företagens styrkor, svagheter och utmaningar.

117 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv - En kartläggning av företagens styrkor, svagheter och utmaningar.

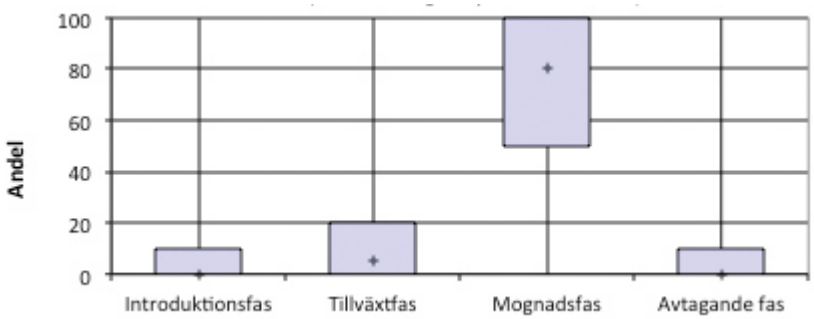

Figure 29: The industrial life cycle, distribution of products on offer.

What innovation activities do the businesses have, i.e. what costs have the businesses had over the previous year that can be related to research and development of their business? 50 per cent of the businesses state that they haven't had any costs for research and development over the past year. 25 per cent state that they invest up to 100,000 SEK in research and development, and 25 per cent invest more than 100,000 SEK in research and development[118]. The small research and development investment share has also been noted in the EU's innovation index *Regional Scoreboard 2016*.

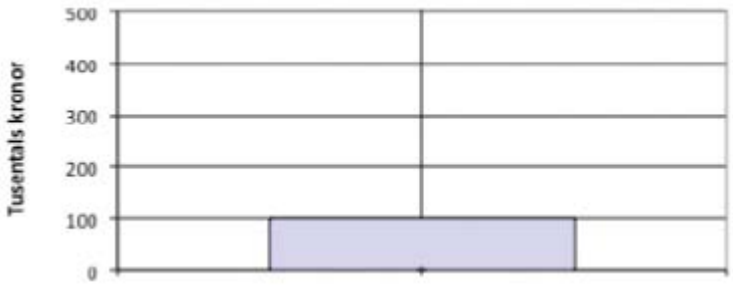

Figure 30: R&D intensity among businesses.

The Public Sector

The public sector includes jointly financed welfare and public services. Measuring added value here is problematic, since actual production consists of delivered health care and education, etc., meaning that gross regional product in this sector is largely based on wage statistics[119].

In Norrbotten, GRP in the public sector has developed more slowly than in the country as a whole, as shown in the figure below. Part of the explanation is likely that the public sector adapts to the population decrease and the demographic development at large with smaller numbers of children, which reduces the base for public services.

118 Örtqvist Daniel, Growth Conditions for Norrbotten's Trade and Industry – a mapping of businesses' strengths, weaknesses and challenges.

119 See regional bookkeeping. Calculation methods for added value. Statistics Sweden, 2008.

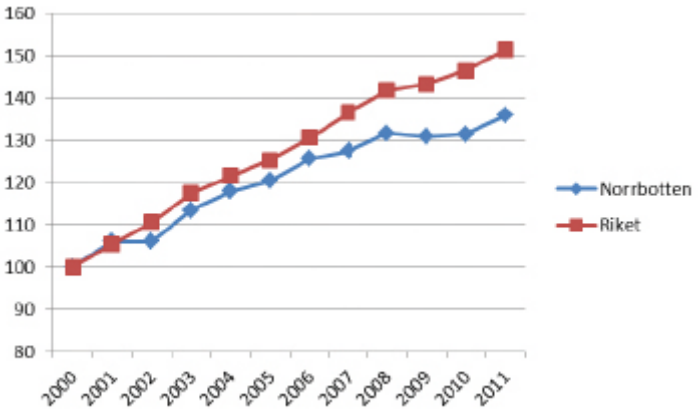

Figure 31: Development of GRP from the public sector (index, year 2000 = 100). Source: Statistics Sweden.

That the size of the public sector in the county is decreasing is clear from the employment development, which is illustrated in the figure below. Since 2000, employment in the public sector in the county has decreased by around 13 per cent. The public sector is, however, still a big employer in the county, and in 2011, it was responsible for around 40 per cent of total employment, to be compared with 30 per cent in the country[120].

At 41 per cent each, only Västerbotten County and Uppsala County had a higher level of employment in the public sector than Norrbotten in 2011. In this context, it's also relevant to note that both Norrbotten and Västerbotten are geographically large counties with a population that is more dispersed, creating demand for accessibility, and limiting opportunities for centralisation. More densely populated environments have the advantage that costs for different kinds of public services can be distributed across more people[121, 122].

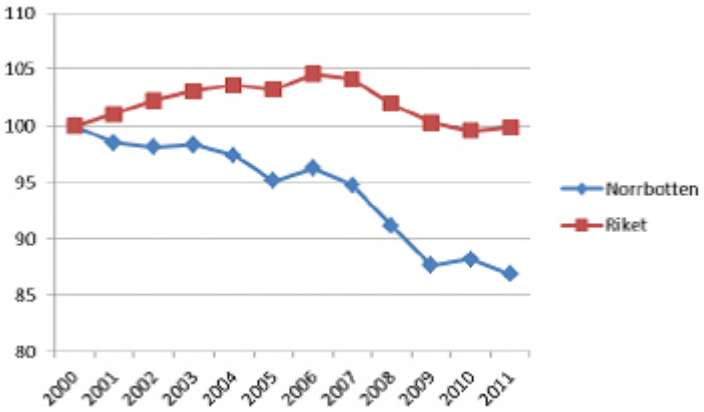

Figure 32: Employment development in service production (index, year 2000 = 100). Source: Statistics Sweden.

Norrbotten's Civil Society

The Norrbotten's Civil Society Now and in the Future, Mapping report shows that Norrbotten's civil society is home to 6,155 organisations active in the region. That's three per cent of Sweden's 238,000 organisations, which is about the same as the region's share of the national population. Of these organisations, most are non-profit (87 per cent), and the

120 Ejdemo Thomas, Söderholm Patrik, Ylinenpää Håkan och Örtqvist Daniel (2016) Norrbottens roll i samhällsekonomin, Länsstyrelsen i Norrbottens län.

121 Westin, 2011.

122 Ejdemo Thomas, Söderholm Patrik, Ylinenpää Håkan och Örtqvist Daniel (2016) Norrbottens roll i samhällsekonomin, Länsstyrelsen i Norrbottens län.

rest are economic associations (eight per cent), trusts benefitting the public, and funds (four per cent), and registered religious bodies (one per cent). Family-owned trusts are excluded, as well as organisations that are run by the state, municipalities or county councils. Civil society employs just over 15,000 people, and has an income of 6.6 billion SEK. Most of this income comes from economic associations (65 per cent), and the remainder from non-profit organisations (20 per cent), registered religious bodies (eight per cent) and trusts benefitting the public (seven per cent)[123].

Gender distribution varies between different organisations and operational areas. It's most imbalanced in forestry (83 per cent men), food production (80 per cent men), retail (70 per cent women), social measures (67 per cent women), and education (62 per cent women). Ten per cent of those employed in Norrbotten's civil society have a foreign background, i.e. they were born abroad, or both their parents were born abroad. This can be compared to 13 per cent of Norrbotten's total population, and 23 per cent of Sweden's. Among the employees with a foreign background, almost 60 per cent are women, and 40 per cent are men, which means that the proportion of women is somewhat higher in this group than among civil society employees at large[124].

Most of Norrbotten's organisations have their headquarters in the region's big towns. A quarter of the organisations (1,558) are located in Luleå, which is lower than the municipality's share of the population at almost a third. 14 per cent of the organisations (838) are located in Piteå, compared to 17 per cent of the region's population. Ten per cent of the organisations (588) are located in Boden, and eight per cent (527) in Kiruna, which is about the same as their shares of the population[125]. When it comes to the operational areas where civil society is found:

- Special interests and religious operations (3,191 organisations)
  Includes representation of the interests of certain groups – either their members' or others' – or the promotion of certain ideas and operations towards the general public, e.g. religious, political, cultural, educational or leisure-related[126].
- Sport, leisure and entertainment activities (1,267 organisations)
  Includes measures within sport, leisure and entertainment, but excludes museums, theatre, dance, music, concerts, gambling and betting activities[127].
- Real estate activities (288 organisations)
  Includes administration, leasing or service[128].
- Artistic and cultural activities and entertainment (189 organisations)
  Includes production, marketing of and participation in shows, events and exhibitions, supply of artistic, creative and technical skills for the production of artistic works and shows, as well as facilities maintenance[129].
- Open social measures (123 organisations)
  Includes the supply of social services straight to citizens, such as the elderly and disabled[130].
- Education (82 organisations)
  Includes adult education and education at preschool, elementary school, upper secondary school and post-upper secondary school levels[131].

123 Norrbottens civilsamhälle i samtiden och framtiden Kartläggning 2017. Region Norrbotten och SEÖN.

124 Norrbottens civilsamhälle i samtiden och framtiden Kartläggning 2017. Region Norrbotten och SEÖN.

125 Norrbottens civilsamhälle i samtiden och framtiden Kartläggning 2017. Region Norrbotten och SEÖN.

126 ww.sni2007.scb.se/snihierarki2007.asp?sniniva=2&snikod=94%20&test=20

127 www.sni2007.scb.se/snihierarki2007.asp?sniniva=2&snikod=93%20&test=20

128 www.sni2007.scb.se/snihierarki2007.asp?sniniva=A&snikod=L%20%20&test=20

129 www.sni2007.scb.se/snihierarki2007.asp?sniniva=2&snikod=90%20&test=20

130 www.sni2007.scb.se/snihierarki2007.asp?sniniva=2&snikod=88%20&test=20

131 www.sni2007.scb.se/snihierarki2007.asp?sniniva=2&snikoll=koll&snikod=85&sok=S%C3%B6k

Sami Industries

A majority of Sami people are currently employed in professions that are not traditionally Sami. This is because only a small number of Sami people are able to engage in traditionally Sami operations. When it comes to reindeer husbandry, for instance, opportunities for reindeer pasturage are currently very limited. Processes of change in trade and industry have obviously also affected Sami society. Restructuring towards a more modern and differentiated professional life has naturally led to Sami people being recruited for jobs outside of their traditional primary industries[132]. This is because only a small number of Sami people are able to engage in traditionally Sami operations. When it comes to reindeer husbandry, for instance, opportunities for reindeer pasturage are currently very limited. Sami families working in reindeer husbandry, however, have always had other jobs to ensure the family's income, and to reduce financial vulnerability.

In Sami society, the connection between industry and culture is very important. So, it's significant to develop and utilise traditional Sami business activities. It's important for Sami people to have the opportunity to develop their culture through education, literature, language and art, for instance, but also through the use of natural resources and the performance of activities that form the basis of their culture. Even if Sami people participate in modern society's differentiated professional life to a high degree, it's the primary industries, such as reindeer husbandry, hunting, fishing, agriculture and duodji (Sami handicraft) that form the basis and cornerstones of Sami industries. Reindeer husbandry

132 Områdesbeskrivning och SWOT-analys av Interreg Nords programområde.

is important, both in terms of industry and with consideration for the crucial role the industry plays as a cultural pillar of Sami society. Therefore, it's important to ensure that reindeer husbandry gets the framework of conditions it needs to strengthen and develop its role in Sami society. In Sweden, the right to reindeer husbandry belongs to all Sami people. In order to exercise this right, however, you have to be a member of a Sami village. There are 51 Sami villages in the country[133].

More and more Sami people have, over the past few years, started tourist businesses that run operations with Sami culture as a signature feature. There is everything from communications and media, experiences and natural tourism, guiding and Sami information, to catering operations. A pilot study that was performed by the National Association of Swedish Sami, SSR, in 2008[134] identified almost 100 businesses in Sweden's Sami tourism industry. They were all small businesses, but they all stated that they had a great potential to grow. Quality, sustainability, safety and credibility are guiding principles for an ecologically sustainable development in Sami industries. A holistic view of the environment that Sápmi is and comes from, i.e. the joint Sami environment heritage, is important[135].

When it comes to features of the business structure in Sami industries, a majority of the businesses are micro-enterprises. Reindeer husbandry and handicraft businesses are often structured in such a way that the business person does many different things in the same business, depending on the time of year. Opportunities to find complementing activities for existing Sami industries is often a higher priority than finding completely new activities. Tourism is, however, incredibly important to Sápmi, as it is a prerequisite for the sale of reindeer meat, crafts, art and design[136].

Challenges for Businesses

In work with the report *Growth Conditions for Norrbotten's Trade and Industry*[137], interviews with businesses about their challenges on the road to growth were carried out. The figure below shows which themes were most frequently mentioned.

Figure 33: Businesses' challenges in realising their growth ambitions.

133Områdesbeskrivning och SWOT-analys av Interreg Nords programområde.

134 Förstudie Samisk turism, 2008, SSR.

135 Områdesbeskrivning och SWOT-analys av Interreg Nords programområde.

136 Områdesbeskrivning och SWOT-analys av Interreg Nords programområde.

137 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv – En kartläggning av företagens styrkor, svagheter och utmaningar.

Staff

One of the factors that the interviewed businesses in the report feel affects growth conditions the most is access to staff with the right competence profile who want to settle in the town and stay in the business for a long time. The businesses feel that there is competition from the mining industry when it comes to staff.

Market

Another factor that affects businesses' growth conditions concerns their market. This includes access to customers, expansion of current markets, and a situation in the economy that stays beneficial[138].

Businesses' Comments on Regional Development Work

In connection with the report *Growth Conditions for Norrbotten's Trade and Industry*[139], there were also interviews performed concerning the regional development work in Norrbotten until 2020. The below figure shows what different themes came up most frequently.

Figure 34: Important issues for regional development work in Norrbotten 2020.

Infrastructure

The area that businesses feel is the most significant for development work in Norrbotten, according to what came out of the report, is infrastructure. In particular, many point out the importance of the construction of the North Bothnia Line between Umeå and Luleå. Many also wish for investments in the road network and flight connections. A couple of comments also concern investments in the expansion of broadband and the phone network.

Attractive Region

The other area that the business people emphasise as one of the most highly prioritised is the need for development of Norrbotten as an attractive region. In the report, they put forward views about the whole county being full of life, that there should be a rich tapestry of activities and culture, that Norrbotten should be an attractive place to live and be in, and that there should be good societal services throughout the county. A number of comments and discussions have also shown the needs that exist in the most sparsely populated areas; it has been said, for instance, that it's hard to run certain operations across the whole region[140].

138 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv – En kartläggning av företagens styrkor, svagheter och utmaningar. .

139 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv – En kartläggning av företagens styrkor, svagheter och utmaningar.

140 Örtqvist Daniel, Tillväxtförutsättningar för Norrbottens näringsliv – En kartläggning av företagens styrkor, svagheter och utmaningar.

Analysis

Norrbotten has a nature-based economy that is built on mines and minerals, steel and forestry. Great investments in these industries have, over the past few years, contributed to increased employment and improved productivity and competitiveness for the businesses. Investments show the businesses' belief in the future, both in terms of their own market, and production that continues to be profitable. The region's trade and industry consists largely of small enterprises, even so-called micro-enterprises with fewer than ten employees. To improve their competitiveness in the market, they need transborder collaboration to gain access to know-how and other resources that they themselves lack.

Businesses' productivity is increasing, but a downside of this in the long term could be reduced demand for labour. Many studies point to nature-based economies constantly increasing their level of automation, and thus successively reducing their significance to employment. The analysis of the county's future recruitment needs also shows a clear downward trend for process operators in certain sub-industries in manufacture and quarrying, but also that demand for more qualified labour, such as engineers and technicians, is increasing.

The level of added value is, however, low among the businesses, as is the whole region's degree of innovation and driving forces to commercialise innovations.

The manufacturing industry is facing increasingly tough demands to streamline and lower their production costs, in part due to globalisation. Proximity to bigger markets and better access to raw materials and energy supply means that businesses choose to move or outsource their operations or parts of their operations to other regions and countries. The region's service businesses, which have traditionally aimed their operations at the needs of basic industry, and that have often operated on a local, adjacent market, have thus been forced to adapt their operations to new markets.

The effects of digitalisation will be a tough challenge for many businesses. Of the businesses that were interviewed as part of the previously mentioned report Digitalisation and Business, some pointed out that digitalisation is crucial to future competitiveness and development. A large share of business leaders stated that digitalisation could give rise to new product, service, process and market innovations.

An increasing level of environmental awareness among people and businesses has also meant that businesses in the region have seen increased environment-driven demand, which in turn has resulted in the emergence of more businesses working in areas like environmental technology, wind power, biofuels and bioenergy. This positive development needs to continue.

The region's small and medium-sized enterprises need to be promoted when it comes to internationalisation and opportunities to reach new markets. Local and adjacent markets are not always big enough for the businesses' profitability, but distances to international markets are great, and often surrounded by institutional, mental and linguistic border obstacles. Relative proximity to markets in Russia and Asia does provide businesses with great opportunities to develop their operations, however. The region's businesses need to utilise the opportunities that exist in the new markets, and therefore, it becomes important too to minimise the significance of border obstacles. Internationalisation creates increased accessibility to new import and export markets, while the content and geography of trade is constantly changing. Stronger coordination between the measures taken by various internationalisation and export-promoting parties is therefore crucial.

The opportunities of internationalisation are great, but conditions for businesses and industries can change quickly, which means that all development is hard to predict. All of Sweden's regions are affected by globalisation, but regional effects concerning pressure to adapt, and businesses' opportunities and ability to grow vary depending on business structure and region size, for instance. In Norrbotten, whose trade and industry is export-intensive, globalisation's effects

are clear, and the region can be affected quickly when global financial crises strike. In summary, globalisation asks a lot of the country's regions when it comes to utilising new opportunities and making strategic and long-term investments that promote regional appeal and competitiveness.

Future opportunities for increased competitiveness among Norrbotten's businesses can also be created through competence development, product development, and more value added to products. A good ability to innovate and renew is crucial to regional competitiveness. Conditions for development and the emergence of regional, transborder, innovative environments will thus need to be improved, as will the promotion of entrepreneurship, increased internationalisation in businesses, and the development of a more varied trade and industry that includes new industries. We also need more collaboration in the region, both between existing and new businesses, and cross-sectorally, in order to find new business opportunities and increase profitability for the businesses. Development of new industries that require new know-how and highly qualified labour is also crucial to ensure diversity and growth in the region. Knowledge-intensive services and new technology contribute to maintaining a high pace of innovation.

The lack of labour risks becoming an obstacle to growth in the region, but can, in part, be solved by labour immigration. This solution is not enough, however, so mobility among the inhabitants also needs to be facilitated. A nature-based economy constitutes a strength, both for inhabitants – as it creates employment opportunities – and for small and medium-sized enterprises – as they get the opportunity to work with product development. The public sector's strong position as an employer can, however, constitute a socio-economic risk. Unfortunately, the distribution of labour between the private and public sectors contributes to a highly gender-segregated labour market where men can often be found in traditional jobs in trade and industry, while women are found in the public sector. In addition, the public sector is often biggest in sparsely populated municipalities, which means that any cutbacks in the public sector will mainly affect women and sparsely populated municipalities. At the same time, the growing private service sector, connected to tourism and health care, for instance, can also result in new employment opportunities for women. The tourism industry, which is often dependent on the seasons, can, with the help of transborder collaboration between tourism businesses and other businesses, find opportunities to develop into year-round operations. The other labour reserve that should be taken into consideration is people in the area who were born abroad. Integration of people born abroad on the labour market is poor. Finding employment is often a main reason why people move, but it's also important for families that there are employment and education opportunities for the whole family for them to move to or stay in the region. Attractive nature, culture and varied recreation opportunities can also be very significant to increase appeal and the number of people moving to the region.

The region's competence, research and development have been further improved over the past few years, as there is good access to education, research and innovation environments, and active research and development operations in a number of towns. This has resulted in special competencies in Arctic technology, space technology and mining and mineral technology, for instance. A challenge for the region, however, is the low proportion of industrial research. There are good opportunities for Norrbotten to continue to develop and increase collaboration between research and trade and industry in order to create increased know-how, more innovation environments, and increased commercialisation of research results.

One challenge that many other developed countries also face is the aging population, which requires new, joint development areas in research and development in the region. Great knowledge needs in the public sector have to be met in order for us to be able to rise to the future challenges of a welfare society. Various social innovations are also going to be needed to increase older people's wellness, and reduce their isolation[141]. There is already Well-developed research and collaboration in e-health in the region, for instance, offering opportunities for future collaboration in new, innovative service solutions.

Improving collaboration, and developing new solutions through new technology, especially in sparsely populated areas, in collaboration with the private, voluntary, and public sectors, can lead to innovative solutions in the service sector, as

141 VINNOVA News, No. 3, June 2013.

well as in other service industries. Knowledge development in small and medium-sized enterprises in particular needs to be continuously improved in order to stimulate innovation ability. Businesses' conditions for participating in knowledge development within universities and research institutes need to be improved, through stimulation of knowledge transfer between businesses, the public sector, the voluntary sector, and research and development environments, for instance. With improved innovation and commercialisation ability among the region's growth parties, more competitive products and services for a bigger international market can be developed. Improving collaboration, and developing new solutions through new technology, especially in sparsely populated areas, in collaboration with the private, voluntary and public sectors, can lead to innovative solutions in the service sector, as well as in other service industries.

The innovation process is often an open process that is characterised by people wanting to benefit from competencies from outside their own organisation, industry or geographical area. Methods that promote transborder openness between different industries and competence areas in the region, but also between the parties of the region and the world around it, need to be developed. It's also crucial that the region develops interfaces between competence areas for improved opportunities for new, innovative businesses to increase the region's ability to create more transborder innovation systems. Open innovation systems also need to be developed through more transborder meeting points for collaboration. The development of digitalisation has enabled collaboration between parties that is less dependent on distance, which is particularly significant for the region. With the help of digitalisation, opportunities to compensate for the disadvantages caused by the sparsity and the long distances between towns, businesses and markets in and outside of the region are afforded, thus connecting the different environments of the region.

In an increasingly knowledge-based economy, where the regions' trade and industry survive on head starts in terms of knowledge, the connection between research, education and innovation becomes an increasingly important success factor[142]. The development of new, innovative solutions based on collaboration models[143] or the knowledge triangle[144] becomes a success factor for regional development. But conditions for achieving a positive development based on a functional collaboration model and knowledge triangle vary. In a dense environment with short distances between people, businesses and academic institutions, businesses and academia can form clusters where the exchange of information, knowledge, people, etc. works and develops. A sparse environment doesn't have the same mass, nor the same conditions. Here, these clusters must be replaced by networks covering longer distances with a lower frequency of information flow between the nodes. The important thing is that knowledge and experiences can still be exchanged[145].

There is a significant need for know-how to be able to meet future challenges in a welfare society with a dispersed and aging population and an Arctic climate. Investing in education and research is a crucial factor for increased value creation and profitability among the businesses and the public sector in the region. Looking to the future, improving collaboration between the private and public sectors is therefore necessary for the degree of innovation and commercialisation to increase, and new employment opportunities to be created. The joint challenges for those who are active in Norrbotten are the long distances and dispersal of industries, as well as the relatively small institutions. Knowledge exchange, transborder research, and societal development as well as exchange programmes among students and researchers in the region need to be actively developed.

On a regional level, universities have an important role to play for the development of innovations. It's key for entrepreneurial competence and conditions for universities to support researchers and students turning research-based knowledge into real benefits to be improved. Continued collaboration between seats of learning, businesses, and society at large is to be promoted. This contributes to regional appeal, and is crucial to meet increased international competition. To promote the innovations that emerge continuously in small and medium-sized enterprises, it's important for these

142 Conclusions on guidance on future priorities for European research and research-based innovation 2982nd COMPETITIVENESS (Internal market, Industry and Research) Council meeting, Brussels, 3 December 2009.

143 Samverkan mellan forskning, samhälle och näringsliv.

144 Samverkan mellan företag, forskning och utbildning.

145 Rapport: På väg mot ett gränsöverskridande innovationssystem i Nord, Kontigo 2012.

enterprises to get support in the shape of networks, competence, capital, and support for goods and service development based on their unique needs. Innovation offices, research parks and incubator activities play important roles in regional innovation systems when it comes to stimulating the growth of new and knowledge-intensive growth businesses.

To reach the sustainable development goals and contribute to energy policy goals, the production and energy system needs to develop so that dependency on fossil energy decreases, the proportion of renewable energy increases, negative environmental impact from the transport sector decreases, and an energy-efficient societal development is promoted. There are also other great environmental challenges that require sustainable development. Efficient and pollutant-free natural cycles, economising with natural resources, and sustainable consumption patterns are required. Climate, environment and energy challenges are also a driving force for technology, and goods and service development in all industries. This creates an environment-driven trade and industry development. Business opportunities are created for Norrbotten's businesses as the global demand for sustainable and resource-efficient goods and services, and renewable energy and production with low environmental emissions, grows. To steer towards a sustainable economy, we need business models, systems and methods that promote a changed administration of technology and ecosystems, renewable energy sources and improved natural cycle flows. Environmental impact takes place both before, during and after a product or service is consumed. Impact can be both local and global. Consumption patterns of goods and services are to cause the smallest possible environmental and health-related problems, which is also in accordance with the generational goal.

The ambitious goals for Swedish climate, environment and energy policy require active and long-term work for sustainable development on all political levels, not least regionally and municipally. Regions and municipalities therefore have a great responsibility to actively contribute to a green, resource-efficient economy, which is an important part of the work to reach the generational goal and the sustainable development goals.

Sápmi

There is great development potential in both traditional and new Sami industries, such as experience-based tourism, culture, food and service sectors, as they are similar in the different countries. By collaborating, both within Sweden and across the borders with Norway and Finland, ideas concerning marketing, production methods, etc., can be exchanged, and new businesses can be created. Traditional Sami industries form the basis for further development of a varied and product-creating trade and industry.

Sami food is crucial to Sami identity and a vibrant Sami culture. Nature's conditions and seasons govern the development of food traditions. This is something that indigenous peoples across the world have in common, and it's a source of inspiration and sustainable development.

Improving applied research to promote production based on businesses' needs is – from a Sami perspective – a very important measure for growth in reindeer husbandry and other Sami industries. One challenge, however, is to convey research to businesses that sometimes struggle to assess the benefits of it. Therefore, collaboration between research and education institutions is needed to facilitate researchers' access to Sami industries. It's also necessary to create information channels to disseminate knowledge about research and its results, and these information channels need to have a shape and content that appeals to the target group. Conveyance should be broadened to include research about women and young people, handicraft, art, and identity. This can become exciting knowledge for everyone who lives and works in Sápmi. There are good opportunities to gain experience from research and technology development for reindeer husbandry and other Sami industries. There is space to work with innovations that can become unique, lead to new growth opportunities, and create new jobs. Demand for change and development in Sami industries means that research and education are themes that the smart specialisation strategy will focus on.

The Innovation Support System – Map of Parties

Norrbotten's general innovation support system plays a role in the development of smart specialisations. When we talk about the innovation support system, we mean parties that offer support for innovators, entrepreneurs and business leaders, and especially new business leaders. The term innovation system is, in a broader sense, individuals and organisations in research, trade and industry, and public operations that in a joint interaction develop ideas to create added value through new products, services, processes or applications. Innovation systems are also the structures that aim to increase the flow of ideas and to stimulate the process of turning ideas into innovations.

The county currently has a functional innovation support system. It obviously has potential for development. We need an increased flow of ideas, and more ideas with potential to grow. We also lack innovators who focus on sustainability, e.g. social innovators, who struggle to get the right kind of support, and there is a gender imbalance among those who partake of the support. To be able to handle more ideas, ideas need to be handled quicker, and tested vis-à-vis the demand of the market earlier, to either be rejected or developed further.

The system should cover all of Norrbotten. Even local, specialised innovation platforms should be able to play a role in the whole region, and the concentration of research, knowledge-intensive businesses and parties that exists in Luleå, Piteå and Kiruna should be able to benefit the whole region.

The innovation support system and its parties are one of the keys to the region's innovation power. Knowledge exchange and joint processes for problem formulation between businesses, universities, and the public sector contribute to more efficient transformation of research results into real benefits. The purpose of the innovation support system is also to meet the need for development of new products and processes in trade and industry, and the public sector. The innovation support system includes all parties in society that have a supportive function somewhere on the road from idea to market. These parties work in the innovation systems to varying extents, based on what need for support there is to develop an idea into an innovation. The innovation support system also includes all parties that supply venture capital and loans, businesses that work with intellectual property, export-promoting businesses and organisations, as well as public parties that provide supportive measures at some stage of the development chain from idea to marknad[146].

An innovation system includes the whole chain from idea to market, and is a way of describing the collaboration and interaction that is necessary for ideas to be turned into innovations. Innovation systems can be consciously created, but are often based on collaborations and dependencies that have grown organically. So, the process isn't always straight and sequential, but is permeated by a number of overlapping and difficult-to-predict sub-processes. Knowledge-building constitutes one important sub-process, but other examples of significant sub-processes are product development, financing, and influencing on the demand side[147].

Innovations are created everywhere in society, but opportunities to partake of the systems and environments that promote innovation are more limited in the region's sparsely populated areas. This is a challenge that needs to be met with measures that promote participation in an innovation system that is not dependent on location, and that is there for both men and women. Development of collaboration between parties that is less dependent on distances can compensate for the disadvantages that come with sparsity and long distances between towns, businesses and markets in and outside of the region.

146 ITPS Lars Bager-Sjögren Martin Rosenberg A 2004:020 Kartläggning av aktörer i det svenska innovationssystemet.

147 ITPS Lars Bager-Sjögren Martin Rosenberg A 2004:020 Kartläggning av aktörer i det svenska innovationssystemet.

Many parties within the innovation support system are financed by public means, and are made up of institutions and organisations, but also of niche projects with limited lifespans. In general, the support system has to have its foundation in competent parties with good collaboration and coordination between themselves.

Innovations can also be developed by individual entrepreneurs and innovators, or by employees in the public sector who – if they have access to knowledge-based resources and capital at all stages – can contribute to the development of the region. These types of innovation and innovative collaboration also need to be noted as a tool for the region's future development. Another important aspect is to support smaller entrepreneurs and encourage entrepreneurial attitudes. Since innovation processes are complex and interconnected, a joint vision concerning common strategic and long-term measures is needed. The purpose of the map of parties below is to show how different parties work in different ways to promote innovation and new businesses in Norrbotten[148].

Many parties have multiple roles in the innovation system, and it's not uncommon for parties in the support system to be both business developers and innovation supporters working towards different target groups and businesses in different phases of development. One party in the support system is Region Norrbotten. The region works as a policy-creating organisation, and as an education, development, and research organisation. Region Norrbotten can also be the customer in the system. The sketch below shows what this can look like.

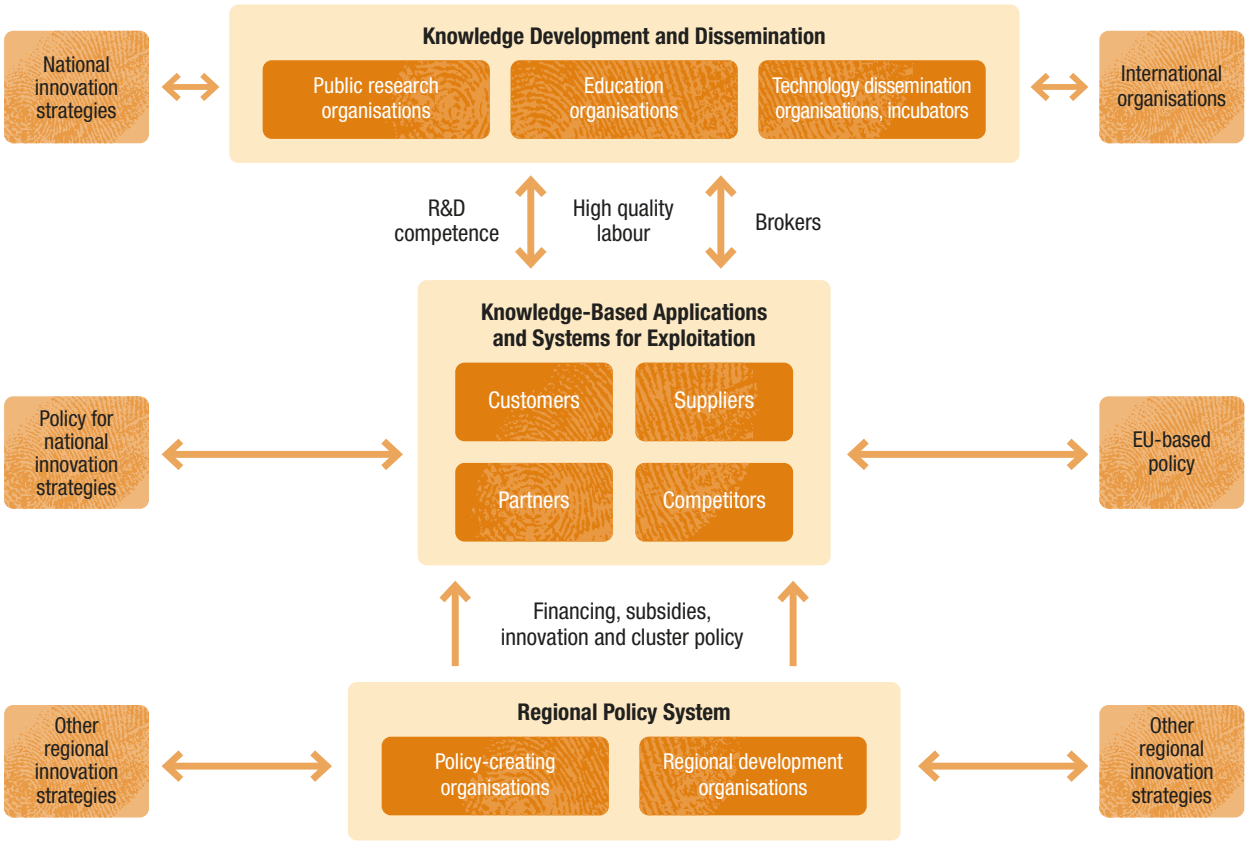

Figure 35: Sketch, innovative systems[149].

148 ITPS Lars Bager-Sjögren Martin Rosenberg A 2004:020 Kartläggning av aktörer i det svenska innovationssystemet.

149 A development of 'innovations and regional innovation systems' according to Cooke et al. 2007.

Parties

The above figure summarises how Norrbotten sees innovations and collaboration in innovation systems. It describes the regional innovation system of clusters of innovative businesses that collaborate to develop new, innovative solutions for the market. The businesses are supported by research and development organisations and various forms of technology brokerage organisations and incubators.

Businesses work as engines, and their demand drives innovation. Businesses can produce their own research and development, and finance other research. Small and medium-sized businesses can be found in the county's clusters, for instance.

Intermediaries have the task of stimulating the process from idea to commercially launched product or service, i.e. a party that is located right between research, academia and businesses. Examples of intermediaries are industrial research institutes, incubators, advisors, clusters and network initiatives, business-promoting organisations, innovation-promoting networks, and interest organisations.

Education and research includes universities and university collaborations. Norrbotten is home to the Luleå University of Technology (LTU). The university operates mostly in the area of technology, but also has extensive teacher training, a health science programme, an economist programme, and other social science programmes and research, as well as programmes in music, dance, theatre and media. The university has around 15,000 students. Since the start, LTU has been located in Luleå, Piteå, Skellefteå, Kiruna, Filipstad and Borlänge[150]. The county is also home to some 20 upper secondary school programmes and a number of vocational training programmes.

Research institutes are organisations that have research as their only or main activity. Research institutes can be focussed on basic research, applied research, or both. They can be state-owned, private, or belong to international organisations.

Industry research institutes have long existed in Sweden. The first institutes were founded at the beginning of the 20th century, and originated from specific industries. Institutes that have formed later often have a cross-industry or inter-technological starting point. Both the state and trade and industry are behind the institutes, and have contributed financially to the operations. The joint interest stems from the view that the industry research system is necessary to improve Swedish businesses' development, competitiveness and employment. Industry research institutes' resources in the shape of researchers, testing and demonstration facilities, and networks constitute an important part of trade and industry's innovation systems. Good collaboration between research institutes and seats of learning is crucial for the efficient dissemination of research results to trade and industry. The competence and infrastructure for research that have been built at the seats of learning constitute an important resource for trade and industry's research, and for the development of the Swedish innovation system[151].

Industry research institutes in the county are Interactive Institute Swedish ICT (Piteå), RISE Energy Technology Center (Piteå), Swerea Sicomp (Piteå), Swerea Mefos (Luleå), Winternet (Boden), RISE SCIS North (Luleå). These are called research institutes from here on in. The research institutes perform experimental projects within Horizon 2020, ERDF (to a decreasing extent), and with the help of national financiers like Vinnova and the Swedish Energy Agency, for instance.

EISCAT is an international research infrastructure with only part of its operations in Sweden. EISCAT is located at the space campus in Kiruna, and has a receiving station a few kilometres east of Kiruna's town centre. EISCAT is one of few international research infrastructures where Sweden is the host nation. EISCAT is currently investing in new infra-structure; the new system, EISCAT_3D, will be up and running in 2022[152].

Infrastructure in the shape of private and public venture capital, but also in the shape of transport networks and broad-band, is a prerequisite for the innovation system to work.

150 ITPS Lars Bager-Sjögren Martin Rosenberg A 2004:020 Kartläggning av aktörer i det svenska innovationssystemet.

151 ITPS Lars Bager-Sjögren Martin Rosenberg A 2004:020 Kartläggning av aktörer i det svenska innovationssystemet.

152 http://roadmap2018.esfri.eu/projects-and-landmarks/browse-the-catalogue/eiscat_3d

Civil Society

The mapping of Norrbotten's Civil Society shows that it comprises just over 6,000 organisations with over 15,000 employees and an income of almost 7 billion SEK. The organisations play an important role for the region's social and financial development as voices for different groups of people, suppliers of various services to members and society, and innovators of pioneering solutions to societal and organisational challenges. Norrbotten's organisations are mainly active in looking after special interests, religious activities, sport and leisure activities, artistic and cultural activities, social measures, education, and retail[153].

Region Norrbotten's Companies

Region Norrbotten owns many companies that contribute to development in the region. The companies create added value for the region in collaboration with other parties. Synergies, which Region Norrbotten would not have been able to create single-handedly, emerge. Ownership governance of Region Norrbotten's companies is one of the tasks of the Department for Regional Development. Governance occurs in cooperation with other owners of the companies. The work includes being responsible for owner and company dialogue, shaping owner directives, administrating owner cooperation, and carrying out information and education activities. The below companies are owned by Region Norrbotten.

Almi Företagspartner Nord AB

Almi Företagspartner Nord AB is a company that is to strengthen Swedish trade and industry's development, and work for sustainable growth. Almi is to offer advisory services and lending, mainly to businesses with profitability and growth potential. Almi is to work for competitive, and thus sustainable, small and medium-sized enterprises to develop and increase in number. Sustainable growth means growth in businesses that is deemed to be financially, socially and environmentally sustainable over time. Almi is to actively seek out new customers, and operations are to be based on the needs of the businesses regionally. The company is to work with stimulating and supporting all customers in the target group, but should have a special focus on early stages and expansion phases in the businesses, and on female business leaders and business leaders with a foreign background. The company is to contribute to the development of businesses with knowledge-intensive business ideas.

Almi's operations should complement the market, and should be aimed at businesses that don't have their need for financing or advice met by the market's private parties. The company is to collaborate and build partnerships with relevant private and public parties wanting to expand or develop[154].

Filmpool Nord AB

Film Pool Nord AB is to support the regional film industry as well as film as an art form in Norrbotten. The film industry is an important cultural industry that contributes to the development of the whole county. The company should also promote interest in film and audiovisual production. Investments are to provide direct and indirect income for the county's trade and industry[155].

Informationsteknik i Norrbotten AB (IT Norrbotten)

The company manages the county's joint fibre-based high-speed network, and offers municipalities to partake of it. The company is to work for the network to come to practical use for local trade and industry and public services, so that a ultitude of services is created[156].

153 Norrbottens civilsamhälle i samtiden och framtiden Kartläggning 2017. Region Norrbotten och SEÖN.

154 Almi Företagspartner Nord AB owner task from owners.

155 Filmpool Nord AB owner task from owners.

156 IT Norrbotten owner task from owners.

BD Pop AB

BD Pop AB is to be a regional resource and production centre for popular music with the purpose of supporting talent, strengthening the regional music industry, and stimulating growth in creative industries[157].

Energikontor i Norr AB

The company is to drive energy and climate issues on local and regional levels from an international perspective. The company's goal is to work to increase the proportion of renewable energy sources in the region, work for a more efficient use of energy and natural resources, contribute to the development of collaboration in the energy and climate area, and support and develop collaboration between regions, nationally and internationally[158].

Investeringar i Norrbotten AB

The company is to work as a coordinator for the region and municipalities in Norrbotten in areas such as marketing and sales, fact management, fairs, competence development, and support with quote work, and should also run outreach operations with international investors and establishers, and market Norrbotten[159].

Norrbotniabanan AB

The North Bothnia Line Ltd is to run consultant operations concerning the North Bothnia Line, and work to see railway built between Umeå and Haparanda[160].

Arctic Business Incubator AB (ABI)

Arctic Business Incubator's task is to develop entrepreneurs and their innovative business ideas into profitable and strong international growth companies[161].

Länstrafiken i Norrbotten AB

The company is to contribute to regional development through efficient public transport connected to the needs of the county's citizens and businesses. The company shall, through cross-county contacts, be prepared to face the consequences that a possible future region enlargement could lead to[162].

Matlaget i Gällivare AB

The Cooking Crew in Gällivare Ltd produces food for institutions in Gällivare Municipality and for the region's local health care operations[163].

Norrtåg AB

Northern Trains Ltd is to conduct regional daytime train traffic in an interconnected system across county borders in the our northernmost counties[164].

157 BD Pop AB owner task from owners.

158 Energikontor i Norr AB owner task from owners.

159 Investeringar i Norrbotten AB owner task from owners.

160 Norrbotniabanan AB owner task from owners.

161 ABI owner task from owners.

162 Länstrafiken i Norrbotten AB owner task from owners.

163 Matlaget i Gällivare AB owner task from owners.

164 Norrtåg AB owner task from owners.

National Parties in the Innovation System

There are also a number of national information and advice parties. The table below shows the mostly national and publicly financed organisations and authorities that assist businesses and soon-to-be business leaders with information and advice. It's important to note that each respective organisation depends on public financing to varying degrees. The table below shows examples of national parties for information/advice (Swedish National Audit Office, 2014)[165].

Aktör	Starta	Driva	Växa	Beskrivning av stöd
Almi Företagspartner				Information och rådgivning för samtliga företagsfaser med 40 kontor över hela landet
Business Sweden				Personlig exportrådgivning, kompetensutveckling kopplat till internationalisering
CONNECT				Mötesplats för entreprenörer, forskare och investerare. Rådgivning till entreprenörer och investerare
Coompanion				Företagsrådgivning med inriktning kooperativa företag, närvaro på 25 platser i Sverige.
Drivhus				Akademinära rådgivning och vägledning till studenter vid flertalet lärosäten samt utbildning.
Enterprise Europe Network				Information och rådgivning om främst EU-regler, internationalisering, EU-finansiering, förmedling av affärskontakter
IFS Rådgivningscentrum (Almi)				Affärsrådgivning med fokus utrikes födda (ägs av Almi)
Industriella utvecklingscentra (IUC)				Driver industriella utvecklingsprojekt tillsammans med framförallt SMEs
Inkubatorer och teknikparker				Infrastruktur för affärsutveckling i form av rådgivning, kontorsyta, events. Ca 65 anslutna medlemmar till SISP
Innovationskontor vid UoH				Kvalificerat stöd i frågor om nyttiggörande av forskningsresultat vid utvalda lärosäten i Sverige.
NyföretagarCentrum				Erbjuder kostnadsfri och individuell rådgivning till individer som avser starta företag och företag i uppstartsskedet
Kommunala näringslivskontor				Tillhandahåller/upphandlar information och stöd gentemot lokala företag
Resurscentra				Regionala och lokala resurscentra med fokus på främjandefasen utifrån ett jämställdhetsperspektiv
Svenska Uppfinnareföreningen				Nätverk där uppfinnare och småföretagare har tillgång till rådgivning, mentorer, problemlösning och inspiration
Ung företagsamhet				Utbildar grundskole- och gymnasieelever i entreprenörskap. Utbildar drygt 20 000 unga per år
Huvudsakliga myndigheter				
Kommerskollegium				Ombudsman för företag som stöter på handelshinder i utlandsaffärer
VINNOVA				Informationsinsatser kopplat till deltagande i EU:s ramprogram för forskning och teknisk utveckling
Tillväxtverket				Informationsinsatser (verksamt.se, Startlinjen, starta företag-dagen i samarbete med andra myndigheter)
RISE				FoU-samverkan, Rådgivning för internationalisering för SMEs (EU/SME)
Jordbruksverket				Stöd för kompetensutveckling
Arbetsförmedlingen				Hjälp med att få affärsidé prövad samt möjlighet att ansöka om starta eget-bidrag
Energimyndigheten				Bidrar med lån, teknisk kompetens, marknadskännedom och affärsutveckling till företag inom energiområdet
Skatteverket				Erbjuder kostnadsfria informationsträffar som delvis riktar sig till målgrupperna blivande företagare och nyföretagare

Table 2: Examples of national information/advice parties.

165 Tillväxtverket, 2015, Kartläggning av det företagsfrämjande systemet i Sverige, Info 0601.

An equivalent table of where Region Norrbotten's companies are in the innovation process is already available. It is important to remember that the companies in the table below that are not said to belong in an innovation system can still belong to one in a wider sense, as we have used a narrow definition below.

COMPANIES OWNED BY REGION NORRBOTTEN	STARTING	RUNNING	GROWING	COMMENT
Almi Företagspartner Nord AB				Yes, is to offer services in advice and lending, mainly aimed at businesses with profitability and growth potential.
Filmpool Nord AB				No, does not work in any of the phases, is within cultural and creative industries (film), i.e. indirect effects on the innovation system.
Informationsteknik i Norrbotten AB				No, should administrate and develop the county's joint, fibre-based high-speed network, and offer the county's municipalities the infrastructure service, i.e. communications – broadband. I.e. indirect effects on the innovation system.
BD Pop AB				In part, yes, by strengthening the regional music industry and stimulating growth in creative industries.
Energikontor i Norr AB				No, is to work to increase the proportion of renewable energy sources in the region, work for a more efficient use of energy and natural resources. The companies don't work in any of the phases, but have indirect effects on the innovation system.
Investeringar i Norrbotten AB				No, the company is to be a coordinator for the region and municipalities in Norrbotten in areas like marketing and sales, fact management, fairs, competence development, and support in quote work, and is to engage in outreach operations towards international investors, i.e. has indirect effects on the innovation system.
Norrbotniabanan AB				No, the company is to run consultant operations concerning the North Bothnia Line.
Arctic Business Incubator AB				Yes. The incubator is to develop entrepreneurs and their innovative business ideas into profitable and strong international growth companies.
Länstrafiken i Norrbotten AB				No. Is to run efficient public transport adapted to the needs of the county's citizens and business infrastructure, i.e. communications that have indirect effects on the innovation system.
Matlaget i Gällivare AB				No, produces food for institutions in Gällivare Municipality and the county's local health care operations. Is part of the innovation system, but is not included in the three defined phases.
Norrtåg AB				No. Running regional daytime train traffic in an interconnected system across county borders in the four northernmost counties. Infrastructure, i.e. communications.

Table 3: Region Norrbotten's companies' place in the innovation system.


SAMHANDLING
FRAMSYN
ÄMSTÄLLDHET

Scenarios for Norrbotten 2050

Painting likely future scenarios based on the facts we currently have to relate to can be a tool for regional planning and development. In the next few chapters, we'll present five possible scenarios, developed by the Luleå University of Technology (LTU), and show what conditions are required for each scenario to become reality. Then, we'll categorise and summarise the most important challenges the county faces if the scenarios become reality, alone or combined[166].

Scenarios as a Method for Regional Planning and Development

A scenario is a cohesive, internally consistent, and believable description of a possible future world state. Scenario planning, also called scenario thinking or scenario analysis, is, in turn, a method for strategic planning that can be used to make flexible long-term plans. A scenario is not only a description of a future state, however, but also a description of the development from the current situation to the projected future state.

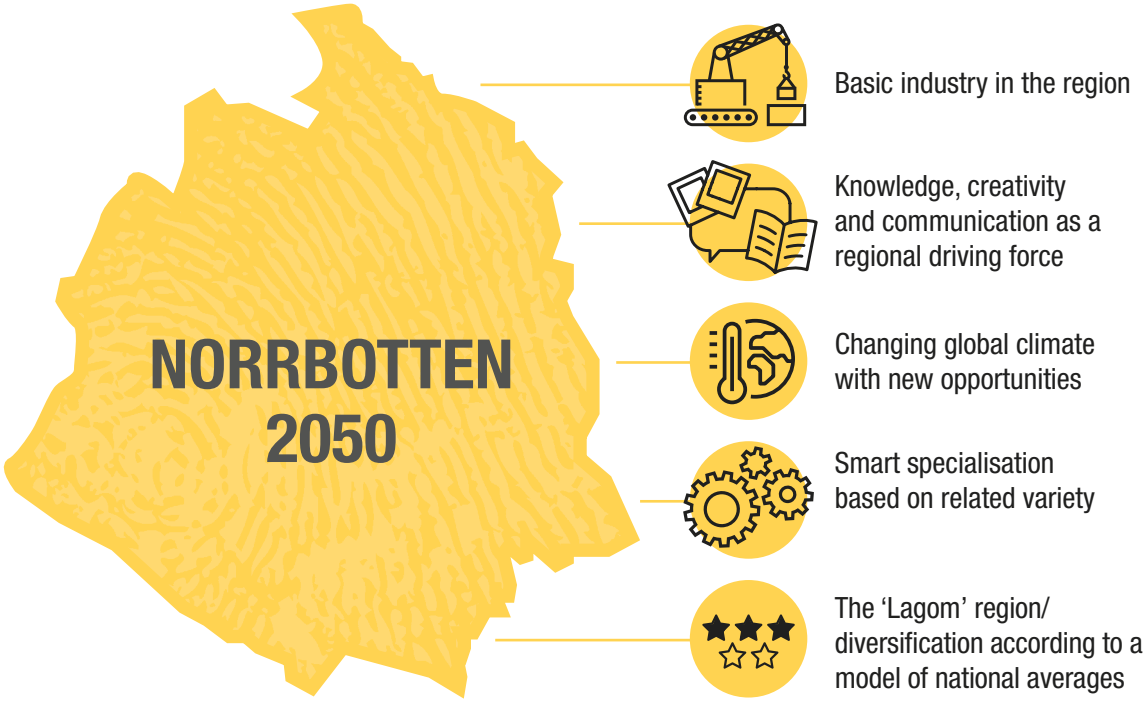

Figure 36: Alternative scenarios for Norrbotten 2050.

166 Scenarierna kommer från Regional förnyelse av och i Norrbotten. En metaanalys av länets utvecklingsförutsättningar, skriven av Thomas Ejdemo, Patrik Söderholm, Håkan Ylinenpää och Daniel Örtqvist.

The basis for a scenario is both various partial and sectorial trends and prognoses, and a possible idea of an 'intrigue,' i.e. a driving force. This makes the scenario methodology interesting, not just for the evaluation of alternative views of the future, but also for the evaluation of options to influence and develop in the direction of what is seen as a desirable future option. The future is not a static history prognosis; many possible futures exist at once. Scenario planning enables a dynamic perspective of the future through an exploration of various development alternatives that lead to a number of different alternative futures. Given the amount of information that has been collected about Norrbotten's conditions over the past few years, and the many unpredictable parameters that influence the future, we have tried to create five alternative scenarios for the county's future. All scenarios are for 2050, but developments up to the present year are also partially described. The purpose of the scenarios is not to create a prognosis for Norrbotten's development, but to raise and discuss what different types of measures and external conditions can mean. The image above shows five different scenarios for Norrbotten. The next few pages present the scenarios developed by LTU in their report *A Meta-Analysis of the County's Development Conditions*.

Scenario I: The Basic Industries Region

In this scenario, Norrbotten in 2050 is a county that is still heavily characterised by a basic industry that adds value to the county's natural resources – minerals, forest and water- and wind-based electricity. This means that the county has held on to a comparative advantage when it comes to the above-mentioned industries, and there is still a relatively high demand for the added value products that the county has to offer. The continued strong position of the county's basic industries has been enabled by capital-intensive investments that have improved the industry's competitiveness, but that have also, in some cases, brought significant structural changes to production. The state has partially financed investments in new technology and infrastructure.

The mining boom that characterised the county's development from 2004 and some ten years forward, when raw materials had high prices, meant that the mining industry's share of GRP reached levels of over 20 per cent. After a downturn with lower prices and negative operating results until around 2020, the county's mining industry has once again recovered, and now enjoys good profitability in general. The expansive plans that came to nothing in the 2010s were partially taken up again a decade later, and mining production's share of GRP is as high in 2050 as it was during the mining boom at the beginning of the century. The industry is still dominated by LKAB and Boliden in 2050, but a number of new companies, some of which have international owners, have opened new mines, among them iron ore and copper mines.

A prerequisite for this development has been a relatively high demand for metals and raw materials. Demand for iron ore in China, for example, has stagnated in 2050, but it has picked up in other regions, such as in a number of fast-growing African countries.

Norrbottens-Kuriren
Onsdag 21 oktober 2015

Fortsatt låga råvarupriser

GÄLLIVARE Efterfrågan på mineraler i Kina är avgörande för prisutvecklingen på råvarumarknaden. De låga priserna kommer inte att stiga ännu.

Det säger Linda Wårell, docent i nationalekonomi från Luleå tekniska universitet som forskat inom energi och mineralmarknaden. Men hon är inte orolig för gruvnäringen i Norrbotten.

– Boliden och LKAB är två stabila företag som varit med om sjunkande reala priser förr, de är ganska väl rustade för det här. Inget företag vill verka på en sådan marknad, men är man tvingad att göra det så måste man göra det, säger hon.

Konsumtionen av aluminium, nickel och koppar har ökat stort från 1950 fram till idag. Ändå är priserna låga idag, men historiskt sett inte lägst.

– Jag ser inte att prisnivån kommer att stiga under den närmsta tiden. Dels för att vi ser en avmattning i efterfrågan, men framför allt för att vi ser en stor ökning i produktionen, säger Linda Wårell.

Tillväxtländerna Kina och Indien har tappat lite fart men fortfarande är efterfrågan på mineraler och metaller hög där jämfört med för tio år sedan. Det som påverkar den framtida utvecklingen av efterfrågan styrs av Kina.

– Exempelvis efterfrågar Kina 50 procent av all stål i världen. Det som händer där får en väldigt stor effekt på marknaden. Under perioden med höga priser är det många företag som satsat på nya gruvprojekt för att öka sin produktion, och de börjar komma ut på marknaden nu. Det leder till att priserna sjunker. Mindre gruvföretag med högre kostnader slås ut, vilket kanske stabiliserar på sikt utbudet men det är svårt att se det just nu.

– Jag tror inte gruvverksamheten i Norrbotten är hotad, den är viktig för hela Europa, säger Linda Wårell.

Monica Olofsson

Figure 37: An illustration of a typical part of a raw materials-based economy. Source: The Norrbotten Courier.

The development has also been made possible by a number of infrastructure investments, such as double-track railway from the mining towns, and continued mining engineer education at LTU and other seats of learning in the country. In 2050, the county also has good opportunities for the mining companies to recruit competent staff and subcontractors within the county, something that is also connected to increased immigration. The companies' competitiveness is still based on the existence of efficient production processes and a high degree of delivery reliability. This has been enabled by investments in increased automation, and continued value added to iron ore pellets for instance.

Periods of respectively high and low prices for raw materials create an ongoing need for other sectors in the regional economy to be able to diversify their operations. Either so that a broader spectrum of mining companies that can hold their own internationally are created, or through other operations, or a combination of these alternatives. Even if certain companies, such as Mobilaris, have developed into world leaders in their niches, the county still experiences strong financial ups and downs in 2050, since prices on the global raw materials markets still fluctuate.

Up to 2050, the work of the mining industry has been characterised by an increased focus on combining maintained competitiveness with increased societal responsibility concerning environmental effects, social issues, and connections to the local economy, to as great an extent as possible. Increased automation and digitalisation of the industry has, in 2050, meant that the number of directly employed people in the mining industry has decreased significantly. Though the county is in a good place – thanks to competent labour – to benefit from the mining industry via subcontractor projects, such as maintenance and replacement investments, and further innovation and added value in 2050, the trend has increasingly moved towards small mining municipalities not getting a lot of benefit from the industry in terms of increased employment numbers and tax income. Mining companies are increasingly being managed from other, bigger cities where highly educated members of the labour force prefer to live. The debate about how the industry can strengthen connections to local economies, i.e. the municipalities, in the long term, is therefore just as intense in 2050 as in 2015.

This is further emphasised by the fact that developments in distance-bridging technology has started to be used more in the public sector, not least in health care. Therefore, the municipalities need fewer publicly employed people on site. Many small municipalities begin collaborations with each other to be able to finance public operations and utilise the advantages of large-scale operation.

The environmental effects of mining have been significantly reduced between 2015 and 2050, for instance as a result of better technology and stricter regulations for after-treatment, increased energy efficiency, etc., but there are still conflicts around environmental impact and land use. This is in part because the positions of the Sami and reindeer husbandry, and Sami peoples' right to land have been strengthened, and it's more important than ever for the mining companies, and for wind power exploiters, for instance, to relate to, and, to an extent, satisfy other parties' rights and interests. The year 2050 is therefore more characterised by collaborations and long-term agreements with Sami villages, as well as tourism businesses. The mining companies have made great efforts to attract competent staff and more women to their operations, but there are still problems with local mining towns seeing an overrepresentation of men in their populations.

The period leading up to 2050 is also characterised by a strong focus on climate and energy adaption. This brings both threats and opportunities for the traditional basic industries. The mining industry has made its operations more energy efficient, and LKAB has phased in natural gas and biofuels in its pellet production plants, for instance. The county has seen a continued, albeit slow, expansion of wind power; a combination of home-produced electricity from individuals, and big wind power parks, some of which are located at sea. The bioenergy sector experiences stronger but also less varied growth. Forestry delivers more and more raw materials to both pulp and paper production and other biobased products, mainly various green transport fuels like DME and ethanol, but also chemicals. The latter has been made possible because the traditional paper and pulp industry has gone through an extensive structural change, turning into so-called biorefineries, where a flexible mix of different products based on raw materials from the forest can be produced.

The steel industry has maintained a focus on high-performance steel, but has worked hard to reduce emissions of carbon dioxide from the furnace process. Both the biorefinery development and the steel industry's carbon dioxide reduction have, to a significant extent, been made possible by state investment support that enabled pilot facilities and research and development projects in close collaboration with the industry, for instance. The creation of low-coal investment and development plans for Swedish basic industry began shortly after the climate meeting in Paris in December 2015.

Some of the challenges facing the mining industry also apply to the other natural resources-based industries to a great extent. Overall, employment opportunities have decreased, in part due to remote management of wind turbines and increased automation and digitalisation in the processing industry. Norrbotten's population in 2050 is no bigger than it was in 2015, i.e. 250,000 inhabitants.

Scenario II: Knowledge, Creativity and Communication as a Regional Driving Force

The main explanation for industrialised regions' financial development has been the establishment of export-based industries, in Norrbotten mainly connected to the mining and forestry industries. These establishments result in labour moving in, and goods- and service-producing companies are thus stimulated to come to the region. In this scenario, labour moves to where there are jobs, and investments in the construction of homes, public services, etc. should only be considered 'follow-up investments,' rather than something that drives further regional development in itself.

The societal development of scenario II is based on other factors and causal links than the ones mentioned in scenario I being, and continuing to be, just as important for the county's development. Rather than people seeking out towns where companies choose to establish themselves, jobs emerge where people want to live. During the 2015 – 2050 period, knowledge-intensive and high-tech production has been further strengthened. This combined with higher incomes and low costs for communication creates changed conditions for the county's financial development.

Digitalisation has, among other things, led to raw materials-based industry establishments creating fewer direct employment opportunities, and it's now easier for the relevant surrounding operations to be located in other regions than the towns where the mines and/or paper production plants are found. In this knowledge-based economy, it's access to competent labour and human creativity that determines where businesses choose to go. In other words, the businesses follow the labour, and the driving forces for regional development are – to a great degree – home infrastructure, public services, leisure activities, good education and career opportunities, culture, etc.

In this scenario for 2050, Norrbotten is a county where the municipalities try to put significant resources into creating attractive societies to live in more than they do today. Many municipalities struggle, however, to finance such investments, and the Swedish state offers relatively little support for this cause. Highly educated labour mainly seeks out towns close to the coast like Luleå, Piteå, Boden and Älvsbyn. In 2050, Norrbotten is a county with close to 300,000 inhabitants, but with a significantly larger proportion of the population in the bigger coastal towns than today. Luleå is a town of 100,000 inhabitants.

Figure 38: Knowledge, creativity and communication as a regional driving force.

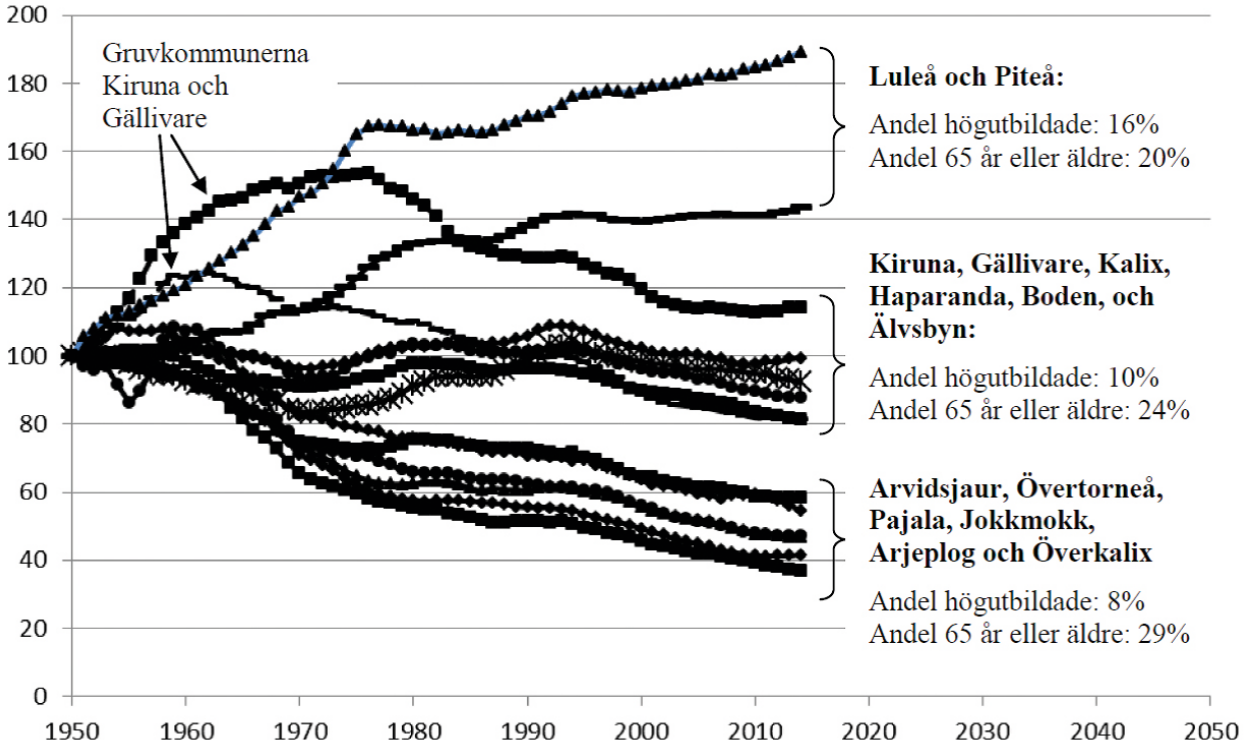

Figure 39: Population development in Norrbotten's municipalities 1950 – 2014 (index = 1950) and education and age structure from 2014. Source: Statistics Sweden.

In the figure above, the proportion of highly educated people responds to the proportion of people aged 16-64 who have at least three years of post-upper secondary school education.

Digitalisation and increased productivity have meant that mining company employees, for instance, have generally high wages, but many people choose to live in other municipalities than the ones where the mines are found. The coastal municipalities are home to many operations concerned with digitalisation and maintenance that support the raw materials-based industry, but that also export ideas to other countries. It's important for the businesses to be close to other businesses, as it's in the meetings between the businesses that new ideas emerge. A number of growth centres attract more labour and businesses still, and are therefore self-sufficient to a great extent.

One important prerequisite for this development has been a well-developed transport infrastructure, and in 2050, the whole North Bothnia Line from Haparanda to Stockholm is complete. The airport in Luleå has also expanded by several international routes, and even the smallest airports in the county remain. Personal, physical meetings are just as important in the knowledge-intensive economy as before, even if technology enables remote meetings.

There are several challenges connected to this scenario. One of them is that great differences appear between the county's municipalities, and that small municipalities end up in a vicious circle when it comes to financing difficulties. To grow, they need to attract well-educated labour, but they often don't have the resources, i.e. the tax income that is required to make the necessary investments to create attractive homes with good opportunities for leisure activities, culture, etc. Therefore, no growth that could make such investments possible takes place.

Even for the municipalities that do grow, the scenario can lead to difficult choices around how public funds should be spent. Since an important prerequisite for development is to attract highly educated labour, there is a risk that public funds are used in areas that benefit this particular group in society. When it comes to culture, there will still be a debate in 2050 about whether investments should be made into more niche and perhaps local culture, or commercial projects whose only purpose is to market the county.

Since highly educated labour, new technology and new ideas are largely the base of national as well as regional financial development, we see relatively extensive differences in income between different groups in society in 2050, primarily between highly educated people and those with little education. At the same time, the tax systems have changed so that there is more wealth tax, including property tax, and tax on very high incomes. This has been made possible in part through an increased degree of international cohesion concerning tax on capital. At the same time, the individual municipalities are still highly dependent on income tax from people who are registered in their municipality.

Scenario III: Changed Global Climate with New Opportunities

In 2050, global warming has changed our world. The lack of water in combination with recurring floods in areas previously considered ideal places to live and work has meant that the countries around the Mediterranean, and American states like Florida and California have become increasingly inhospitable. Cities that were previously overpopulated look more and more like dried-out ghost cities, characterised by an aging population, and increasing poverty and crime. Other megacities, like Shanghai, have been flooded by salt water, and are uninhabitable. The combination of droughts and floods has caused conflicts between people and nations in the fight for drinking water. The following maps (see below figure) of the water situation in the world in 1995 and 2050 respectively illustrate how drinking water has become an even scarcer resource in the world.

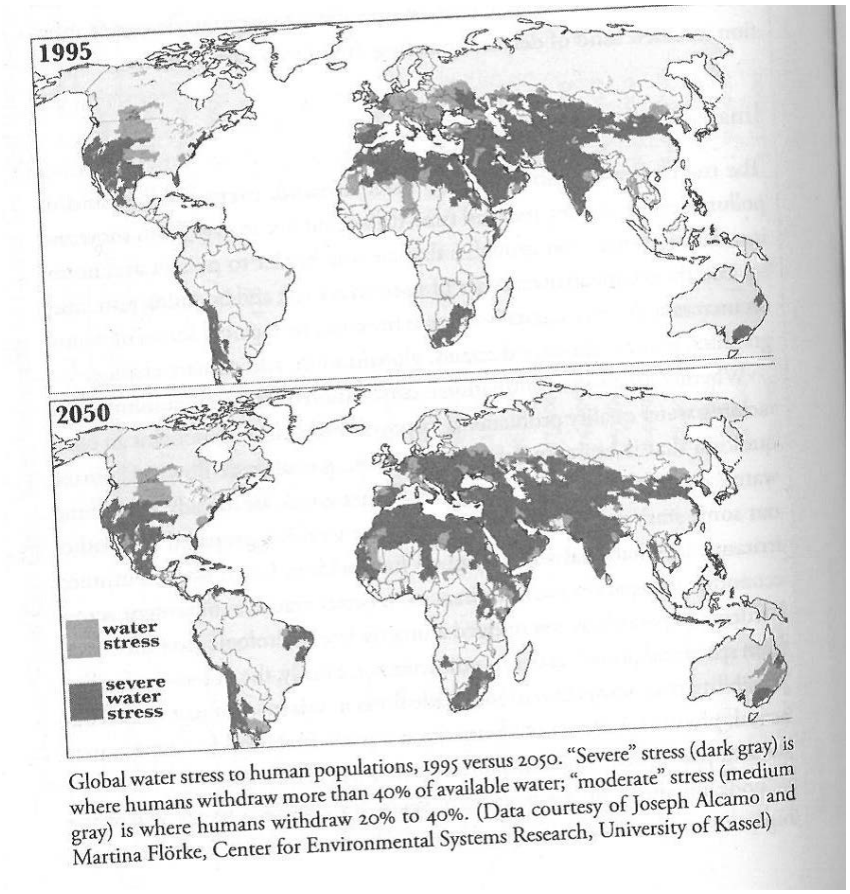

Figure 40: Access to clean water in the world from 1995 to 2050. Source: Lawrence Smith (2012) The new north: The world in 2050.

Instead, Arctic areas like Russia, Alaska, Canada and Scandinavia have stepped forward as increasingly important regions, and thanks to a progressively more pleasant climate, they attract more and more businesses and inhabitants. The Arctic regions' natural resources in the shape of oil, gas, minerals and clean water have also contributed to this positive development. Regions like northern Sweden, which were previously seen as negative migration regions, are now blossoming, also thanks to the political stability they can offer. The lack of natural disasters like earthquakes, tsunamis and floods creates good and stable living conditions for businesses and households. In 'Europe's last wilderness,' in Norrbotten, trade and industry based on natural resources and green renewable energy coexists with modern information technology and a tourism industry that offers experiences to visitors with purchasing power from across the world.

This development began as early as one or a couple of decades into the 2000s, when mega-corporations like Facebook chose to establish its first European facility in Luleå because of the region's advantageous climate, good communications, political stability, and access to cheap, renewable and delivery reliable energy for cooling of the company's many servers[167]. The lack of snow in the Alpine countries and southern Sweden also meant that interest in Norrbotten's mountains and their winter sports facilities increased dramatically, both among visitors and the entrepreneurs who previously ran facilities in places like Kitzbühel, St. Moritz, Grenoble and Sälen, and who now, through facilities in northern Sweden, have gotten themselves another 'basket for their eggs' in offering their guests guaranteed snow. The import of entrepreneurial and financial capital from other parts of Sweden and Europe has also enabled big investments into a regional tourism industry that used to have a great need for different types of societal measures. The opportunity, offered when there is no snow on the ground, to dip your mug in a babbling mountain brook to quench your thirst during your mountain or forest hike, hunting or fishing tour, or other nature-based activity, has been named the global tourism industry's experience of the decade by Lonely Planet, which also highlights how competition over natural resources like land and water risks becoming an arena for regional conflicts between different interest groups.

The conflicts between exploiters, natural interests, and indigenous peoples that often characterised debates in the early 2000s sometimes reignite, even if the insight has been reached that the region's natural resources can create win-win solutions for everyone involved through careful exploitation based on understanding and recognition of different parties' interests. 'Sustainable mines' that don't impact the environment negatively are a reality, thanks to research at the Luleå University of Technology, and through a widely accepted set of rules. LKAB's visitors' mine in Kiruna has also been complemented by a subterranean train line of 40 kilometres that offers visitors from around the world special experiences in the world's biggest subterranean mine.

Global warming has, however, also had positive effects on other nature-based industries. Thanks to a more beneficial climate, a longer growing season, and midnight sun that leads to higher intensity and positive qualitative effects on many crops, agriculture and vegetable-growing, which was almost killed off as an industry in 2015, has made something of a comeback in the region's business structure. The industry now employs twice as many people as at the turn of the millennium, thanks to the use of new technology developed at the Swedish University of Agricultural Sciences, and an extensive added value industry. These employment opportunities are spread across the region. The region's KRAV-labelled products with the brand "Produced in Top of Europe" are very in demand in other parts of Europe. The region's reindeer husbandry industry faces new challenges, however, when a warmer climate leads to reduced pasturage and changes to the use of traditional calving grounds and migration paths, and when changes to winter pasturage require increased supplementary feeding.

167 See the study performed by Håkan Ylinenpää et al. on this theme, commissioned by Näringsdepartementet and Tillväxtverket in 2014.

Scenario IV: Smart Specialisation Based on Related Variety

The year is 2050. Norrbotten, with its 350,000 inhabitants, and the main town of Luleå with its 100,000 inhabitants, can look back on a dynamic and relatively transformational development. An earlier marked dependency on basic industries with cyclical variations to demand has been replaced by a more balanced regional economy where basic industry in the shape of mines, forestry and paper industries, and energy production are now complemented by operations that, in various ways, are related to the region's traditional industry and competence[168]. In 2050, the mining industry is responsible for around ten per cent of the county's GRP, but the number of direct employments in the mining industry has decreased significantly.

The fact that ongoing capital rationalisation and digitalisation of basic industries have led to a reduction of a large number of employment opportunities has been more than adequately compensated by growth in new operations and businesses that can exploit synergies with basic industry in a number of ways. This includes the clusters of some 50 small and medium-sized ICT businesses that, with basic industry as customer and partner, develop products and services that are now sold to basic industries across the world – a development that began with the ProcessIT Innovations project in 2002. Another example is the cluster of large and small businesses working in data storage and cloud services that – helped along by Facebook's establishment of its first European data centre in Luleå in 2013 – has appeared in various places in the region, in which a European research and development centre with a great reputation, helped by researchers at the Luleå University of Technology, has been putting important measures into place in the development of completely new, energy efficient products, services and system solutions for several years[169].

So the dichotomy between traditional and – according to some – outdated basic industries and more modern operations that characterised and often paralysed the debate around fifty years ago is no more. Instead, insight concerning the value of combining and utilising the region's characteristic competencies and unique resources in new areas and applications has become a prominent regional development strategy that characterises behaviour in the region's public organisations and in its businesses alike.

This also applies in other traditional strength areas such as energy production from local hydropower and wind power. Increased awareness of the environment has not just contributed to increased demand for renewable, green energy of the traditional kind, but also to a development of renewable energy sources – a development in which researchers from the Luleå University of Technology have performed important work. Waste heat from the region's basic industries and data centres are important requirements for the vegetable-growing under glass that now takes place in many places in the region. Cooling water from the region's paper pulp factories, which in a paperless society manufacture completely new, fibre-based products, similarly provide important location conditions for the many fish and shellfish farms that are competing successfully on both the national and international market.

Not everything is about combining basic industries with digitalisation, however. Goods and services that have been created based on the need for using new technology to look after an aging population living in more sparsely populated parts of the region have finally started to develop into a more significant industry with a great export potential. Over the past few decades, the tourism industry has also been established as a new basic industry in the region, connected both to subterranean experiences in Kiruna and Malmberget, and to unique experiences at the Swedish and European space centre in Esrange and LTU's space campus in Kiruna. The region's traditions in food production connected to reindeer husbandry, game, fish and berry businesses have, alongside conditions for high-class vegetable farming thanks to the

168 The significance of a development based on related variety was determined as early as in the 1990s through contributions from researchers like Ron Boschma, Björn Asheim, etc.

169 Ylinenpää et al. (2014).

clean air and water in combination with the effects of the midnight sun, created conditions for unique, high-quality products and food experiences on site. Businesses like Lapp-Simon and Polarica have thus developed into large corporations with agents and sales companies on most international markets, and there is an ongoing development of products, services and franchise concepts that supply an increasing demand for what the region has to offer. The traditional Sami culture is also an invaluable asset that competitors with copycat ambitions struggle to match.

The development towards traditional but developed basic industries being connected to other, related operations in new areas has had a beneficial effect on the region's population and education structure.

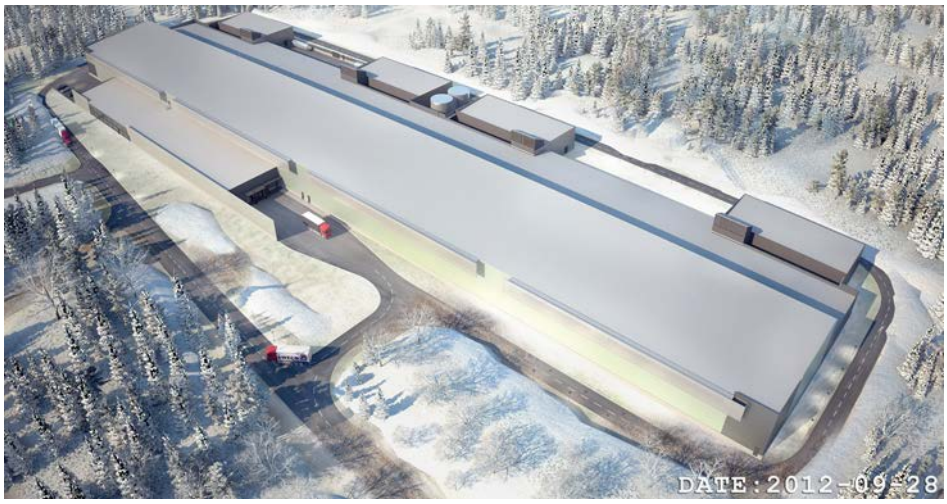

Figure 41: The Facebook establishment in Norrbotten.

Women, who on a previously male-dominated labour market felt marginalised, and often chose to leave the region, are staying for the sake of their own professional careers to a greater extent, but the developed labour market also attracts women and whole families from other parts of the country and abroad. The high level of labour immigration to the region from 2015 to 2025 in particular has enriched regional and local culture in a beneficial way, and led to exciting meetings between regional and international competencies. One visible result is the many new, smaller businesses with completely new products and services that have been established by Swedes and new Swedes for whom the step onto the international market is no longer an insurmountable obstacle. The diversity of different backgrounds and experiences has also contributed to a more pluralist and multifaceted cultural scene.

The development towards smart specialisation, which was so hotly debated during the first decades of the 2000s, was countered by mental blocks in an established industry structure and an outdated division of different industries for a long time. New inhabitants moving in from other countries has, however, led to a valuable influx of both new perspectives and new competencies, and counteracted the 'home blindness' that a population based only on people born in a place can often lead to. The import of well-educated labour has been particularly significant in new areas in the region like media, pedagogical information and communication technology products, and e-health.

Scenario V: Diversification According to a Model of National Averages

The final scenario for 2050 is based on Norrbotten trying to work to strengthen the industries that are currently weaker when compared to the rest of the country. To get there, strategies to counteract the sensitivity to market fluctuations that the region has, due to specialisation in cyclical, nature-based industries, have been used. The scenario can thus be interpreted as a qualitative vision of a Norrbotten where the idiosyncrasies that characterise the industry structure of 2019 have been partially erased, for better or worse.

In the 2000s, Norrbotten saw a period of strong economic growth which, to a high extent, was driven by developments on the global raw materials markets, especially increased demand for iron ore from China and India. Local communities, however, increasingly felt that it was hard to absorb the financial benefits generated by mineral quarrying, except for the income tax that local labour's wages brought. As a result of a lack of housing, and imbalances in the regional labour market, for instance, labour sought out well-paid jobs in and around the mines, where work was often organised in shifts to enable longer commuting periods to homes in other towns. The term 'fly-in-fly-out' was borrowed from the international vocabulary, and came to be synonymous with different kinds of long-term commuting, and the term was often used in connection with debates about how tax income disappeared to other towns. So, when the metal prices dulled down a few years into the 2010s, and the last ten years of iron ore price increases had all but stagnated, a number of projects were put on ice, and potential new employment opportunities in the mining industry never emerged. The industry remained an important local employer, but while news reports about the mining industry were characterised by growth, record profits and the emergence of new business opportunities in the early 2010s, the latter half of the decade dealt with savings programmes and survival in tough, international competition.

In 2050, Norrbotten is in a position that is considerably different to what it was 40 years prior. Global demand for iron ore has been low since development in China has stagnated, and no other country has taken over as a clear growth engine. Norrbotten is not dependent on the mining industry in the same way as before, however. In connection with a weak economic development in basic industries in the 2010s, the region's interest in promoting these industries' long-term development decreased. Instead, the will to break away from this path and create a more diversified economy set the tone. This was expressed in unwillingness from the region's representatives to collaborate with basic industries on competence supply and issues of infrastructure. In 2050, a number of mines are still operating in Norrbotten, but the businesses struggle more and more to maintain profitability, and have started to look abroad for new investment projects and future plans. Existing operations have taken on the characteristics of 'oil rigs,' with poor connections to local communities, in part because of long term difficulties recruiting local labour and a lack of local subcontractors. Higher taxation for the mining industry, which was brought in at the end of the 2010s, reduced the appeal for foreign parties, and the only prospecting that has been performed has taken place in connection with existing operations.

Higher taxes on mineral quarrying benefited the region to some extent, as some of the income fell to the region, but in spite of this, there was a determination among Norrbotten's businesses to choose other routes of development, and break away from the dependency on basic industries. Some of the mineral income financed investments in making the county an attractive place to live to benefit population development, which had been modest but positive, largely due to immigration. Now in 2050, Norrbotten has just over 250,000 inhabitants. Significant investments have been made to develop a more diversified trade and industry, with the country as the model. One consequence of the will to break dependency on mining and forestry was a lack of interest from the public in financing development projects connected to basic industries. Instead, there was a strong focus on diversification, which led to existing operations in the county being poorly supported for many years. Instead, various projects and investments that were inspired by national trends in industries where Norrbotten lacked important knowledge infrastructure and other conditions were often promoted. These types of investments often led to poor profitability and a relatively inefficient use of development means, but there were

also examples of successful investments.Thanks to new technology and changed working methods that enabled increased productivity in areas like health care and other care, and not least because of a big effort concerning immigration that was partially financed by income from basic industries, competence supply in Norrbotten has worked relatively well.

The collective result of the diversified strategy of this fifth scenario is successful in some interpretations. The regional economy has been transformed by 2050, and no longer shows any particularly strong specialisations compared to the country. In general, an industry structure that is more similar to the country's has been established, but independent analysts say that the region's resources could have been used more efficiently with a strategy that promoted smart specialisation rather than diversifying with the country as the blueprint. Whether a strategy that aims for 'the average' can be a successful recipe to achieve an attractive and sustainable region is likely debatable, as it probably risks focussing on the region's identified weaknesses rather than promoting the existing strengths. The driving force behind the scenario that is described here seems therefore to contradict the purpose of regional development strategies – that each region should use and benefit from their unique sets of circumstances. This can be characterised as the big challenge of the scenario – ignoring the so-called comparative advantages, and trying to build a new business structure that reduces vulnerability. Attracting the competence and necessary capital to achieve this appears to be a great challenge, especially considering that the region's opportunities to practically influence business structure are limited to potentially being able to stimulate development in different directions. We also note that even if a regional so-called diversification strategy could be implemented, significant local specialisations – and vulnerabilities – will probably remain, especially in the smaller municipalities.

A Synthesis and Categorisation of Important Challenges

In most scenarios, basic industry is important to the county, but the scenario descriptions differ when it comes to how big and how significant it will be, and how varied other trade and industry will be. Norrbotten has a comparative advantage in raw materials-based industry, and for as long as that is the case, there are clear challenges connected to handling the fluctuating development of raw material prices. These challenges are partially psychological – there is a risk that both private and public parties overestimate long-term profitability of new investments during long periods of high prices, and periods of low prices can equally be a source of exaggerated pessimism.

Dependency on the development of raw material prices on the world market can be somewhat broken, for instance in the scenario that is based on smart specialisation and the emergence of a more varied business structure. But this too holds significant challenges. In such a scenario, important synergies emerge between new, innovative businesses and basic industry, around process IT and digitalisation etc., and one challenge is achieving this without increasing dependency on the development of raw material prices. This can be done through the export of generic, technical solutions to other countries and industries, for instance. An increased focus on smart specialisation and related variety also leads to challenges connected to the county not being able to specialise in everything. Difficult choices have to be made, and the ability and courage to prioritise are required. In the scenario with diversification according to a model of national averages, the risk of conformity and a lack of unique businesses becomes especially clear.

The need for competence and education is highly dependent on the business structure that develops up until 2050. Since industry processes that are based on raw materials become increasingly digitalised and capital-intensive, it's important to attract highly educated and well-paid engineers to the county, while creating conditions for them to want to live here. In the scenarios with a more varied business structure, there is likely a challenge for the Luleå University of Technology, for instance, in identifying new combinations of education programmes where subjects like technology, design and art meet. There is also a great potential around new innovations in the public sector, which, in turn, could lead to an increase in female entrepreneurs[170].

170 See Malmström, M & Johansson J (2015), Under ytan: Hur går snacket och vem får pengarna? Stockholm: Tillväxtverket. 58 s

Virtually all the scenarios lead to a relatively great need for investments, even if the content thereof differs. The scenarios where industry based on raw materials still plays an important role hold challenges. Improvements may need to be made to the railway network and new shipping harbours, for instance. The more knowledge-based scenarios, like II and IV, on the other hand, ask more of housing infrastructure and passenger transport in the shape of high-speed trains and flight connections. The scenarios all share one common challenge though, and that is how this infrastructure is to be financed, for instance how much private and public parties should invest respectively.

CHALLENGES CONNECTED TO	BUSINESS STRUCTURE	INVESTMENT NEEDS	EDUCATION AND COMPETENCE NEEDS	NORMS AND ATTITUDES	SIGNIFICANCE AND FORMS OF POLITICAL INTERVENTION
Scenario I: The Basic Industries Region	Mines a large part of GRP. Rationalisation and fewer people directly employed in industry. Continued sensitivity to market fluctuations.	Need for investments in infrastructure (railways), and in technical development in the iron, steel and pulp industries.	Great need for engineers with competence in processing industry, which can be hard to satisfy regionally (e.g. via LTU).	Risk of ongoing male majorities in mining towns, and young women leaving. May lead to recruitment problems too.	Need for state support for infrastructure and R&D. Need for development of a clear set of regulations around land usage conflicts.
Scenario II: Knowledge, Creativity and Communication as a Regional Driving Force	Knowledge and ideas-oriented production, sometimes but not always connected to basic industry.	Need for functional communications in the shape of high-speed trains, flights, etc., to enable physical meetings.	Increased focus on higher education and art and science combinations. Creating meeting points.	Risk of greater differences in income and norms between groups (e.g. culture, taxation, etc.).	Financing of public operations, especially in smaller municipalities. Focus on encouraging people to move in.
Scenario III: Changed Global Climate with New Opportunities	A more varied business structure, but often connections to traditional industries. Tourism businesses more important.	A more attractive county for immigration and tourism, so greater needs when it comes to housing infrastructure and the tourism industry.	Great need for education in both traditional and new industries, due in part to a growing population.	Potentially a more multicultural society that requires integration and the formation of norms to free entrepreneurial spirit..	Increased need for investments in infrastructure, both homes and communications, with an environmental profile. Measures for increased integration.
Scenario IV: Smart Specialisation Based on Related Variety	A more varied business structure, but without putting eggs in too many baskets. NACE codes become partially outdated..	Important to enable 'non-traditional' industry establishments. Improved communications with the world (trains, flights, etc.).	High levels of education and competence important in many areas and in new combinations, e.g. art, design, technology, etc.	Difficult to gain acceptance of the idea of municipalities being different and doing things differently. Important to integrate new inhabitants.	Important to have positive norms around entrepreneurship to utilise the competence of all citizens.
Scenario V: Diversification According to a Model of National Averages/The Land of Semi-Skimmed Milk	Business structure that is similar to Sweden's average. Difficulties with competitiveness and keeping unique competence.	Investments in education and infrastructure to promote sectors that have traditionally been weak in Norrbotten.	New competencies must be trained and encouraged to come to the county, e.g. in the finance sector. Pressure for LTU to become a broader university.	Risk for great tension between different parties as the county conforms with little consideration for its comparative advantages.	Great need for political intervention in order to create regional equality in different ways. Strategies that avoid specialisation.

Table 4: Scenarios for Norrbotten 2050: A categorisation of important challenges.

Guide to Norrbotten's Future Competitiveness

The county's foremost advantages are in its mineral assets and forestry resources, the capacity for renewable energy, attractive landscapes, networks between industry and research, as well as proximity to Norway and Finland[171]. The nature-based economy is Norrbotten's smart specialisation area. To increase diversification in the economy, existing strengths in mining and forestry, as well as added value and technology related thereto, have to be used in order to create new business and employment opportunities. Diversification of the economy related to these advantages will make development of the economy possible.

Our nature-based economy, i.e. ore, steel, forest and hydropower, should be the focus of research and development in the future as well, in order to ensure European competitiveness. As an example, we can mention that Sweden's mining and mineral-quarrying industry is already at the front edge when it comes to sustainability and efficiency, and we have a unique ecosystem where the businesses' development takes place in close collaboration with universities and institutes. This has led to Swedish mining companies being extremely productive, and they are far ahead when it comes to digitalisation and automation. Furthermore, Norrbotten is an innovation hub for the industry, with both the national (SIP STRIM172[172]) and parts of the European (EIT RawMaterials[173]) innovation programmes based in the county. We are also home to Sweden's mining university LTU, which is globally acknowledged for its research that is closely connected to industry across the value chain, as well as research institute SVERIM[174].

Economy revitalisation through knowledge dissemination between related operations is termed 'related variety.' It means that the county is to build new industries based on the strengths and competitive advantages that Norrbotten already has, while daring to take risks and trying things previously untried. A very good example is data centres establishing facilities in Norrbotten. Our safe, secure power grid, and our renewable energy supply were strong contributing factors in Luleå – in competition with the whole world – managing to secure the establishment. The data centre is now building even more data halls, and is investing in an international research centre in Luleå's Porsön.

In related variety, many important synergies emerge between new, innovative businesses and basic industry, such as around process IT and digitalisation, and one challenge is to achieve this without increasing dependency on the development of raw material prices. This can be done through the export of technical solutions to other countries and industries. An increased focus on smart specialisation through related variety also means that the county can't specialise in everything. On the other hand, education and competence in several areas, and in new combinations, such as art, design and technology, are important.

The county's innovation parties also have to understand that we can't specialise in everything, and that we have to prioritise and dare to make difficult choices, i.e. focus on things that we think can develop a Norrbotten that offers even more value in the future. This way, we can continue to move our innovation power forward, and create an even stronger and more attractive Norrbotten.

171 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas.

172 Strategiskt innovationsprogram för svensk gruv och metallproducerande industri. https://www.sipstrim.se/sv/hem/

173 https://eitrawmaterials.eu

174 Formerly known as Swerea MEFOS.

An attractive Norrbotten is also crucial for us to be able to develop an appealing society where classic commercial aspects are united with the driving forces of public parties and civil society. In this strategy, we have chosen to call this 'smart society,' an overall focus area in which you combine commercial, public and civil society interests with the purpose of increasing the region's total appeal, both for those who are already established here, and for those who choose to invest/move here, and contribute to our continuing process. Working with smart differentiation and smart societies through related variety means that we build stronger trade and industry, public operations and civil society based on the county's natural conditions.

Smart societies require us to live, travel and use transport in new ways to contribute to a more sustainable society and increase the region's appeal and competitiveness by becoming a national leader in services for smart societies, which, in turn, is done by developing and creating a fossil-free society that still has heavy industry and that still communicates with the rest of the world as people fly to and from here. Norrbotten could offer test environments for future transport systems, future homes, future management of natural resources, future circular systems for waste, sewage, water, heating, and for sustainable health care in spite of sparse population, etc.

Below, we have selected five areas that are believed to have the capacity to create smart diversification through related variety. Working with smart differentiation and smart societies through related variety means that we are building stronger trade and industry and public operations based on the county's natural conditions.

1. Arctic Test Beds for Europe

The vehicle testing industry's direct share of GRP in the regions that have testing operations in Norrbotten varies from 0.5 per cent to 14.2 per cent. The direct share of GRP is below one per cent in both Arvidsjaur and Älvsbyn. In Arjeplog, however, the share is 14.2 per cent[175].

One of the industries that is intimately connected to the testing industry is the hotel industry. Testing businesses attract a large number of visitors every year, working with testing during high season, see appendix 9.

The Arctic climate also creates opportunities when it comes to testing technology. This has meant that Norrbotten is a world-leading region in testing, since we can offer excellent areas for winter testing in a stable winter climate with temperatures that stay below zero for several months. Testing in Norrbotten first began in the early 1970s when the first courses were cleared on frozen lakes. Since then, the testing industry has grown and developed with a number of highly successful businesses that now constitute an Arctic testing cluster. Norrbotten offers testing environments for the car industry, but also for new composite materials, wind power in cold climates, track vehicles, and a long line of various future solutions. The testing industry in the region turns over around 100 million euros per year. This Arctic knowledge and connected competencies show the significance of these definite advantages for growth and development in rural regions[176].

Arctic testing has a great growth potential. The region's natural conditions, combined with competence and high levels of technology, constitute important competitive advantages. The region has unique opportunities for running Arctic testing with access to large areas that are sparsely populated, in an environment with a stable winter climate of snow, darkness and dry cold, clean air, midnight sun, airspace, and a well-developed infrastructure. There are good opportunities for expanding testing operations to other areas like flight, trains and mobile communication. See examples of different testing and demo facilities in Norrbotten in appendix 9.

175 Regionala effekter – Testnäring i Norrbotten, 2018, Thomas Ejdemo och Daniel Örtqvist, Luleå tekniska universitet.

176 OECD's (2017) Territorial Reviews – Northern Sparsely Populated Areas.

2. Our Green Industries Have Strong Growth Power in Energy Technology

One of Norrbotten's unique conditions is the access to a large amount of renewable energy in the shape of environmentally friendly hydro- and wind power. In addition, the power grid, which our basic industries are completely dependent on, is stable and built for Arctic conditions.

Political goals and regulations for reducing carbon dioxide emissions provide an incentive to invest in renewable energy. The move to renewable energy sources provides forestry's investments in the production of bioenergy with completely new growth opportunities. Increased competitiveness requires measures that promote sustainable energy usage and an energy supply based on renewable energy sources.

Porjus is home to a testing station where you can run full-scale hydropower experiments – the only one of its kind in the world[177]. Porjus' old power station, with the two research and education aggregates U8 and U9, is a centre for world-leading research. The use of hydropower has changed, due to deregulation and renewable energy sources, which means that hydropower aggregates stop and start more frequently. Norrbotten is home to experiments in research areas like rotor dynamics, turbine, storage and generator technology. This makes it possible to measure how the different parts of the aggregate are affected and how they behave while in operation, and when starting and stopping – research that is followed with great interest by the national and international hydropower industry.

177 ttp://www.porjus.se/upload/Motesplats%20porjus%20web.pdf

3. Europe's Space Centre Is in Norrbotten

Norrbotten is Sweden's and Europe's space centre. Space can enable research that contributes to solutions to global societal challenges. Space exploration gives Sweden and the EU the tools needed to handle global societal interests, like climate change, migration, mobility and energy security.

There is a strong research environment for space in the county with the Esrange Space Center, the Swedish Space Corporation's launch base, control of satellites, and tests of space vessels. The Swedish Institute of Space Physics (IRF) is located here, constructing instruments for measuring the northern lights, for instance. There is also the Institute for Space Science, which educates space engineers and space scientists, and the European Space Agency's (ESA) satellite station Salmijärvi[178]. The head office is at the Space Campus in Kiruna. EISCAT also has a receiving station that is located a few kilometres east of Kiruna's town centre. EISCAT is an international research infrastructure with only part of its operations in Sweden. It's is one of few international research infrastructures where Sweden is the host nation. EISCAT is currently investing in new infrastructure. Many new facilities in Finland, Norway and Sweden will be built. The existing facility near Kiruna will be replaced by a new one some 30 kilometres west of the town. The new system, EISCAT_3D, will be up and running in 2022[179].

In 2018–2020, the government is investing 80 million SEK to expand Esrange's capacity[180] which is a strategic resource for national and international research and development. Esrange is to develop launching technology for small and large rockets, more environmentally friendly engines, flight tests, and satellite technology. It should also be possible to use the facility to demonstrate new components for space application, for instance. The government has developed a strategy for Swedish space operations[181]. The strategy is based on developing the Swedish space industry so that Sweden becomes a strong space nation.

178 www.esa.int/swe/ESA_in_your_country/Sweden/Kiruna_Sveriges_rymdhuvudstad

179 http://roadmap2018.esfri.eu/projects-and-landmarks/browse-the-catalogue/eiscat_3d/

180 https://www.regeringen.se/pressmeddelanden/2018/07/regeringen-investerar-i-rymden--esrange-far-testbadd/

181 En strategi för svensk rymdverksamhet, Diarienummer: Skr. 2017/18:259.

4. Cultural and Creative Industries Have a Crucial Power to Change

Norrbotten needs to broaden its business structure. Cultural and creative industries contribute to this. The area encompasses operations in several industries: communication, design, architecture, music and sound, film and TV, literature, photography, visual arts, stage, gaming and gamification, etc.

Developments are moving quickly, and competition is global, regardless of what industry you're working in. So, it's important to see transborder opportunities for collaborations in which different industries can complement each other. Together, we can create new, innovative services and products that it hasn't been possible to create before. It's important that Norrbotten can offer greater competence in several areas and in new combinations, such as in art, design and technology.

5. The Tourism Industry, an Industry Experiencing Strong Growth

The tourism industry is growing, and in Norrbotten, turnover has increased by 58 per cent since 2010. In 2016, the tourism industry had a turnover of 6.5 billion SEK. In 2016, the tourism industry brought a tax income of 645 million SEK, and an employment increase of 9.35 per cent compared to 2015. The tourism industry in Norrbotten provided 4,068 annual work units in 2015[182].

The tourism industry is a growth area with great conditions to develop and contribute to increased regional competitiveness. The region's nature, culture and history, in combination with the development of good communications, provide good opportunities for creating products and experiences of a high quality. The development of Sami tourism, which uses the Sami population's conditions and needs as its starting point, can stimulate increased appeal, and more innovations and entrepreneurship in the region. The supply of Sami tourism products is limited, while awareness of and demand for Sami tourism products have grown. This can lead to future business opportunities. Development of Sami tourism in the Sápmi region should be a positive experience for individual Sami persons, Sami villages, and people who live in sparsely populated areas in general. Such a development creates employment and improves the economy of sparsely populated areas' businesses. There is a great growth potential in Sami food and handicrafts connected to the development of Sami tourism products.

The combination of new technology, research, and innovation power promotes the development of new business ideas, which provides good opportunities for Norrbotten's tourism to be competitive in an international perspective. The tourism industry is also growing with an increased focus on creating attractions for summer and winter, and connecting this to local food production.

182 http://www.affarerinorr.se/nyheter/2017/augusti/rekord-foer-besoeksnaeringen-i-norr/#.WztzR1KpWwk

Norrbotten's Focus Areas

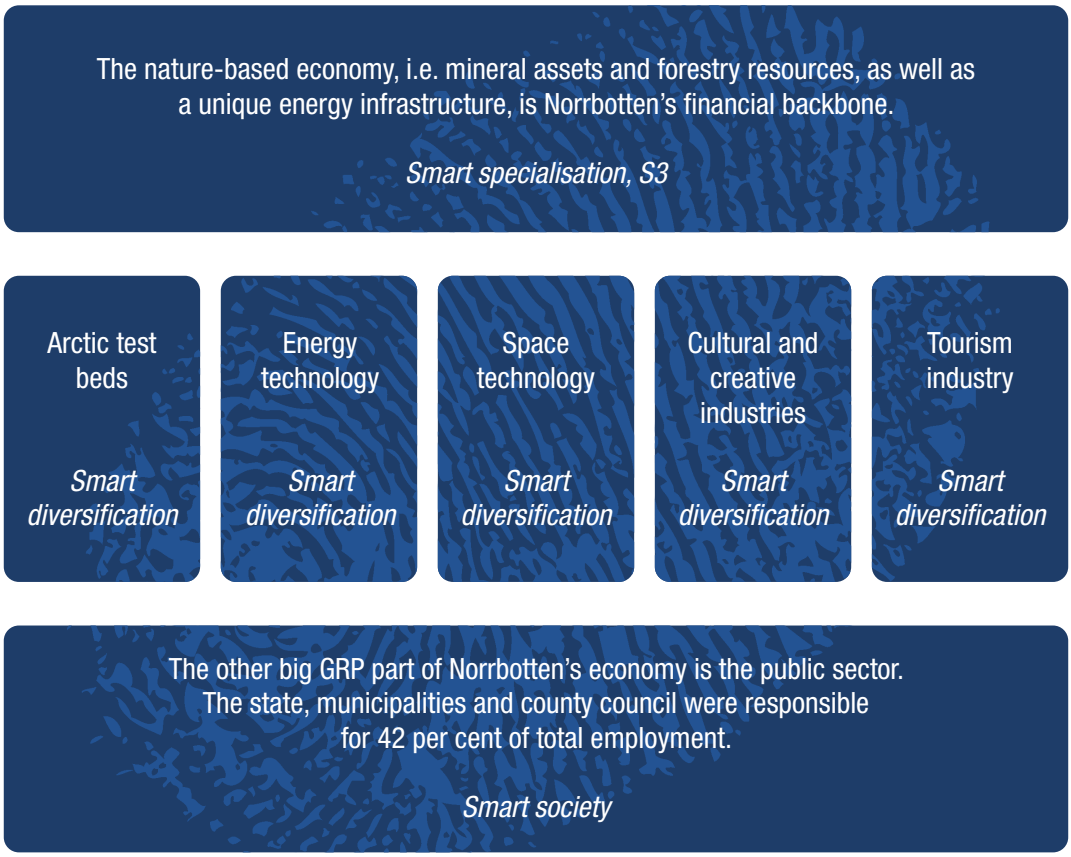

Figure 42: Norrbotten's focus areas.

The foundation of Norrbotten's trade and industry is the nature-based economy, i.e. a high degree of specialisation (around 50 % of GRP). The five middle areas show smart differentiation, where Norrbotten can grow through related variety, and the lower area shows the connection to smart societies.

For us to succeed in establishing and building new focus areas in Norrbotten, we need measures from all regional parties, however. Because new focus areas are in the beginning stages or need to be developed further, the region's parties have to take on long-term responsibilities to build new focus areas and a new innovation system.

The table on the next page shows Norrbotten's different focus areas and how well they meet the criteria to be labelled strong: research operations, there being both small, medium-sized and large businesses in the area, and established businesses that drive development in the county.

Only two of the focus areas, basic industry and energy technology, meet all four criteria for being labelled strong.

FOCUS AREA	RESEARCH	DRIVING BUSINESSES	MEDIUM-SIZED BUSINESSES	MICRO- AND SMALL BUSINESSES	COMMENT
Arctic test beds – Smart differentiation	Yes	No	Yes	Yes	The big testing businesses have their home addresses in other countries; their development departments are there. Few medium-sized and large businesses.
Energy technology – Smart differentiation	Yes	Yes	Yes	Yes	Norrbotten's S3 since the whole chain exists.
Space technology – Smart differentiation	Yes	No	No	Yes	Space incubator ESA BIC established, able to generate microbusinesses in the area.
Cultural and creative industries – Smart differentiation	No	No	No	Yes	An opportunity exists, and is in line with Scenario IV: Smart specialisation based on related variety, which highlights the importance of education and competence in several areas, and in new combinations, e.g. art, design, technology, etc.
Tourism industry – Smart differentiation	No	No	No	Yes	There is research in different parts, like e-trade, but not specific tourism research.
Nature-based economy – Smart differentiation	Yes	Yes	Yes	Yes	Norrbotten's S3 since the whole chain exists.
Society – Smart societies	Yes	Yes	No	No	Yes, driving parties exist in the area. Research area Kiruna Sustainable.

Table 5: Norrbotten's focus areas and their different possibilities.

Because Norrbotten's innovation strategy is based on the idea of related variety, which is a variant of smart specialisation, it's crucial to use the interface method. Research shows that when an area of competence or an industry intersects with another area or industry, new innovations, or so-called innovative leaps, can emerge from the interface between the two. Thus, there is a potential for future innovations in the promotion of meetings in and between industries and different types of businesses, organisations and competence areas. The image below shows examples of interfaces.

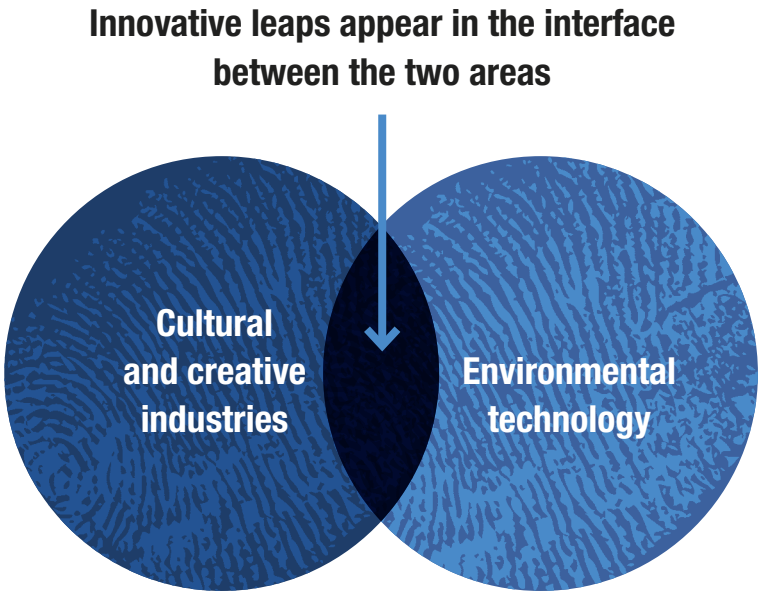

Figure 43: An illustration of innovative leaps.

One example of an interface point is industry's technology and service development, which requires applications and other digital services. Development towards equality is improved in society when the forestry and ore industries, for instance, need access to both men and women as labour, and when the manufacturing industry increases its investments in service development. With diverse people, businesses and industries, we create an important prerequisite for innovation, especially when many businesses are formed around several complementary competence areas. In these new interface points between competence areas, opportunities for new, innovative businesses, as well as a more innovative public sector, increase. This requires competent innovation labour, and labour with the right skills.

Norrbotten is to work with the tool of smart specialisation. It means that we should build new industries based on the strengths and competitive advantages we already have, while daring to take risks and trying things previously untried.

Norrbotten's Strategic Challenges

In this section, we'll show challenges that apply to all focus areas, that are strategic in character, and that it is very important for us to address in future investments.

Norrbotten has a nature-based economy, so it's important that the county works long-term with *Agenda 2030*[183]. One of its aims is to achieve equality, and to ensure lasting protection for the planet and its natural resources. The development goals are integrated in Agenda 2030. According to Agenda 2030, sustainable development has three dimensions: a financial one, a social one, and an environmental one. In Norrbotten, we need to make progress in sustainable development so that we can meet today's needs without compromising the needs of future generations. Utilising the innovation power that exists in the population of the whole region is the key to success. Therefore, Norrbotten should develop into one of the country's most attractive regions to live and work in, regardless of gender, age and ethnic origin.

183 See appendix 1 for the goals Norrbotten's smart specialisation strategy is working towards.

Investments that are made should contribute to a positive development in equality, integration and diversity, environment, and young people's situation. The horizontal criteria are the foundation for the development measures. Everything that is done has to last in the long term. Equality increases growth, appeal, innovation ability, and social capital. A region's appeal is improved by individuals seeing opportunities to grow and contribute to the region's development, regardless of gender. Equality also contributes to economic growth, as all people's competence and power to create is utilised and promoted. Equality also means that the resources that are distributed within innovation policy benefits both men and women.

Equality is a basic right, and a necessity for Norrbotten's development, so we must always have a clear image of how priorities and decisions affect equality and, not least, innovativeness in society. Increased equality also contributes to financial growth, as women's and men's collective competencies, talents, creativity and entrepreneurship are utilised on the labour market.

Norrbotten is to utilise the opportunities afforded by growing diversity. Diversity is about people with backgrounds in different ethnic and cultural environments enriching the society around them, which can happen if their experiences and abilities are encouraged rather than marginalised. Integration and diversity are growth issues for Norrbotten. Integration of people born abroad and recent arrivals leads to opportunities for the county, and contributes to solutions to the big challenges of competence supply through increased labour supply, and increases innovation in the county.

Social innovations are pioneering solutions that contribute to meeting society's challenges, in working life, health, equality and integration, for instance. In Norrbotten, a large number of social innovations have been realised by voluntary, public and private parties. They are innovations that contribute to increased quality of life and welfare in the region.

Climate change is one of the biggest challenges of our time. At the same time, the challenges of environment, climate and energy constitute a driving force for technology, goods, and service development in all industries. Trade and industry has to find a better way to utilise the growth potential of growing global demand for green and resource-efficient solutions. Renewable energy, environmental technology, more efficient energy, societal planning and building, sustainable transports and vehicles, and tourism are some examples of areas where change is needed.

Young men and women are the future. Therefore, everyone has a responsibility to give them options and knowledge about the unique opportunities the county has. Young people have to be allowed to show what they can do, want and think. It's important that young people get the opportunity to contribute to regional growth work, to practise entrepreneurship practically, and develop innovations, and that they are offered alternative career paths, get the chance to participate in higher education and contribute to developing the labour market of tomorrow.

We believe that the best way to take on solving Norrbotten's structural challenges is to use open innovation[184]. Open innovation means that businesses or organisations invite more parties to take part in the innovation processes, and systematically look for innovations outside their organisation. This can include businesses that invite other businesses and people from across the world to contribute with suggestions, and the opportunity to test developed solutions. The central idea behind open innovation is that in a world where knowledge is widespread, businesses can't afford to rely solely on their own research, but should purchase or license processes or inventions from other businesses.

Civil society also plays an important role in open innovation. A strong, engaged, and functional civil society is an important prerequisite for the ability to meet strategic challenges. Civil society gives a voice to different groups of people, supplies various services to members and society, and is an innovator of pioneering solutions to societal and organisational challenges. Civil society has an important function in contributing to the greater good, both locally and regionally.

184 Open innovation and smart specialisation are also important to the strategy's equality perspective. Research shows that civil society, which often drives or participates in the innovation systems that are organised around social service development and female-dominated networks, is marginalised in innovation-promoting measures, as a consequence of the triple helix model (Lindberg, 2018).

Strategic Challenges to Solve with Open Innovation Are

- supporting equality, e.g. women's entrepreneurship and innovation
- supporting integration and diversity, e.g. the entrepreneurship and innovation of people born abroad
- supporting the Sami population, e.g. entrepreneurship and innovation
- supporting climate change, e.g. environmentally driven business development
- supporting the innovation process, e.g. the interface method to facilitate so-called innovative leaps
- supporting innovation flow through experimental projects, i.e. the idea of the trial and error process
- supporting smart societies.

Strategic Opportunities

To be able to reach the vision of the smart specialisation strategy – Norrbotten is to be a permanent world fair for a sustainable and innovative future – the analysis in the previous chapter states that there are five strategic opportunities that the measures should focus on:

A. Digitalisation that creates global competitiveness.

B. Observing the world around us for sustainable growth.

C. Creation of test beds that give access to the innovation environments of the public sector.

D. Creation of clusters and attractive, innovative environments.

E. More efficient collaboration between innovation parties.

> Norrbotten is to be a permanent world fair for a sustainable and innovative future.

A. Digitalisation that Creates Global Competitiveness

Digitalisation concerns all parts of industry and the public sector, such as product development, production, business systems, interaction with subcontractors and customers, and the relationship with employees. Development is fast, and there are great risks – in terms of competitiveness – of falling behind. In production contexts, digitalisation is strongly connected to automation.

Norrbotten faces challenges that have to be solved for the county to be able to participate in and lead digital transformation. Advanced technology development with industrial applications, new business models, and the ability to change the organisation and develop staff competence are required for the utilisation of new technology to be possible. To improve businesses' ability to utilise digitalisation's opportunities, we need public operations to meet the new requirements for knowledge and competence that the development brings, and to ensure basic infrastructure. Today, there are completely new opportunities for smaller businesses to export and participate in the global economy. Digitalisation in the shape of e-trade, electronic payments, and e-administration solutions, for instance, means that even a small business with the right product can sell their goods on a global market.

Digitalisation can be about development and implementation of e-health with the purpose of developing access to health care and other care in sparsely populated areas. Investments in new technology and innovation systems provide opportunities to develop qualified services. This forms a base for good and equal health care, and for businesses to develop competitive products and services. Innovative solutions in the health care area can also be solutions to demographic challenges.

Digitalisation creates different processes that are based on complementing competencies, where many parties, such as small and medium-sized enterprises, researchers, non-profit parties, and public parties cooperate, in close dialogue with users, customers and citizens. Such collaboration to develop new goods and services is called open innovation, and is characterised by the utilisation of competencies outside of one's own organisation, industry andregion. For businesses,

authorities, organisations, and research institutes that operate in our region, it's important to keep up with developments, especially against Norrbotten's background of sparse population structure and distances to bigger markets. Open innovation is to contribute to more parties with different resources, genders and ethnic backgrounds being included. Norrbotten is to be a pioneer when it comes to open innovation efforts in early stages, which requires an open mind towards new collaborations across industry and sector borders.

The emergence of the sharing economy means new arrangements for renting, sharing or borrowing things instead of owning them. The combination of a sharing economy that removes traditional middlemen, and increased digitalisation and automation will have effects in the shape of changes in the labour market. People have indeed done this before, but the sharing economy leads to the extent of it growing exponentially. The sharing economy creates new services and leads to better utilisation of resources.

The move towards more sustainable production brings several challenges, as well as opportunities. To approach sustainable production, it's crucial to improve existing techniques, and to develop new techniques with higher resource efficiency, lower energy use and better environmental performance. The manufacture of products that are based on recycled materials requires new production processes and methods for assuring the quality of the materials. New techniques, like additive manufacture, have the potential to contribute to increased resource efficiency, for instance by reducing material use, waste volumes and transport requirements. The change also requires trade and industry to develop new business models with improved resource efficiency, environmental adaptations across the life cycle, and reuse through upgrading.

Suggested Possibilities

- Stimulate development and use of digital technology that has the potential to lead the transformation of industry and the public sector.
- Encourage new business and organisation models to benefit from the potential of digitalisation.
- Develop an innovation system that is not dependent on distance.
- Utilise the potential of new digital and other techniques for the change to a fossil-free and circular economy.

B. Observing the World Around Us for Sustainable Growth

The ability to deliver and benefit from innovations affects the development of welfare to a great extent. This ability is currently exposed to global competition. Mobility and change, positive or negative, happen quickly. Innovation leads to growth, which leads to welfare – a development that happens at the cost of the regions or countries that don't have the ability to develop innovations in the long term. For the county, openness towards the world means increasing collaboration and cooperation with other regions and countries. The region has to dare to see and learn from what is going on in other areas and other places. Small and medium-sized enterprises in different industries have different needs when it comes to internationalisation and exportation. It's therefore very important that society's export-supporting organisations are able to help businesses, and are available, regardless of where in the region the businesses have their operations. To better meet these needs, the formation of hubs, i.e. support points, should be stimulated in the county. The role of the hubs is to support business development[185].

185 One example of an innovation hub that we can learn from and adapt to our conditions is Sustainable Business Hub (www.sbhub.se). It's a hub based in Malmö that describes itself as 'a membership network that works passionately to form the sustainable societies of tomorrow. With members from trade and industry, the municipality, and academia, the network encourages contact and collaboration between them. The hub offers members a platform where sustainable solution innovation, development and business take place.

Prerequisites for developing the innovation environment are for research to be bolstered to improve opportunities in areas that are strategically vital to trade and industry, and for research results to be transformed into goods and services that are, in turn, commercialised. To achieve this, goals and strategies have to be developed from a collaboration model[186] and a knowledge triangle perspective[187]. Trade and industry, the university, the research institutes, the voluntary and public sectors can, together, strengthen regional development and the region's innovation power.

Smart growth means that know-how and innovation are strengthened as driving forces for future growth. One way to do this is to improve the quality of education, enhance research measures, promote innovation and knowledge transfer, utilise information and communication technology fully, and ensure that innovative ideas can be turned into new products, services and employment opportunities.

For Norrbotten to achieve strong growth, we need three parallel structures that support each other. Each one of these three need to be internationally competitive in the industries where Norrbotten's innovation strategy believes that the county has good opportunities for growth.

Research Impact and Testing Environments

To be able to compete on an international market, we need knowledge, and it must be possible to turn this knowledge into new products and services. Apart from great competence, this requires a strong research environment with different levels of testing and laboratory environments. Norrbotten's access to internationally strong research environments within the region's growth areas is crucial to how the region's growth conditions turn out. But this isn't the only crucial aspect – the region's education chain is just as important.

Education Chain

The growth that the region is to generate until 2030 should also continue to benefit all people in Norrbotten. Therefore, we need an adaptable, flexible and durable education chain that begins at an early age, and continues through elementary school and upper secondary school to research education. Folk high schools, vocational education and adult education are just as important as elementary school and university education. Study and vocation counsellors play an invaluable role by showing the way to the right education. Creating optimal conditions for each separate individual to get the most out of their education at any given time utilises the region's labour in the most efficient way, and a lack of labour is counteracted. Over time, we also need a continuous increase in the region's efficiency and, not least, an increase in the number of people in Norrbotten who are of working age.

Trade and Industry Development

The third part of Norrbotten's structural conditions for high growth is businesses. Transferring regional businesses' needs to an aggregate level through cluster formations or other collaborations, and meeting these needs faster than anyone else, create conditions for Norrbotten's businesses to reach the market faster than others. Good access to capital and competent staff is, according to the growth criteria, fundamental, and a challenge for the region. For businesses and future business people, access to business advice, information and regulations, support and other services can be very significant to the decision of whether to start or develop a business. The innovation and business advice that is financed by public means should be based on the needs of the businesses/individuals, regardless of gender, age and background. It's also important that collaboration between advisory parties on local and regional levels is improved to better meet entrepreneurs' needs and increase the efficiency of the system.

186 A collaboration model is a thought model that is about collaboration between academia, businesses, public authorities, and other parties.

187 The idea of the 'knowledge triangle' is about collaboration between education, research, and innovation on all levels and within all relevant operations, such as through partnerships between universities and businesses, including knowledge-based institutions.

The three units that have been described over the previous pages – research, education and trade and industry development – need to keep pace with each other to create the best conditions for sustainable growth over time.

Suggested Possibilities

- Stimulate investments in research and development, and in innovations for increased sustainable growth.
- Stimulate opportunities for businesses to increase their own research and development..
- Work to break the labour market's gender division.
- Improve flexibility around models for the provision of vocational education and higher education.
- Stimulate capacity-increasing measures that contribute to improving the target group's ability to participate in different European programmes, such as FP 9, with many sector programmes.
- Stimulate improved regional research infrastructure with developed national and international collaboration.
- Connect service industries with Finland and Norway.
- Stimulate the development of new service industries.
- Functional cooperation and geographically independent cooperation between regions and parties in the innovation system are important to stimulate innovation in sparse regions.
- Stimulate small and medium-sized enterprises' export ability.
- Encourage a more coordinated modus operandi for smart specialisation between NSPA regions.

C. Creation of Test Beds that Give Access to the Innovation Environments of the Public Sector

In the public sector, the concept of innovation is still relatively new, and there is not currently a coverall definition of the differences between the public and private sectors when it comes to innovativeness. There are many reasons for this.

- The public sector includes many different types of societal tasks, which makes it harder to cohesively outline who should take responsibility for innovation issues.
- The responsibility for stable, broad societal services means that the public sector often has to act in a way that is more risk-aware than the private sector.
- There is legislation and rules for the public sector that can limit the organisations' opportunities to efficiently introduce innovative solutions.
- Silo thinking in large organisation constitutes an obstacle for developing and spreading innovations, which applies in both the public and private sectors.
- The public sector can limit opportunities for innovativeness and cooperation with other parties.
- The public sector must simultaneously be able to act as an upholder of the rule of law – where everyone is treated equally, a democracy – where the majority rules, and as a welfare state – with attractive and efficient societal services. These principles aren't completely compatible, and tension and contradictory forces are therefore a natural part of the management and governance of the public sector[188].

188 Fogelberg Eriksson Anna, Nählinder Johanna, (2015) Ledarskap för innovation i offentlig sektor, Linköpings universitet http://www.liu.se/helix

The concept of innovation has to be translated in such a way that the distinctive character of the public sector is visible. This can be done through clarifying the different roles of the public sector, for instance[189, 190].

The public sector is a valuable innovation environment, as it has natural access to societal contacts, physical locations, and broad operations. It's home to the people and operations that need welfare technology and experiences both in physical and digital shape. There are also great demographic challenges that will force renewal and development of efficient societal services to emerge within the framework of the public mission, regardless of whether they are performed privately or publicly. These are the conditions that make Norrbotten's public sector an exciting innovation area over the next ten years. At the same time, limited access to resources, stricter legislation, the generational shift, and high operational pressure make it harder for the public sector to act and be resilient in development investments and innovation work. This impedes renewal work and makes it harder for new parties to develop services and products that can be disseminated within the sector. Measures are needed to enable a faster pace of innovation and development.

The organisations of civil society often discover needs early, and take responsibility for contributing to solving the problems and challenges that exist before the public sector takes over, and before there is an interest from trade and industry. These entrepreneurs with new ideas that could benefit society often come across obstacles in their attempts at establishing themselves. Their business models don't fit in with traditional ways of valuing innovations and businesses. To utilise these initiatives, we need innovative solutions that give support and incentives for the area to develop.

Test beds where parties from the public sector, civil society, traditional and new industry can be given opportunities to try and let in new solutions that deliver benefits for society, and to contribute to new, vital operations and increased employment are needed.

Suggested Possibilities

- Create defined testing areas/testing sites where innovation, development and test delivery have more space.
- Create meeting points so that inventors, businesses, researchers and ideas-driven organisations get the chance to meet and develop products that make health care better and safer for patients. In this context, the patient should also be included since they possess invaluable expertise, user influence.
- Promote innovation power in the public sector through innovation purchasing, for instance.
- Be strategic in purchasing, so that it benefits the county's development.
- Give employees and citizens space to create innovative solutions.
- Increase the use of digital technology and innovative collaboration between the private and public sectors to drive innovation forward when it comes to the provision of services.
- Social innovation and social entrepreneurship should be encouraged and stimulated to solve challenges.
- Create conditions for cross-sector and co-creative processes to shape and develop efficient welfare services based on citizens' needs.

189 Nählinder Johanna, Vi tar höjd för innovationerna – Att förstå innovationer i kommunal sektor, Linköpings universitet, http://www.liu.se/helix

190 See chapter 'The Innovation Support System – Map of Parties' for a more descriptive image of the public sector.

D. Creation of Clusters and Attractive, Innovative Environments

The region should invest resources to stimulate the creation of attractive, innovative environments where different parties from trade and industry, universities, research institutes, the public sector, and ideas-driven organisations can gather to create new innovations. This can contribute to sustainable development from a local and global perspective.

These innovative environments should not just be meeting points where people can meet, but also an environment where competence development and inspiration in the innovation area is provided. Ultimately, these environments are to be creative lab environments, permeated by collaboration between universities, research institutes, trade and industry, authorities, and ideas-driven organisations, with the goal of getting more products and services onto the market quicker.

Norrbotten is a sparsely populated region, and the county needs to bridge the distances to be able to create innovative meeting points for innovative parties, and support the participation of both men and women. These types of meeting points, physical and virtual, can compensate for disadvantages that come with sparsity and long distances between towns, businesses and markets in and outside the region.

Innovative environments can lead to the emergence of clusters. Clusters (see appendix 6 ERIS and IRIS) consist of a number of different parties working together. The parties can complement each other, but could also be in competition. The core of the clusters is businesses. Collaboration in clusters has the purpose of creating good conditions for growth and renewal. There are results that show that businesses that are part of cluster organisations grow faster than other businesses. For a cluster to be competitive, there has to be systems around it that support clusters and collaborate with them. There are two types of ways in which clusters can be initiated. Institutional Innovative Systems (IRIS) are clusters that are created institutionally, i.e. initiated by society, based on what is assessed as important areas for the region, and where growth potential is believed to be present. Entrepreneurial Innovative Systems (ERIS) are based on existing strong businesses in a region, and on society supporting initiatives from businesses and making it possible for them to develop further[191]. Conditions are very different depending on what perspective is chosen. ERIS and IRIS have completely different starting points and differ from each other especially when it comes to regional development work. The IRIS model starts from predetermined strong industries, while the ERIS model focusses more on processes for support and development. The point isn't that either of these two ways of collaborating to develop new innovative solutions is better than the other. The different types of approaches do both partially capture, however, different parties and different phases of innovative processes. In other words, if you rely solely on one method or the other, you risk not utilising a nation's or region's full innovative potential.

191 See appendix 6 for differences between the innovation systems.

Suggested Possibilities

- Stimulate development around regional clusters (ERIS and IRIS).
- Establish and develop innovative environments, test beds and demonstrations.
- Develop innovative environments that work as physical and virtual meeting points in the whole county.
- Implement measures that increase the county's participation in international networks and arenas.
- Develop research and innovation environments for increased collaboration between trade and industry, universities, the voluntary sector, and public parties.
- Develop open innovation systems, for instance to promote transborder and transnational collaborations and innovation processes within and in collaboration between industries and organisations.
- Smart specialisation is to make it possible for parties in the regional innovation system to increase their ability to supply the right competence, advice, networks, meeting points, venture capital, etc. to parties that develop innovations in the ideas-driven sector with ideas for both technical and social goods, services, methods and ways of working.

E. More Efficient Collaboration Between Innovation Parties

Smart specialisation requires openness and coordination between different supporting structures. Within and between focus areas, there are a number of financing instruments, operative plans, programmes and strategies on the EU, national, regional and local levels. The region should create coaction for these financing instruments and programmes, so that structural fund means, state and regional development means etc. are used, channelled, and create synergies in the best way. There are many local, regional, national and international parties in the regional innovation system. For progress to be made, we need efficient ways of working for financing instruments, programmes and parties, as well as continuous follow-up and evaluation of different ways of working in a learning process.

Conversations with parties in the innovation system, such as universities, research institutes, businesses and organisations should form the foundation for how best to adapt financing instruments so that they have the greatest possible effect. Examples of coaction are joint, focussed investments in prioritised areas with a strong growth potential.

Regional leadership is a requirement for achieving collaboration between public measures, and for reaching the county's goals and vision. Clear regional leadership generates a powerful development of trade and industry, which in turn becomes significant to the development of public operations. Leaders set the level of ambition, and create conditions for how we support growth companies and build national strength areas..

Suggested Possibilities

- Develop transborder collaboration and coaction between different parties.
- Work to gain access to more private capital, and initiate new forms of capital supply.

Innovation Index

Being able to continuously follow up how innovations and regional dynamics develop in Norrbotten is an important task, in order to be able to create data to assess the effects of the regional innovation strategy and its role in learning, for instance.

It's important to follow up the region's development in the innovation area, at least initially, through specifically developed measuring tools, in order to decide, later on, which follow-up system(s) the region should use.

Regardless of which follow-up system is used, it is, however, reasonable to count on data recency lagging around two years behind. In other words, the figures that various established measuring systems, based on registered data, present are not up to date. In order to efficiently initiate and parry various innovation-promoting measures at the right time, therefore, the region needs access to more recent indicators of which direction the development is headed in, see also the section 'More Efficient Collaboration Between Innovation Parties.'

Creating a clear image of a regional innovation climate using an index number or a small number of indicators is a challenge. This is evident not least from the many ways in which innovation is seen, as well as from the number of indexes that aim to assess regional and national innovation climates. Some of the more common indexes and measuring methods to assess regional/national innovation are:

- Global Innovation Index
- Global Competitiveness Index
- Global Entrepreneurship Monitor
- EU's Community Innovation Survey (CIS)
- EU's Innovation Scoreboard (IUS)
- Growth Analysis Indicators for the National Innovation Strategy
- REGLAB's Regional Innovation Index.

Based on these indexes, there are a number of variables and methods with which innovation can be assessed. Some of them, especially those that are based on national comparisons, have a strong focus on political and legal conditions. Other measuring tools, such as Growth Analysis Indicators for the National Innovation Strategy, show the importance of basing innovation indexes on the proposed strategy. Then, the innovation index becomes a tool to follow up and evaluate the strategy.

In the following work, we have integrated what we've learnt, and developed a model that measures economic development centrally, and conditions for innovation at different layers. Thus, we create a number of central indicators to follow up the smart specialisation strategy. We choose not to collate the key figures to one index number, but instead see the importance of measuring and following up a number of indicators.

The design of the index is based on an idea of input- and output-related variables. Many of the existing indexes assess both output variables, such as measurements of regional innovation activity (e.g. patent applications), and economic development (e.g. gross regional product). Conditions for innovations, so-called input variables, where measurements of the region's competence supply (e.g. proportion of people in the region with university education) could be one example of a prerequisite for an innovative region, are assessed simultaneously. In the developed index for Norrbotten, we have structured these different variables like the layers of an onion, where the centre of the onion is made up of output-related variables that show economic development, and where the next layer consists of regional innovation activities. The subsequent layers include input-related indicators that the innovation strategy has deemed crucial, and important parameters for creating conditions for regional innovation.

The figure below shows the construction of the innovation index. The central aspect, as mentioned, is economic development per capita. The second layer consists of applications for patents, brands and designs. These are the most common way to protect intellectual assets, and give an idea of innovation activity, even if far from all new innovations are protected with the help of these tools.

The third layer is made up of the region's business population. This includes renewal numbers in the shape of the proportion of new businesses, number of gazelle companies (i.e. companies with durable growth; at least a 20 % turnover increase for three subsequent years), the proportion of new medium-sized businesses, and finally, the proportion of bankruptcies.

The fourth layer is made up of industrial conditions. Here, we measure industrial specialisation, proportion of operations classified as high-tech, and related variety. Finally, we also state the proportion of regional businesses' turnover that is made up of exports.

The fifth and final layer is made up of human capital variables and variables related to competence supply. Here, the number of people of working age is stated, as well as net immigration, proportion of people with university education, and the concentration of gender per industry branch.

The purpose of the following indicators is that they, especially over time, can indicate how well the regional innovation strategy is adhered to, and can show in which areas research and development – an extension of innovation – emerge and develop.

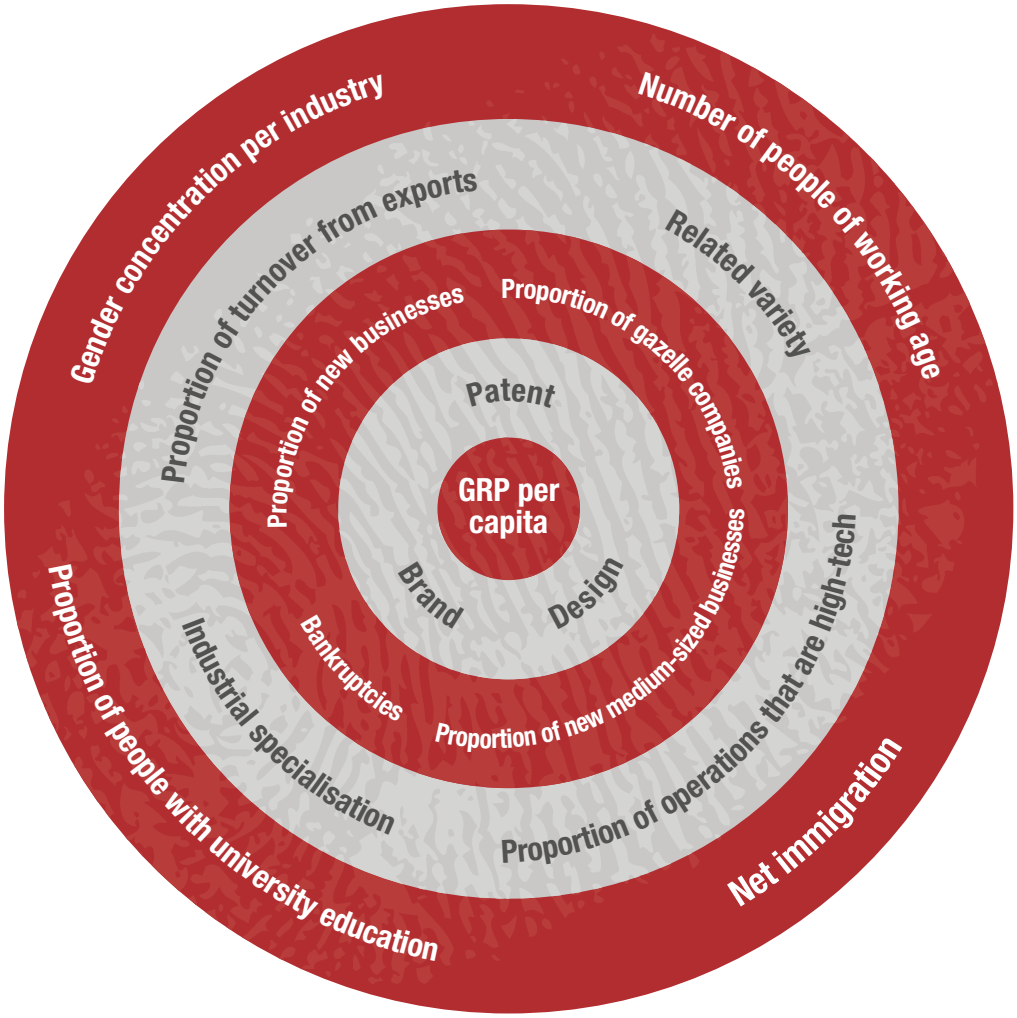

Figure 44: Basic sketch of the construction of the innovation index.

Indicators

The goal of the innovation strategy is to create sustainable growth that ensures future competitiveness in Norrbotten by 2030. There are a number of indicators that show whether we are moving towards our goal or not. They are:

- At least 1,700 new businesses per year with a survival rate of more than 75 per cent after three years. Current situation 2016: 1,484.
- Degree of internationalisation. The proportion of SMEs exporting products and services should increase to 23 per cent. Current situation 2016: 20 per cent.
- Share of SMEs investing in R&D. Should increase by 30 per cent. Current situation 2013: 20 per cent.
- Number of women working at SMEs increases. Should increase to 30 per cent, compared to 17 per cent today.
- Number of open innovation sites increases: Should increase from zero to ten in the county.
- Number of clusters (IRIS). Should increase from one to three in the county.
- Number of clusters (ERIS). Should increase from zero to ten in the county.
- Number of experimental projects increase. Should increase from zero to ten per year.

Learning Plan

A learning plan is a document that shows how Region Norrbotten and other parties can increase knowledge about Norrbotten. The latest learning plan was completed in 2019, and was written by Region Norrbotten. You can't plan the future, as the future is not predictable[192]. So, it's important to constantly measure, evaluate and reconsider your strategies and modus operandi for them to constitute necessary support in future work. The work has to be partly systematic and recurring according to joint planning for the parties in the region. A significant part of learning also takes place in the daily work situation when parties exchange thoughts, ideas and experiences around issues of development and growth. Follow-up of goals should take place continuously so that changes can be noted quickly. Follow-up and analysis are important parts of learning.

For follow-up and evaluations to be efficient instruments in regional growth work, there has to be a well-functioning learning system. The learning plan aims to create a more systematic follow-up and evaluation, and to contribute to increased learning thanks to the development measures taken within the framework of regional growth work.

The learning plan is to contribute to turning know-how and experiences into updated and new strategies, action plans, operations and projects. The learning plans are to be living documents that should be revised as new programmes and measures are planned and implemented within the framework of regional growth work.

Learning is often defined as 'the acquisition of knowledge or skill.' Both parts are important – what you learn and the understanding of why and how it's used. Learning can also be defined as an increased ability to act efficiently. For an organisation, for instance, learning could be a continuous improvement of processes to reach strategic goals. Learning could be said to be the product of three types of activities: individual learning, group/team learning, and system learning, which all take place simultaneously.

192 Göran Lindqvist, Örjan & Sölvell, Organising Clusters for Innovation: lessons from city regions in Europe..

- Individual learning happens whenever someone reads instructions, performs an investigation or gets feedback.
- Team learning takes place when two or more individuals learn from the same experience or action. Team learning can include new ways of shaping the team's responsibilities or different forms of interaction.
- System learning happens when organisations develop systematic processes for acquiring, using and communicating knowledge. Learning on a system level means seeing relationships between parts (= wholes), rather than just linear cause and effect chains.

Learning can be described as a cycle where the parts activity, experience, reflection and understanding are connected. If the learning process works so that the parts improve each other, learning that affects planning and implementation of new activities or projects takes place. Both successful and plainly bad efforts can work as good examples for efficient learning.

The figure below provides a simplified image of how learning in regional growth work can be described with the help of the learning cycle.

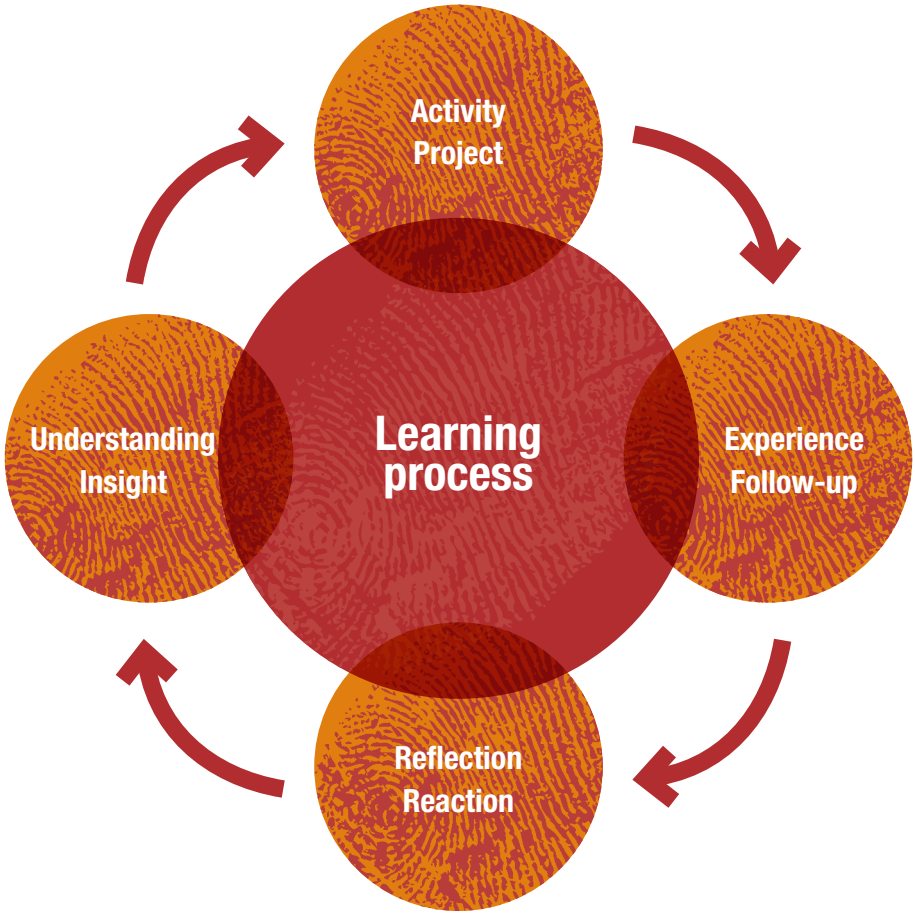

Figure 45: Basic sketch of the learning process in regional growth work.

A prerequisite for an organisation to be able to improve and quality-assure its operations is that the employees can perform their tasks in a professional way. To be able to do this, they need conditions for learning directed at adaptation, and learning directed at development.

Learning directed at adaptation means learning to follow routines, instructions, and to perform your work duties in a satisfactory manner. Learning directed at development means to question and reflect on attitudes, modus operandi, routines, and current conditions in the operation, and aims to develop and change an operation.

Organisations have to find a balance between the two forms of learning, and especially a way to utilise the knowledge generated in the development processes. The extent to which an organisation facilitates and encourages learning that leaves lasting marks in the organisation depends on the attitudes of management and employees, the support system for learning – meeting points, guidance, education format – and the demand for knowledge in the organisation. If these conditions are lacking, there is a risk that individuals' new knowledge, skills and attitudes are not used. An organisation that can manage to find a balance between these perspectives and that can create reflected and integrated learning has good chances of reaching its operational goals.

Education can be organised with the help of education coordinators, in the shape of specially designed courses or university courses, for instance. But education can also take place in the workplace where colleagues learn from each other. Both kinds can be planned and more formal in character, but the latter form of learning often takes place informally in day-to-day work. This is where silent knowledge is created. Creating functional forms for individuals' learning is, of course, a prerequisite of success, but it's just as important to create conditions for organisational, joint learning. If this is not done, there is a risk that the organisation won't develop, quality will go down, and long-term effects don't appear, i.e. the organisation won't reach its operational goals[193].

Financing

Smart specialisation may be financed in a number of different ways. The regional fund (ERDF) and – to some extent – the social fund (ESF) for upper Norrland are important financing sources alongside state regional development means, municipalities' and the region's own financing, and private co-financing.

In addition, there are opportunities for financing from other national and European funds and programmes. Below is a list of a selection of financiers, funds and programmes:

- Regional fund – national programme[194]
- Regional fund – upper Norrland[195]
- Social fund – upper Norrland
- The Rural Areas Programme
- Interreg North
- Northern Periphery and Arctic
- The Baltic Sea Programme
- Interreg Europe
- COSME
- Horizon 2020
- The Swedish Energy Agency
- The Foundation for Knowledge and Skills Development
- Swedish Agency for Regional and Economic Growth
- Vinnova
- The Kempe Fund

193 The text comes from Follow-up and Evaluation of Regional Growth, learning project 2010, with some adjustments.

194 Action area 1. Strengthening research, technical development and innovation.

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Framtidens industri, vart vi är på och varför, SWERA

Klimat- och energistrategi för Norrbottens län

Norrbottens politiska plattform för Arktis

Områdesbeskrivning och SWOT-analys av Interreg Nords programområde

Regional strategi för Innovativ och hållbar utveckling av mineralsektorn i Norrbottens och Västerbottens län

Regional utvecklingsstrategi för Norrbotten 2030 – Remissversionen

Smart industri – en nyindustrialiseringsstrategi för Sverige

Strategi för att skapa en världsledande teknikregion i Norrbotten för klimatsmarta effektiva datacenter

Sveriges exportstrategi

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Appendices

Appendix 1 - The Strategy's Connection to Other Programmes

Smart specialisation as a method emphasises the significance of looking outward to achieve results. Subsequently, we need to relate to and understand the meaning of a number of overall strategies in order to clarify the connections between regional, national and global conditions. There are interfaces between these overall strategies and the county's own work with smart specialisation in several aspects.

Agenda 2030 – Global Goals for Sustainable Development

Agenda 2030 is the new development agenda, consisting of 17 global goals with a total of 169 targets. The global goals for sustainable development supersede the millennium development goals. The agenda raises issues of sustainable development consisting of three equally important perspectives; socially, economically and environmentally sustainable development. Industry is the backbone of business, and the UN's goals for sustainable development, Agenda 2030, say that industry should be prepared for digitalisation and sustainable, resource-efficient operation, and have access to necessary competence and innovation power. Goals 8 and 9 are particularly relevant to the areas of business and innovation development:

- **Goal 8.** Target – Promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all.
  Within this goal, Norrbotten's innovation strategy has chosen to raise and focus on decent working conditions and economic growth.
- **Goal 9.** Target – Build resilient infrastructure, promote inclusive and sustainable industrialisation, and foster innovation.
  Norrbotten's innovation strategy has chosen to raise and focus on sustainable industry, innovations and infrastructure.

European Perspective

Europe 2020

Within the EU, the idea of smart specialisation has been adopted as a tool for the distribution of regional development means[196]. It's a strategy to achieve high levels of employment, low carbon dioxide emissions, productivity, and social community. It has also been adapted to regional conditions. To the extent that it is applicable, measures in all sectors should be in line with the region's priorities in the strategy for smart specialisation, in order to build capacity and contribute to synergies.

196 Europeiska kommissionen (2010). Europa 2020 - En strategi för smart och hållbar tillväxt för alla. KOM (2010) 2020 slutlig.

Europe 2020 is based on three priorities that are to enhance each other:

- Smart growth – developing an economy based on know-how and innovation.
- Sustainable growth – promoting a more resource-efficient, green and competitive economy.
- Inclusive growth – stimulating an economy with a high degree of employment, and with social and territorial community.

There are seven main initiatives connected to the prioritised areas. See image below.

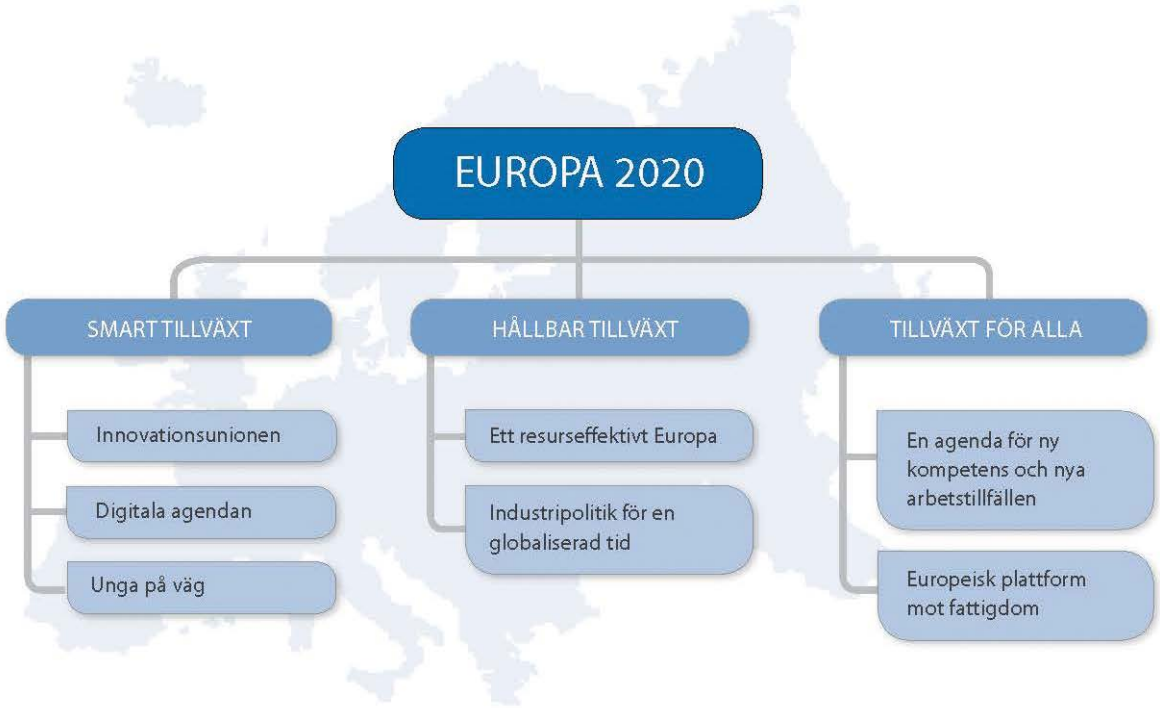

Figure 46: Europe 2020 strategy. Source: Regional development strategy for Norrbotten 2012-2020.

The Innovation Union

The Innovation Union aims to improve conditions for and access to financing of research and innovation, and to thereby improve conditions for innovative ideas to be turned into products, services, or new solutions. The Innovation Union has three basic principles:

- Innovation can contribute to solving Europe's big societal problems.
- Innovation should have a broad definition.
- Inclusive work with innovation that concerns all parties in the innovation cycle – not just big businesses, but also small and medium-sized businesses in all industries, the public sector, the socio-economy, and inhabitants. The work concerns all regions, not just the most developed ones.

The Innovation Union initiative sets the agenda for the EU's financing programme for research and innovation. It states specifically that programmes should, to a greater extent, aim for crucial societal challenges, and promote dissemination of so-called key enabling technologies. Enabling technology is technology in the following six areas:

- Micro- and nanoelectronics
- Nanotechnology
- Photonics
- Advanced materials
- Industrial biotechnology
- Industrial biotechnology.

From the county's perspective, it's particularly relevant to connect a strategy to advanced manufacturing technology[197] som är direkt relevant att ansluta en strategi till. Advanced manufacturing technologies – especially with a connection to advanced automation through intelligent systems – are the most relevant for Norrbotten. Advanced manufacturing technology is divided into innovations in the construction, manufacturing, and processing industries respectively.

The Digital Agenda

The digital agenda focusses on three areas, of which one – digital growth – is particularly relevant to smart specialisation.

Horizon 2020

Horizon 2020 is the EU's framework programme for research and innovation, and continues to be one of the most important instruments for realising the Innovation Union[198]. The programme focusses on three parts, in accordance with the main priorities for research and innovation that the European Commission developed for 2020:

- Part I: Excellent Science – this part is to strengthen the EU's global position in research and innovation.
- Part II: Industrial Leadership – this part is to make Europe more attractive to investments in research and innovation, provide answers to the financial crisis, i.e. create employment and growth, and attract more private and strategic investments to research and innovation.
- Part III: Societal Challenges – this part focusses on the big societal challenges that face the EU and the rest of the world[199].

Norrbotten's participation in Horizon is relatively successful. In relation to population, the county is in sixth place when it comes to the number of Horizon application that have been granted, see figure below. For more information, see appendix 5.

197 See website of the Directorate General for Research and Innovation: European Commission (n.d.) Research in Production, for instance. Available on http://ec.europa.eu/research/industrial_technologi-es/production_en.html

198 European Commission (n.d.) Horizon 2020. http://ec.europa.eu/programmes/horizon2020/en.

199 The National Innovation Strategy. Article number: N2012.27, page 5. In Horizon 2020 – the framework programme for research and innovation (2014 – 2020) – the following societal challenges have been raised as particularly crucial: health, demographic changes, and welfare. Challenges for European bioeconomy: food safety, sustainable agriculture and forestry, marine, seafaring and inland water research. Safe, clean and efficient energy. Smart, green and integrated transports. Climate measures, resource efficiency and raw materials. Europe in a changing world: inclusive, innovative and reflecting societies. Safe societies: protecting Europe's freedom, safety and citizens.

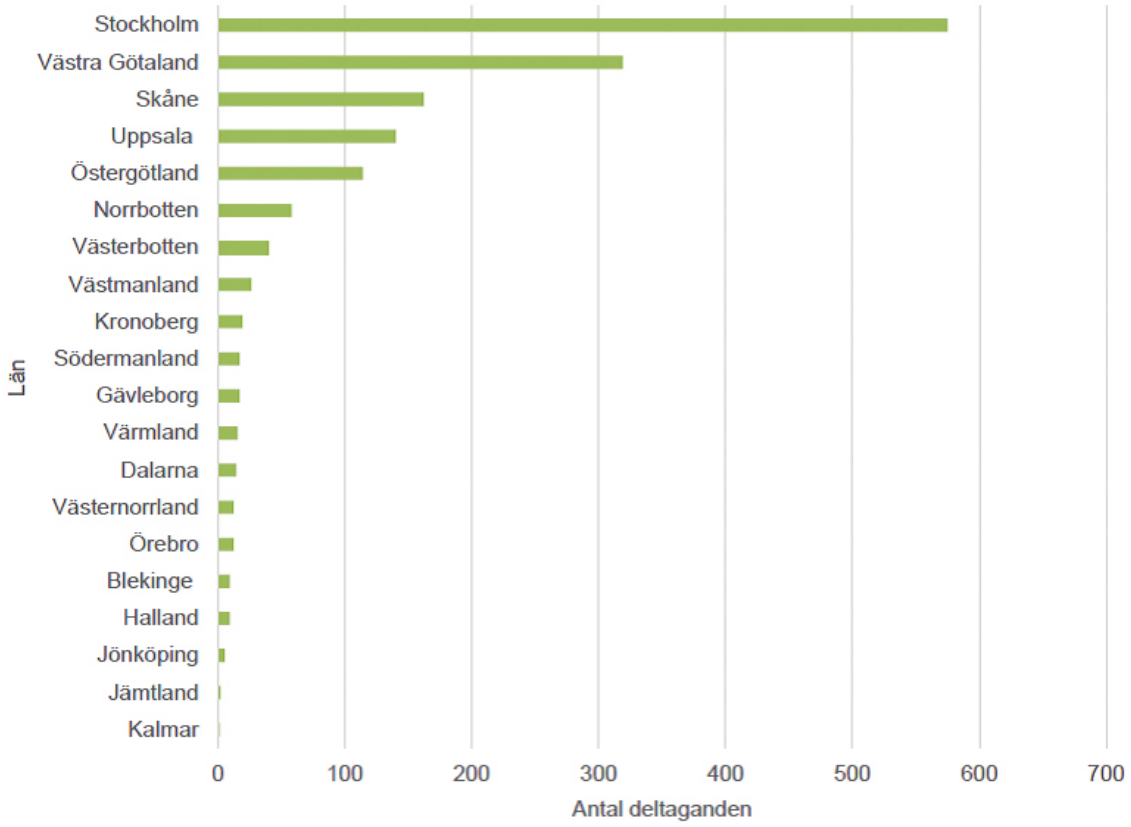

Figure 47: Geographic distribution of Swedish organisations' participation in Horizon 2020 by county.

National Perspective

On a national level, the interest in smart specialisation is made clear through several initiatives from the Ministry for Enterprise and Innovation, and its subordinate authorities such as Vinnova and the Swedish Agency for Economic and Regional Growth, the latter with a specific mission to support the regions in their work with innovation development based on smart specialisation[200].

National Strategy for Sustainable Regional Appeal 2015-2020

A national strategy for sustainable regional growth and appeal 2015-2020 guides the work, and is to contribute to the goal of regional growth policy being reached.

The strategy describes the government's priorities as well as the tools and processes that are needed in regional growth work. The government's priorities are 'innovation and enterprise,' 'attractive environments and accessibility,' 'competence supply,' and 'international collaboration.' The prioritisations are intersectoral, and include policy areas where European, national, regional and local measures and financial resources are coordinated and complement each other. The economic, social and environmental sustainability dimensions should be considered in all prioritisations. The prioritisations are to contribute to coordination and an aggregation of measures and resources for such aspects as:

200 Regleringsbrev för budgetåret 2016 avseende Tillväxtverket inom utgiftsområde 19 Regional tillväxt och utgiftsområde 24 Näringsliv.

- Innovation, entrepreneurship, and environmentally driven business development to improve trade and industry's competitiveness.
- Accessibility through the transport system and information technology.
- Commercial and public services.
- Competence supply for trade and industry and public operations.
- International collaboration to meet societal challenges and improve trade and industry's competitiveness.

The prioritisations are to guide development and implementation of the counties' regional development strategies, as well as other strategies and programmes in regional growth work. They should also form the basis of government authorities' participation in the work. The strategy states that 'there are many parties on regional and national levels, both in the public sector and in businesses and civil society, that have important roles to play to promote Sweden's innovation power. Since innovation processes are complex, a joint view of common strategic, long-term measures is needed. Through smart specialisation, internationalisation, and an increased focus on facilitating and stimulating businesses' growth, regional innovation environments can develop their abilities to contribute to structural changes that lead to sustainable regional growth and development[201].

Strategic Collaboration Programmes

In October 2016, the government launched five collaboration programmes. They can be found in the *Strategic Collaboration Programmes* document on the government's website. The programme presents five different themes. The content deals with what to invest in to find innovative solutions to many comprehensive societal challenges. Norrbotten can, with its resources, contribute to four of these themes. In them, Norrbotten becomes a natural collaboration party, thanks to our know-how and competence in smart specialisation. These five themes are part of the programme:

- **Smart cities.** A smart city utilises information and communication technology to improve the quality, performance and interactivity of municipal services in order to reduce costs and resource consumption, and to improve contact between citizens and authorities. Norrbotten can contribute with intelligent production systems, for instance.
- **Connected industry and new materials.** New sustainable materials, cloud services, robotics and additive manufacturing create opportunities in all industries, and is a prerequisite for achieving competitiveness in Sweden. In addition, new sustainable materials and advanced environment and climate technology are key to reaching more efficient and toxin-free production. Connected industry and new materials are closely connected to the government's New Industrialisation Strategy. Norrbotten can contribute with data centres, for instance.
- **The next generation of travel and transport.** This part of the programme is aimed at the need for a more transport-efficient society where transports are used in a smarter way, with resource-efficient and even safer vehicles, renewable fuels, and fewer emissions. Sustainable and efficient logistics solutions developed within and in the interface between the two can contribute to the development of this aspect. Norrbotten can contribute with knowledge about renewable fuels.
- **Life Science.** Collaboration between health care, businesses, and academia is needed for new innovative pharmaceuticals, care methods and medical technology to benefit society, and solutions to the societal challenges that exist in the health area. This theme isn't applicable to Norrbotten, which currently lacks research and businesses in this area.

201 En nationell strategi för hållbar regional tillväxt och attraktionskraft 2015–2020.

Smart Industry – New Industrialisation Strategy

The purpose of the government's New Industrialisation Strategy[202] is to contribute to improving businesses' transformative ability and competitiveness in four focus areas:

- Industry 4.0 – businesses in Swedish industry are to be leaders in digital development and in developing the opportunities of digitalisation.
- Sustainable production – increased resource efficiency, environmental consideration, and a more sustainable production are to contribute to industry's value creation, employment creation and competitiveness.
- Knowledge boost industry – the competence supply system is to meet industry's needs, and promote its long-term development.
- Test bed Sweden – Sweden is to be a research leader in the areas that contribute to the improvement of industrial goods and service production in Sweden.

The New Industrialisation Strategy has been conceived as an initiative from the government to prioritise industry. The government wants politics to do its part to improve businesses' conditions for managing the digital transformation and the climate transformation.

Regional Perspective

Region Norrbotten is responsible for developing a regional innovation strategy based on the region's strength areas, a so-called RIS3 (Regional Innovation Strategy with smart specialisation).

Regional Development Strategy for Norrbotten

The revision of the current Regional Development Strategy for Norrbotten (RUS) was adopted in 2019.

RUS raises the megatrends that will influence Norrbotten's development over the coming decades. The development is decidedly uncertain, and world events – trade wars, quick technological changes, or political upheaval – can quickly have a direct impact on Norrbotten.

Megatrends are the big changes that affect us all, whether we want them to or not. They have a global reach, and a far-reaching effect on our future, economy, culture, and all other parts of society. We have to discuss them in our systematic work with the world around us to be able to make important choices for the future.

THE FIVE MEGATRENDS ARE:

1. Demographic changes and urbanisation – people get older, and more people live in cities.
2. Globalisation with increased mobility for people, services, capital and information that cross all national borders.
3. Individualism ahead of the group, which creates a need for tailored solutions for each individual, but also asks a lot of the individual's ability to take responsibility and make decisions.
4. Digitalisation of practically all goods, services and relationships.
5. Climate and environment challenges as a direct consequence of our consumption and production patterns.

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202 Regeringen (2016) Smart Industri – En nyindustrialiseringsstrategi för Sverige.

The regional development strategy points out 'smart specialisation with related variety' as a key concept of Norrbotten's innovation strategy. This means that we are to build new industries based on the strengths and competitive advantages we already have. Both strategies are clearly connected to the industrial parties that exist in the region, and utilise their competence and resources to achieve a development that can also function as an incubator for new businesses, and as an accelerator for small and medium-sized businesses. The network of suppliers connected to the basic industries in the region can also benefit from better horizontal contact surfaces, closer connections with research, and the public innovation measures that are accessible regionally.

The vision is for Norrbotten to become Sweden's most welcoming and innovative county. To get there, we have a lot of work to do, and – more importantly – we have to do it together, across the whole county. The regional development strategy has four action areas of goals and measures:

Figure 48: Prioritised action areas.

The chapter *Smart Sustainable Innovations and Entrepreneurship* raised the fact that Norrbotten is to work with smart specialisation. This means that we are to build new industries based on the strengths and competitive advantages we already have, while daring to take risks and trying things previously untried.

The regional development strategy is part of a collection of European and national policy documents and strategies. The overall governing document is EU 2020, which concerns how we work with regional development. The implementation of the regional development politics that the EU has decided on takes place in cooperation with the UN's global sustainability goals Agenda 2030.

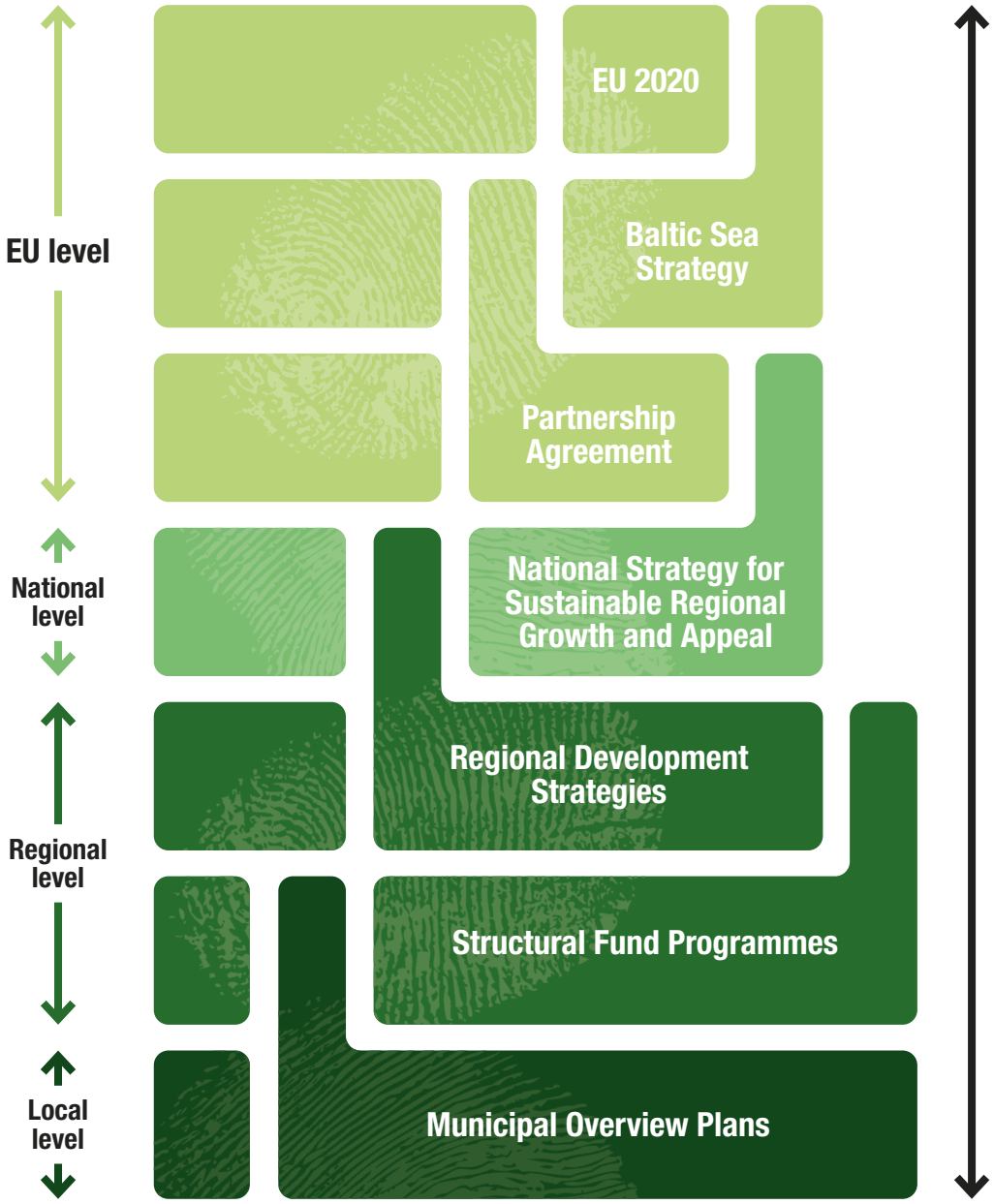

Figure 49: Schematic image of how strategies and programmes are connected from an EU level to a local level.

The regional development strategy is an overall strategy document with the aim of building a sustainable future in Norrbotten. The strategy is to contribute to increased cohesion and coordination between plans, programmes and strategies in different administrative levels and sector areas. RUS provides choices for future sustainable growth. The table above is a schematic image of how strategies and programmes are connected from an EU level to a local level.

Appendix 2 - The Composition and Work of the Competence Group

During the 2014 – 2018 period, the competence group for smart specialisation has had network meetings, participated in study visits and workshops, and developed the strategy together. The following people have been part of the competence group:

Name	Period
Anna Utsi, Swerea Mefos	2014-2018
Eva Moe, Reg Lab	2017-2018
Katarina Delsing, Energikontor i Norr AB	2014-2018,
Kenneth Sjaunja, Region Norrbotten	2014-2018
Ola Lidström, Piteå kommun	2017-2018
Per Erik Andersson, Region Norrbotten	2014-2018
Pär Johansson, LTU Business	2014-2018
Daniel Örtqvist, Luleå tekniska universitet	2014-2020

Resigned during the period

Carola Medelid, Länsstyrelsen i Norrbottens län	2014-2016
David Sundström, Piteå Science Park	2014-2017
Håkan Ylinenpää, Luleå tekniska universitet	2014-2016
Katarina Öqvist, Aurorum Business Incubator	2014-2016

Examples of Workshops and Dialogues We've Had with Businesses, Academia and Society

- Gällivare kommun
- Luleå kommun
- Övertorneå kommun
- Luleå tekniska universitet
- Malin Lindberg (LTU) gender analysis of the old strategy (RIS) and the new S3
- Latitud 66
- Tillväxtberedningen, multiple times
- Regionalt forum, multiple times
- Regionala partnerskapet, multiple times
- Tillväxtverket – Peer review – national network for S3

Consultation Responses to Norrbotten's Smart Specialisation Strategy

Coompanion, EISCAT Scientific Association, Industriellt utvecklingscentrum (IUC Norr), Malin Lindberg professor LTU, Luleå tekniska universitet, Länsstyrelsen Norrbotten, Norrbottens kommuner, Region Västerbotten, Region Norrbotten (Enheten för förbättring och förnyelse), Region Västernorrland, Sametinget, Social ekonomi övre Norrland, The Swedish Proving Ground Association, Vänsterpartiet och Tillväxtverkets nätverk för S3.

Appendix 3 - Examples of Parties in Norrbotten's Innovation Support System

PARTIES	
Advokater	Länsstyrelsen i Norrbottens län
Almi Företagspartner Nord AB	Node Pole Alliance
Arbetsförmedlingen	Norrbottens kommunförbund
Arctic Business Incubator (ABI)	Norrlandsfonden
Banker - Swedbank, Handelsbanken, Nordea, SEB, etc	Norrskenet
BD Pop	North Business Arena
Business Sweden business support office AB	North Sweden
Centrumbildningarna på Ltu ca.26 st.	NyföretagarCentrum Nord
Connect Sverige Region Norr	Partnerinvest Norr
Coompanion Norrbotten ekonomisk förening	Polarrenen
EIT RawMaterials	Region Norrbotten
Energikontoret Norr	Reklambyråer t.ex. svenska
Företagarna i Norrbotten, finns även kommunkontor	Revisorer: PWC, etc.
Företagarna Norrbotten Service AB	RISE SICS North
Go Business	Science Parks/företagsparker/ företagsbyar/teknikbyar/, teknikparker
Handelskammaren	Skatteverket?
Hushållningssällskapet	Smart tillväxt (nyföretagarcentrum i Piteå)
Innovationskontor på LTU	SP Energy Technology Center (gamla Energitekniskt Centrum i Piteå)
Institutet för rymdfysik(IRF) i Kiruna	Startkapital i Norr AB
Interactive Institute Swedish ICT, Piteå	Swedish Lapland Visitors Board ekonomisk förening
Invest in i Norrbotten	Swedish Space Corporation (SSC) tidigare Esrange i Kiruna
IUC Norrbotten	Svenskt näringsliv
Kommunala näringslivskontor/-bolag (14 st)	Svenska samernas riksförbund
Konsulter: SWECO, WSP etc.	Swerea Mefos i Luleå
Kreditgarantiföreningen Norr ekonomisk förening	Swerea Sicomp i Piteå
Lantbrukarnas Riksförbund	TCO
LO	Ungföretagsamhet
LTU Business AB	Unionen
LtU Holdingbolag	Utbildning Nord
Längmanska företagarfonden	Winternet i Boden
Mötesplats Social Innovation	

Appendix 4 - Regional Environment Goals, Norrbotten County[203]

1. **Limited Climate Impact**
   To achieve the global climate goal, powerful international measures and collaboration between the countries of the world are required. In Norrbotten County, the emissions of greenhouse gases have decreased somewhat since 1990. The county's heavy industry is responsible for most of the emissions..

2. **Fresh Air**
   EA positive trend with reduced air pollution has improved the conditions for reaching the environmental quality goal, but continued measures are needed. Ground-level ozone is a further problem in the county, and in some circumstances, traffic and wood-burning can worsen air quality in towns.

3. **Only Natural Acidification**
   In Norrbotten, man-made acidification is thought to affect mainly coastal environments. The reason is land usage in areas with acidic sulphate soil. There are enough governing tools concerning acidic precipitation. There is, however, a lack of guidelines for land usage in areas with acidic sulphate soil..

4. **Toxin-Free Environment**
   There are heightened levels of environmental pollutants in Norrbotten, some from local sources, some from faraway sources. Some substances are decreasing, having been regulated in the market. Other substances have increased or show unchanged levels in the environment.

5. **Protective Ozone Layer**
   The negative impact on the ozone layer from ozone-depleting substances has been reduced. The direction of development is positive when it comes to the ozone layer's ability to protect against UV radiation. The problem with the thinning ozone layer is global.

6. **Safe Radiation Environment**
   Radiation safety is acceptable in many areas, but the number of skin cancer cases has increased over a long period of time. Reducing exposure to UV radiation is crucial to reducing the number of skin cancer cases. This requires changed attitudes and behaviours concerning appearance and sunbathing.

7. **No Over-Fertilisation**
   Norrbotten has a small population, and a small proportion of farmland, so doesn't have great problems with over-fertilisation. There are around 100 lakes and rivers in the county that are over-fertilised. The problems are often local.

8. **Vibrant Lakes and Rivers**
   If we abide by the EU's water directive and the joint fishing policy, we have the conditions to reach parts of the goal. Restoration and protection of valuable natural and cultural environments have to increase markedly. Environmental consideration is lacking at certain operations, which increases strain on the environment.

9. **Good Quality Groundwater**
   Access to, and quality of water are generally good in the county. Many water sources lack protection, however, and knowledge of the status of the groundwater is poor in many areas. We could be close to the goal in the future if the biggest problems are prioritised in state and municipal work with the environment.

10. **Balanced Ocean and a Vibrant Coast and Archipelago**
    The great challenges in the Gulf of Bothnia are pollutants and physically exploited habitats. Other problems are over-fertilisation in sensitive bays and inlets, partially weak fish populations, alien species and threatened cultural environments. Action programmes in accordance with the Marine and Water Management Regulation are important governance tools.

203 https://www.miljomal.se/Miljomalen/Regionala/?t=Lan&l=25

11. **Vibrant Wetlands**
    Norrbotten is home to a third of the country's wetland area, and thus has a great responsibility for the preservation of their natural and cultural values. With the current resources for area protection, wetlands are not prioritised. A changed climate and more intensive land usage are expected to affect the wetlands adversely.

12. **Vibrant Forests**
    In a longer perspective, great changes to Norrbotten's forests have taken place, with negative consequences for species that are sensitive to disturbance. To preserve biological diversity in the county, we need more formally protected forests, improved environmental consideration, and landscape-based conservation.

13. **A Rich Agricultural Landscape**
    There are decreasing numbers of agricultural businesses in the county, and the average age of farmers is high. The areas used for fields and pasturage are diminishing, in part due to dairy farmers decreasing in number. Hayland areas are growing, however, in the shape of hay-mires. Norrbotten is second in the country among the counties when it comes to hayland area.

14. **Magnificent Mountains**
    The magnificence of Norrbotten's mountains remains, even if they have been affected locally by exploitation and wear and tear, especially driving damage. Looking at the mountain region at large, however, there has only been a moderate effect over the past decades, and mainly in connection to existing roads.

15. **Good Built Environment**
    The lack of homes and the demographic development are serious threats to a good built environment in large parts of the county. Other problems are that cultural environment values and other town planning values often take a back seat when new buildings are planned. The goal is not reached, but development is positive.

16. **A Rich Flora and Fauna**
    Norrbotten's forests and coasts, and the Gulf of Bothnia, are affected by intensive land and water usage. Many types of nature and animals lack a favourable conservation status. The situation is deemed much more favourable in the mountains, wetlands, forests and rivers close to the mountains.

17. **The Generational Goal**
    The great environmental problems will remain, even until the next generation. As a result of extensive consumption, we are also causing increased environmental and health-related problems outside Sweden's borders. Even if there are high natural values in the county, intensive land usage does have negative effects on the ecosystems.

Appendix 5 - Innovation and the Public Sector

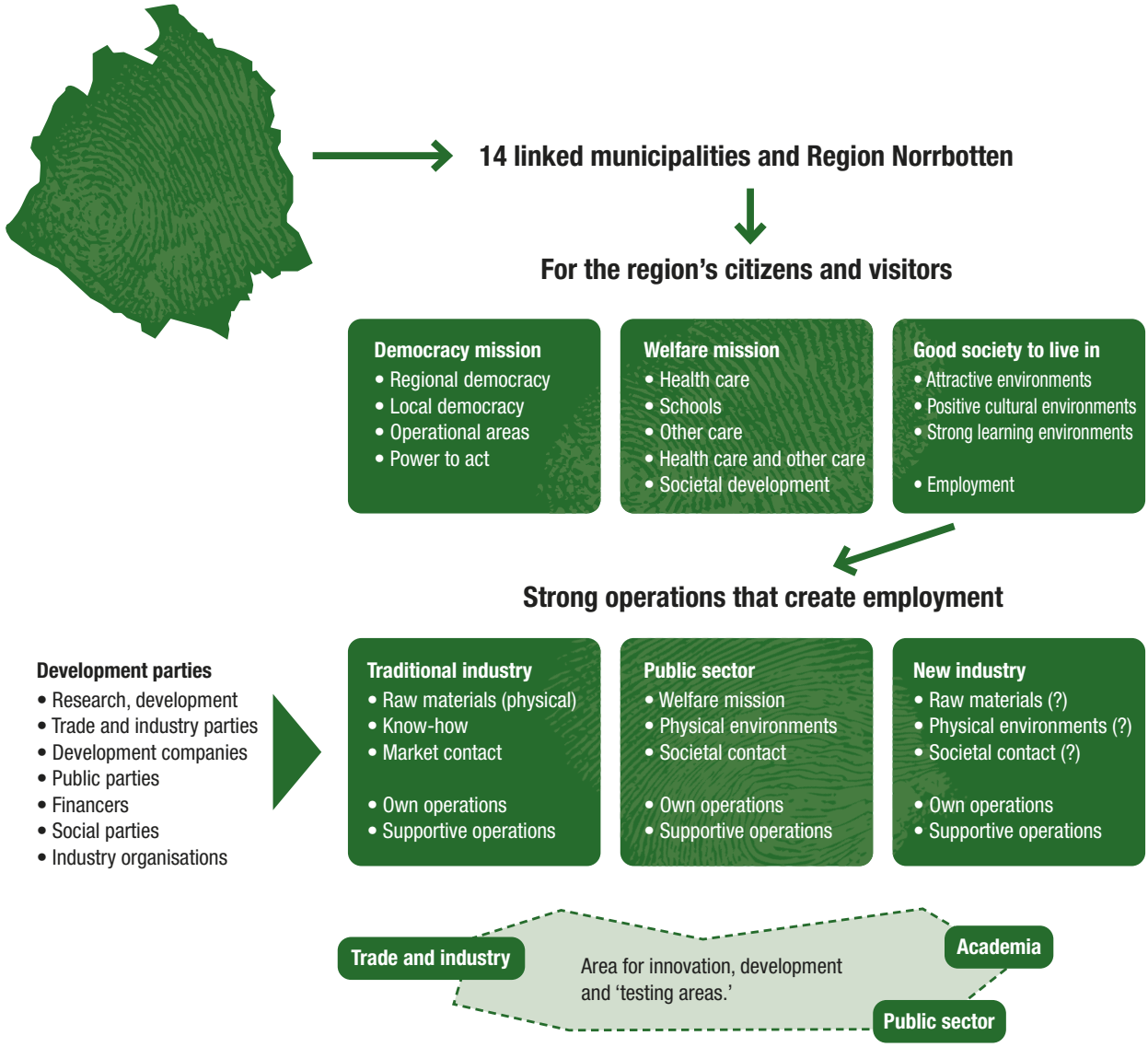

Figure 50: Innovation and the public sector. Source: Ola Lindström, digital strategist.

Appendix 6 - Entrepreneurial Innovative Systems or Institutional Innovative Systems

In research, Entrepreneurial Innovative Systems (ERIS) and Institutional Innovative Systems (IRIS) are often differentiated. The former concerns varying constellations of parties, often individuals or separate businesses that through a process of trial and error develop new innovative solutions step by step, starting from resources that they have or have access to. This form of innovative collaboration is most common in Anglo-American economies, such as the US[204]. ERIS emerge when there is a need among the businesses. The network is dissolved when the need has been met.

System level

Actor level

Type of system	Entrepreneurial Regional Innovation Systems (ERIS)	Institutional Regional Innovation Systems (IRIS)
Image of the market	Ambiguous, potential collaborative space	Uncertain, risky competitive space
Type of innovation process	Action-oriented: based on experimental learning	Planning-oriented: based on the need for overview control and risk minimizing
Strategies	Emergent	Planned
Time perspective	Emergence; fuzzy vision combined with step-by-step action	Present and future; more clear vision combined with long-term planning
Organizational structure	Organic (looseley coupled); to a large extent based on trust	Mechanistic; to a large extent based on a contratctual ties
Critical resources	Entrepreneurial skills Venture capital	Management skills Institutional capital
Decision logic	Effectuation: Taking action based on available/accessible resources	Causation: Planning for and controlling the future
Cooperation	Ad hoc-based, intermittent and often termed short-termed	Planned and long-termed
Critical performers	Actors: Individuals who form teams of complementary competences	Agents: Representatives of different sectors of society

Figure 51: Contrasting entrepreneurial and institutional regional innovation systems. Published in: Håkan Ylinenpää; European Planning Studies 2009, 17, 1153-1170.

Institutional innovative systems (IRIS) are often driven by institutional parties, such as businesses, authorities, universities and research institutes that are involved in long-term collaboration, and start from a plan spanning several years where milestones and effects have been predefined. The resources that are needed are acquired as and when, often with the help of external financers who have deliberated the consortium's plan and found it interesting and realisable. This kind of more long-term collaboration is said to characterise large parts of Europe, and especially Nordic countries like Sweden[205]. In the IRIS process, owners should take responsibility for financing operations, and for the coordinating IRIS party performing needs analyses for its members.

204 See Cooke & Leydesdorff, 2004, or Ylinenpää, 2008.

205 See Cooke & Leydesdorff, 2004, or Ylinenpää, 2008.

Sweden is one of the countries that have perhaps most explicitly invested in innovative constellations according to the IRIS model. Through the creation of a special state authority for innovative systems, Vinnova, and supranational and state efforts via EU programmes and structural funds, the focus has been on big projects spanning several years, rather than on many smaller, explorative attempts in early stages. Even if many programmes have been able to grant pilot study means that are better adapted for the ERIS model, these are comparatively modest sums that have only been able to counter the imbalance in prioritisation of which innovative systems we strive for in a very limited way. This is unfortunate, as ERIS-based innovative constellations are often the base and the first steps in the development of bigger, IRIS-like development investments. For this reason, we propose, in this revised programme, a budget for explorative pilot studies and experiments, and a simplified application process for means for businesses and organisations that want to try new ideas.

ERIS

One important part of the regional innovation strategy is to better utilise the innovative potential represented by entrepreneurial innovation systems (ERIS)[206], through offering support to development arenas that exploit the borders between already established strength areas. It can include businesses and organisations that want to develop new, untried modus operandi. It can also include support for parties that want to develop solutions to known or future needs with short time frames through a process of trial and error.

New modus operandi and methods that, in themselves, lead to development of innovation tools are encouraged. Modus operandi and methods that foster openness between different areas offer the opportunity to find innovations in the interface between different focus and technology areas. New approaches, new ways of working, and new incentive systems are needed.

Innovations can also be developed by individual entrepreneurs and innovators, who, with knowledge-based resources and access to capital at all stages, contribute to the region's development. This type of innovation and innovative collaboration also needs to be noted as a tool for the region's future development. Therefore, it's important to support smaller entrepreneurs, and encourage entrepreneurial attitudes.

ERIS is a temporary network that is dismantled when the challenge has been met.

IRIS

Clusters[207] consist of a number of parties that work together. The parties can complement each other, but may also compete. Jointly, they want to collaborate for better conditions and effects in one or more industries that interact with each other. Those who are part of the cluster take a joint responsibility for the future. The county has access to a supply of instruments that can be used to improve the region's dynamics and appeal, and contribute to innovation gaps in clusters being bridged. It's based on people moving between parties, speaking and passing on news to others, discussing with others, changing jobs and connecting the systems in many different ways.

For a cluster to be competitive, there have to be systems around it supporting it and collaborating with it. Apart from the businesses, a greater perspective also includes research organisations, educators, financers, politicians and authorities, public supportive organisations, etc.

Clusters go through different phases, and the need for support from other parties varies throughout the clusters' development phases and levels of maturity. If we choose to divide clusters' levels of maturity into three phases, these could be the 'initiation phase,' the 'establishment phase,' and finally the 'mature phase.' Clusters aren't an end goal in themselves, but a tool for developing new products, services, business models and markets for businesses that, in turn, lead to sustainable growth, and ensure future competitiveness for Norrbotten.

206 ERIS includes innovative systems that are based more on individuals than on institutions, more on learning by doing and short planning time frames than on long-term plans, and that have a varying set of parties that contribute to innovation development (cf. Cooke & Leydesdorff, 2004).

207 Clusters have many names. Domains, networks and ecosystems are termed clusters from here on in.

In reality, clusters don't look like this, unfortunately. There is a lack of knowledge across party borders and in collaborations. There are barriers to collaboration that lead to gaps, white patches, or a lack of parties. These are obstacles that make it hard for parties to communicate with each other, initiate collaboration, and transfer knowledge further. So, it's important to understand the driving forces behind why different parties are in a cluster. The central aspect is – in IRIS too – that members have a responsibility to finance operations, and that IRIS are to make needs analyses for their businesses.

Driving Forces

There are different driving forces that ensure that the businesses develop together in innovative environments:

- Competitiveness and rivalry drive the businesses' strategy development. To reach or keep a position at the front, they have to constantly increase their own capacity and innovation ability.
- Businesses cooperate and collaborate within the clusters. This takes place through innovation projects around new products, processes and business models.
- In innovative environments, businesses can get access to technical equipment and competence that don't exist in their own operations.
- The cluster's innovative environment makes it easier to develop new knowledge and new innovations. Spontaneous knowledge dissemination through the clusters' informal and formal meeting points is also important[208].
- It's easy to redistribute resources within innovative environments. If conditions change for an operation, it's easy for the individual to utilise their competence in a similar operation at a different business.

Parties

The parties in a cluster are everyone from big and small to national and international businesses and organisations. We recognise many of them as parts of the innovation system:

- Research institutes and universities provide access to laboratories, test beds and demo environments where businesses can develop and test their products.
- Educators provide businesses with competent labour. This can be anything from upper secondary schools and vocational training to university education.
- Financers are central parties. There are a number of different categories here: business angels, state venture capital, venture cap businesses, and business banks that assist businesses with investment means or liquid assets at different phases of their development.
- Politicians and authorities influence the clusters through infrastructure investments or innovation programmes, for instance.
- Bridge-builders are an important category in the innovative environment. Here, we'll find science parks, incubators, innovation offices, and organisations that supply locations for networking and collaboration[209].

Qualification Criteria for Cluster Organisations

Focussing on fewer clusters and longevity is often a success factor for achieving results. Therefore, there needs to be clear criteria for which organisations can be included in the cluster strategy. Cluster organisations that are not yet fully established should, in the future, be able to apply to be included as clusters.

208 The criteria are taken from the Värmlandsmodellen 2,0/klusterstrategi 2013-2017.

209 Innovativa miljöer för ökad attraktionskraft, Rapport från IVAs projekt Attraktionskraft för hållbar tillväxt.

Norrbotten is home to only one cluster that is labelled[210] an IRIS cluster, and that is the car testing operation, SPGA. The SPGA cluster organisation is its own legal person with around 80 Norrbotten businesses or more as members.

To join an IRIS, you must meet the following criteria[211]:

1. The members finance a basic organisation with an operational leader and further necessary leadership resources. The lowest total investment from the members put together is one million SEK per year.
2. The cluster organisation works within a delimited geographic area with its emphasis in Norrbotten.
3. The goal for the organisation is to support innovation, increase business and growth among the member businesses, and thus growth in Norrbotten.
4. There is a strategic idea or vision for the development of the industry that the cluster comprises, as well as strategies and action plans for it.
5. The cluster organisation reports annual development in relation to vision, strategies and action plan, as well as factors from the surrounding world.
6. Equality and diversity aspects are a clear part of strategies and activities that are performed by the cluster organisation.
7. Developments move in an environmentally sustainable direction for the cluster as a whole.

In addition to the formal requirements, the following factors are also significant for the development of clusters:

- The cluster consists of businesses from industries that are related to each other, through products, services or competence, for instance.
- The participating industries have a high degree of regional export or a potential for high regional export.
- The included industries are experiencing strong growth.
- Sufficient competence levels and appropriate personal qualities in the cluster management group.
- Good support and unity concerning the project among trade and industry in participating industries.

210 Regionala vinnarkluster- en fråga om kompetensförsörjning Värdeskapande relationer och barriärbrytande visioner, NUTEK.

211 The criteria are taken from the Värmlandsmodellen 2,0/klusterstrategi 2013–2017.

Appendix 7 - Norrbotten's Municipalities, Regional and Local Specialisation

To begin with, we'll present regional and local specialisation by reporting the proportion of people in gainful employment per industry in Norrbotten's municipalities 2016. The equivalent table can be found in the original investigation that was published in 2014 (Örtqvist, 2014). The table doesn't show any great changes compared to the one published in 2014. Certain municipalities have a large proportion of people gainfully employed in one industry. Gällivare, for instance, had 28 per cent of all people who were gainfully employed in 2014 in manufacture and quarrying. In Kiruna, 23 per cent were employed in the same industry. In Haparanda, 18 per cent of those gainfully employed were employed in retail. Information and communication is responsible for less than one percentage unit of the gainfully employed in most municipalities, much like financial and insurance operations, for instance. Health care, other care, and social services employ a large share of the gainfully employed in many of the region's municipalities. The table below shows the share of gainfully employed people per industry.

	ARVIDSJAUR	ARJEPLOG	JOKKMOKK	ÖVERKALIX	KALIX	ÖVERTORNEÅ	PAJALA	GÄLLIVARE	ÄLVSBYN	LULEÅ	PITEÅ	BODEN	HAPARANDA	KIRUNA
G01 AGRICULTURE, FORESTRY AND FISHING	6%	5%	8%	12%	6%	10%	12%	3%	6%	2%	4%	3%	3%	2%
G02 MANUFACTURE AND QUARRYING	5%	1%	5%	4%	14%	8%	10%	28%	16%	10%	14%	3%	7%	23%
G03 ENERGY SUPPLY AND ENVIRONMENT OPERATIONS	1%	2%	7%	1%	1%	1%	1%	1%	2%	1%	1%	1%	1%	1%
G04 CONSTRUCTION	7%	13%	12%	10%	8%	7%	10%	10%	11%	8%	9%	10%	9%	8%
G05 WHOLESALE AND RETAIL	9%	6%	6%	7%	8%	7%	7%	8%	8%	9%	9%	8%	18%	8%
G06 TRANSPORTING AND STORAGE	5%	3%	4%	10%	4%	8%	5%	5%	5%	5%	5%	4%	4%	7%
G07 ACCOMMODATION AND FOOD SERVICE ACTIVITIES	4%	6%	5%	3%	2%	2%	3%	4%	2%	3%	3%	3%	3%	6%
G08 INFORMATION AND COMMUNICATION	1%	0%	0%	0%	0%	0%	1%	0%	0%	4%	1%	0%	1%	2%
G09 FINANCIAL AND INSURANCE ACTIVITIES	0%	0%	1%	1%	1%	1%	1%	0%	0%	2%	2%	0%	1%	1%
G10 REAL ESTATE ACTIVITIES	2%	6%	1%	1%	1%	1%	1%	1%	2%	1%	1%	2%	1%	2%
G11 BUSINESS SERVICES	10%	19%	8%	7%	13%	7%	4%	7%	4%	12%	9%	7%	7%	10%
G12 PUBLIC ADMINISTRATION AND DEFENCE	16%	9%	7%	5%	5%	7%	4%	4%	4%	10%	2%	22%	7%	5%
G13 EDUCATION	11%	9%	11%	8%	10%	14%	12%	7%	12%	11%	12%	9%	12%	8%
G14 HEALTH CARE, OTHER CARE, AND SOCIAL SERVICES	18%	15%	16%	25%	23%	21%	24%	19%	23%	18%	20%	21%	20%	13%
G15 CULTURAL AND PERSONAL SERVICES, ETC..	3%	4%	7%	3%	4%	3%	4%	2%	4%	4%	3%	4%	4%	3%
G99 OKÄNT	2%	1%	1%	3%	1%	3%	2%	1%	1%	1%	3%	1%	1%	1%

Table 6: Proportion of gainfully employed people per industry 2016. Source: rAps-RIS.

Norrbotten's Biggest Employers

In Norrbotten, the biggest employers are the municipalities, the region, the armed forces, and the university. The five biggest businesses are LKAB, Samhall, SSAB, Coop Norrbotten, and Boliden. Tables with figures from 2017 show the biggest employers in Norrbotten, their share of the total number of employees in the county, and the number of people employed in the organisation[212].

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE COUNTY	NUMBER OF EMPLOYEES
LULEÅ KOMMUN	6,8	7 475
REGION NORRBOTTEN	6,8	7 425
PITEÅ KOMMUN	4,1	4 525
LUOSSAVAARA-KIIRUNAVAARA AKTIEBOLAG	3,2	3 475
BODENS KOMMUN	2,8	3 075
KIRUNA KOMMUN	2,3	2 475
FÖRSVARSMAKTEN	2,1	2 275
GÄLLIVARE KOMMUN	1,9	2 125
KALIX KOMMUN	1,6	1 725
LULEÅ TEKNISKA UNIVERSITET	1,4	1 525
ÄLVSBYNS KOMMUN	1,1	1 225
SAMHALL AKTIEBOLAG	1,1	1 175
SSAB EMEA AB	1,1	1 175
HAPARANDA KOMMUN	0,9	1 025
COOP NORRBOTTEN EKONOMISK FÖRENING	0,8	875
ARVIDSJAURS KOMMUN	0,7	775
POLISMYNDIGHETEN	0,7	725
BOLIDEN MINERAL AB	0,6	675
INRE KRAFT I NORR AB	0,6	625
PAJALA KOMMUN	0,6	625
ÖVERTORNEÅ KOMMUN	0,6	625
FÖRSÄKRINGSKASSAN	0,5	575
SMURFIT KAPPA KRAFTLINER PITEÅ AKTIEBOLAG	0,5	575
TELIA SVERIGE AB	0,5	575
JOKKMOKKS KOMMUN	0,5	525

Table 7: 25 biggest employers in Norrbotten 2017.

212 Regionfakta; SCB, Företagsregistret.

Arvidsjaur

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
ARVIDSJAURS KOMMUN	33,3	775
FÖRSVARSMAKTEN	7,5	175
ARBETSFÖRMEDLINGEN	3,2	75
REGION NORRBOTTEN	3,2	75
FÖRSVARETS MATERIELVERK	3,2	75
SAMHALL AKTIEBOLAG	3,2	75
LAPONIA HOTELL & KONFERENS AB	1,5	35
COOP NORRBOTTEN EKONOMISK FÖRENING	1,5	35
FIRST RENT A CAR AKTIEBOLAG	1,5	35
ARVIDSJAUR FLYGPLATS AKTIEBOLAG	1,5	35
FÖRSÄKRINGSKASSAN	1,5	35
LELU AKTIEBOLAG	1,5	35
SECURITAS SVERIGE AKTIEBOLAG	1,5	35
KRIMINALVÅRDEN	1,5	35
SVEASKOG FÖRVALTNINGS AKTIEBOLAG	1,5	35

Table 8: 15 biggest employers in Arvidsjaur 2017.

Arjeplog

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
ARJEPLOGS KOMMUN	31,4	425
TJINTOKK KOMMANDITBOLAG	12,9	175
TJINTOKK AKTIEBOLAG	5,5	75
TRANSPORTSTYRELSEN	5,5	75
ARJEPLOG HOTEL SILVERHATTEN AB	2,6	35
REGION NORRBOTTEN	2,6	35
ICEMAKERS AB	2,6	35
COLMIS AKTIEBOLAG ARJEPLOG	2,6	35
FIXAR'N I ARJEPLOG AB	2,6	35
COOP NORRBOTTEN EKONOMISK FÖRENING	1,1	15
STENBERGS I SLAGNÄS AB	1,1	15
AKTIEBOLAGET WIDMANS GRÄV	1,1	15
SOFTRONIC DOKUMENTHANTERING AB	1,1	15
TJINTOK FÖRVALTNING AKTIEBOLAG	1,1	15
P-O FLINKFELDTS BUSS AKTIEBOLAG	1,1	15

Table 9: 15 biggest employers in Arjeplog 2017.

Jokkmokk

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
JOKKMOKKS KOMMUN	31,4	525
VATTENFALL VATTENKRAFT AB	7,5	125
REGION NORRBOTEN	4,5	75
LAPPLANDS KOMMUNALFÖRBUND	4,5	75
SAMHALL AKTIEBOLAG	2,1	35
SAMESKOLSTYRELSEN	2,1	35
COOP NORRBOTTEN EKONOMISK FÖRENING	2,1	35
VATTENFALL SERVICES NORDIC AB	2,1	35
AJTTE, SVENSKT FJÄLL- & SAMEMUSEUM	2,1	35
KÅBDALIS SKIDLIFTAR AKTIEBOLAG	2,1	35
JOKKMOKKS FÖRSAMLING	2,1	35
LAPPLANDS LASTMASKINER I JOKKMOKK AB	2,1	35
LÄNSSTYRELSEN I NORRBOTTENS LÄN	2,1	35
JOKKMOKKS KORV AKTIEBOLAG	0,9	15
VATTENFALL BUSINESS SERVICES NORDIC AB	0,9	15

Table 10: 15 biggest employers in Jokkmokk 2017.

Överkalix

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
ÖVERKALIX KOMMUN	42,4	525
REGION NORRBOTTEN	6,1	75
VINAB, VERKSTADSINDUSTRI I NORR AB	6,1	75
SAMHALL AKTIEBOLAG	2,8	35
LÄNSTRAFIKEN I NORRBOTTEN AKTIEBOLAG	2,8	35
ALLSÅNS ÅKERI AKTIEBOLAG	2,8	35
BRÖDERNA OLOFSSONS BAGERI AKTIEBOLAG	2,8	35
NORR MÅLERI AKTIEBOLAG	1,2	15
COOP NORRBOTTEN EKONOMISK FÖRENING	1,2	15
ÖVERKALIX KULTUR- OCH MILJÖSKOLA	1,2	15
ÖVERKALIX LIVS AB	1,2	15
JÖRGEN ROKKA AB	1,2	15
TRAFIKVERKET	1,2	15
ISAKSSONS TERRÄNGTRANSPORT I ÖVERKALIX AB	1,2	15
ÖVERKALIX FÖRSAMLING	1,2	15

Table 11: 15 biggest employers in Överkalix 2017.

Kalix

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
KALIX KOMMUN	29,7	1 725
REGION NORRBOTTEN	9	525
BILLERUDKORSNÄS SWEDEN AB	6,5	375
PARTBYGGEN I KALIX AB	5,6	325
HUMANA ASSISTANS AB	2,2	125
KALIX TELE 24 AKTIEBOLAG	2,2	125
BYGGMÄSTARE S.A. ENGLUND AKTIEBOLAG	2,2	125
SAMHALL AKTIEBOLAG	1,3	75
SETRA TRÄVAROR AB	1,3	75
COOP NORRBOTTEN EKONOMISK FÖRENING	1,3	75
ANVA COMPONENTS AKTIEBOLAG	1,3	75
EMRIC OPERATIONS AB	1,3	75
STATENS INSTITUTIONSSTYRELSE	1,3	75
FÖRSÄKRINGSKASSAN	1,3	75
MEDHELP AB	1,3	75

Table 12: 15 biggest employers in Kalix 2017.

Övertorneå

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
ÖVERTORNEÅ KOMMUN	45,8	625
UTBILDNING NORD	5,5	75
REGION NORRBOTTEN	5,5	75
SAMHALL AKTIEBOLAG	2,6	35
SLÄP OCH LASTBILSPÅBYGGNADER I ÖVERTORNEÅ AB	2,6	35
JAXAL AKTIEBOLAG	2,6	35
BRÖDERNA JUNTTIS ÅKERI AB	2,6	35
SVENSK MARK & SCHAKT AB	2,6	35
STIFTELSEN TORNEDALENS FOLKHÖGSKOLA	2,6	35
HIETANIEMI FRISKOLEFÖRENING	2,6	35
MAGNUS & ROBERTS TRANSPORT AB	2,6	35
GÖRAN SIMU AB	1,1	15
BYGGPOLARNA I JUOKSENGI AKTIEBOLAG	1,1	15
HEM & DIG I KALIX AB	1,1	15
PROFFSMAT I ÖVERTORNEÅ AKTIEBOLAG	1,1	15

Table 13: 15 biggest employers in Övertorneå 2017.

Pajala

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
PAJALA KOMMUN	36,6	625
REGION NORRBOTTEN	4,4	75
AKTIEBOLAGET KREKULA & LAURIS SÅG	4,4	75
LAPPLANDS KOMMUNALFÖRBUND	2	35
SAMHALL AKTIEBOLAG	2	35
SNELLS ENTREPRENAD AKTIEBOLAG	2	35
MD I PAJALA AB	2	35
TAPANIS ENTREPRENAD AKTIEBOLAG	2	35
INISSION PAJALA AB	2	35
EXPLORE THE NORTH AB	2	35
POLARFÖNSTER AKTIEBOLAG	2	35
JUTOS TIMBER AB	2	35
COOP NORRBOTTEN EKONOMISK FÖRENING	2	35
PAJALA FÖRSAMLING	0,9	15
ARCTIC ROAD AB	0,9	15

Table 14: 15 biggest employers in Pajala 2017.

Gällivare

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
GÄLLIVARE KOMMUN	23,5	2 125
LUOSSAVAARA-KIIRUNAVAARA AKTIEBOLAG	13	1 175
REGION NORRBOTTEN	9,1	825
BOLIDEN MINERAL AB	7,5	675
LAPPLANDS KOMMUNALFÖRBUND	1,4	125
GISAB GÄLLIVARE INDUSTRISERVICE AB	1,4	125
NORDSTRÖM ASSISTANS AB	1,4	125
COOP NORRBOTTEN EKONOMISK FÖRENING	0,8	75
GÖRAN ERIKSSON MASKINTJÄNST AKTIEBOLAG	0,8	75
SAMHALL AKTIEBOLAG	0,8	75
TOTALTECH, NORDISK TRANSPORT TEKNIK AB	0,8	75
EUROMINING AB	0,8	75
ISS FACILITY SERVICES AB	0,8	75
PAASANNE AKTIEBOLAG	0,8	75
VEOLIA INDUSTRIAL SERVICES SWEDEN AB	0,8	75

Table 15: 15 biggest employers in Gällivare 2017.

Älvsbyn

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
ÄLVSBYNS KOMMUN	42,8	1 225
POLARBRÖD AKTIEBOLAG	7,9	225
ÄLVSBYHUS AB	6,1	175
REGION NORRBOTTEN	2,6	75
BRÖDERNA ÖHMAN AB	2,6	75
ÄLVSBYNS FASTIGHETER AB	2,6	75
STORFORSEN HOTELL AKTIEBOLAG	1,2	35
COOP NORRBOTTEN EKONOMISK FÖRENING	1,2	35
STIFTELSEN KARLSDAL MED ÄLVSBY FOLKHÖGSKOLA	1,2	35
NORRBOTTENS BERGTEKNIK AKTIEBOLAG	1,2	35
ÄLVSBYN LIVS AB	1,2	35
TINOR AB	1,2	35
POLARBRÖDSGRUPPEN AKTIEBOLAG	1,2	35
ÄLVSBY FÖRSAMLING	1,2	35
ARCTIC FALLS AKTIEBOLAG	1,2	35

Table 16: 15 biggest employers in Älvsbyn 2017.

Luleå

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
LULEÅ KOMMUN	18,7	7 475
REGION NORRBOTTEN	8,1	3 225
LULEÅ TEKNISKA UNIVERSITET	3,6	1 425
SSAB EMEA AB	2,9	1 175
FÖRSVARSMAKTEN	1,9	775
TELIA SVERIGE AB	1,4	575
GESTAMP HARDTECH AKTIEBOLAG	1,3	525
FERRUFORM AKTIEBOLAG	1,2	475
FÖRSÄKRINGSKASSAN	0,9	375
DIN FÖRLÄNGDA ARM I NORR AB	0,9	375
SAMHALL AKTIEBOLAG	0,9	375
TRAFIKVERKET	0,8	325
VR TRACK SWEDEN AB	0,7	275
LÄNSSTYRELSEN I NORRBOTTENS LÄN	0,7	275
COOP NORRBOTTEN EKONOMISK FÖRENING	0,6	225

Table 17: 15 biggest employers in Luleå 2017.

Piteå

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
PITEÅ KOMMUN	28,4	4 525
REGION NORRBOTTEN	8,9	1 425
SMURFIT KAPPA KRAFTLINER PITEÅ AKTIEBOLAG	3,6	575
LINDBÄCKS BYGG AKTIEBOLAG	2	325
SCA MUNKSUND AB	2	325
SWEDBANK AB	1,1	175
ABB AB	1,1	175
SCA TIMBER AB	0,8	125
COOP NORRBOTTEN EKONOMISK FÖRENING	0,8	125
AKTIEBOLAGET INFJÄRDENS VÄRME	0,8	125
SPARBANKEN NORD	0,8	125
LULEÅ TEKNISKA UNIVERSITET	0,8	125
STENVALLS TRÄ AKTIEBOLAG	0,8	125
BURLINK TRANSPORT AB	0,5	75
ADECCO SWEDEN AKTIEBOLAG	0,5	75

Table 18: 15 biggest employers in Piteå 2017.

Boden

EMPLOYER	ASHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
BODENS KOMMUN	29,8	3 075
FÖRSVARSMAKTEN	12,8	1 325
INRE KRAFT I NORR AB	4,1	425
REGION NORRBOTTEN	3,1	325
FÖRSVARETS MATERIELVERK	3,1	325
MIGRATIONSVERKET	2,7	275
SAMHALL AKTIEBOLAG	1,2	125
INRE KRAFT I SVERIGE AB	0,7	75
TEXTILIA TVÄTT & TEXTILSERVICE AB	0,7	75
JOHANSSON & BJÖRNSTRÖM ELINSTALLATIONER AB	0,7	75
ASSISTANSTEAMET ERIK HEGGLUND AB	0,7	75
COOP NORRBOTTEN EKONOMISK FÖRENING	0,7	75
AKTIEBOLAGET INGE WIKSTRÖMS SCHAKTMASKINER	0,7	75
GREEN CARGO AB	0,7	75
SILENTIUM CONTACT AB	0,7	75

Table 19: 15 biggest employers in Boden 2017.

Haparanda

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
HAPARANDA KOMMUN	33,1	1 025
IKEA SVENSKA FÖRSÄLJNINGS AKTIEBOLAG	7,3	225
REGION NORRBOTTEN	4	125
SAMHALL AKTIEBOLAG	2,4	75
STORBUTIKEN I HAPARANDA AB	2,4	75
POLARICA AB	2,4	75
NORD CLEARNESS AB	1,1	35
DITT LIV I NORR AB	1,1	35
KRIMINALVÅRDEN	1,1	35
HAPARANDA MONTESSORIFÖRENING	1,1	35
TRANSDEV SVERIGE AB	1,1	35
VARDAGA ÄLDREOMSORG AB	1,1	35
POLISMYNDIGHETEN	1,1	35
SVERIGEFINSKA FOLKHÖGSKOLAN	1,1	35
PIPELIFE HAFAB AKTIEBOLAG	1,1	35

Table 20: 15 biggest employers in Haparanda 2017.

Kiruna

EMPLOYER	SHARE OF TOTAL NUMBER OF EMPLOYEES IN THE MUNICIPALITY	NUMBER OF EMPLOYEES
KIRUNA KOMMUN	19,3	2 475
LUOSSAVAARA-KIIRUNAVAARA AKTIEBOLAG	17	2 175
REGION NORRBOTTEN	4,1	525
LAST & TERRÄNG HÄGGROTHS TRAKTOR AKTIEBOLAG	2,5	325
LKAB MALMTRAFIK AB	1,8	225
RADIOTJÄNST I KIRUNA AKTIEBOLAG	1,8	225
LAPPLANDS KOMMUNALFÖRBUND	1,4	175
POLISMYNDIGHETEN	1,4	175
SVENSKA RYMDAKTIEBOLAGET	1	125
TEKNISKA VERKEN I KIRUNA AKTIEBOLAG	1	125
KIRUNABOSTÄDER AKTIEBOLAG	1	125
CENTRALA STUDIESTÖDSNÄMNDEN	1	125
COOP NORRBOTTEN EKONOMISK FÖRENING	1	125
SAMHALL AKTIEBOLAG	1	125
BRAVIDA SVERIGE AB	0,6	75

Table 21: 15 biggest employers in Kiruna 2017.

Appendix 8 - Norrbotten's Participation in Horizon per Party and Programme

The data comes from Vinnova's yearbook 2016 – Swedish participation in European programmes for research and innovation, Katrin Danerlöv & Judit Wefer – Series: Vinnova Analysis VA 2017:03.

Tabell 54 Deltagare från Norrbotten (sorterat på beviljade medel)

ORGANISATION	DELTAG-ANDEN	KOORDI-NATORER	BEVILJADE MEDEL (€)
NORRBOTTENS LÄN	58	7	35 701 978
SWEREA MEFOS AB	5		12 638 140
LULEA TEKNISKA UNIVERSITET	26	5	11 714 726
EISCAT SCIENTIFIC ASSOCIATION	5	1	4 083 781
KIRUNA WAGON AB	2		2 698 515
SWEREA SICOMP AB	6	1	2 184 648
OPTIMATION AB	2		425 875
LINDBACKS BYGG AB	2		423 125
INSTITUTET FOR RYMDFYSIK	2		404 213
BLATRADEN AB	2		374 516
ELECTROTECH KALIX AB	1		188 750
LUOSSAVAARA-KIIRUNAVAARA AB	1		164 750
ENERGIKONTOR NORR AB	1		164 525
LULEA ENERGI AB	1		148 750
LTU BUSINESS AB	2		87 665

Figure 52: Norrbotten's participation in the Horizon 2020 programme.

Tabell 49 Fördelning av beviljade medel (€) per program och län - Sverige

PROGRAM/ LÄN	BLEK-INGE	DALAR-NA	GÄVLE-BORG	HAL-LAND	JÄMT-LAND	JÖN-KÖPING	KAL-MAR	KRONO-BERG	NORR-BOTTEN	SKÅNE	STOCK-HOLM	SÖDER-MAN-LAND	UPPSALA	VÄRM-LAND	VÄSTER-BOTTEN	VÄSTER-NORR-LAND	VÄSTMAN-LAND	VÄSTRA GÖTA-LAND	ÖREBRO	ÖSTER-GÖTLAND	SUMMA
ÖVRIGT										730 037	718 000					702 975		2 989 677			5 140 689
ERC										28 319 893	49 048 355	55 262	24 299 175		3 499 414			14 218 277		1 499 759	120 940 135
FET								1 457 653	501 250	1 750 448	11 148 312		3 515 221		1 720 250		140 000	13 795 013		597 475	34 625 621
MSCA	790 978		67 500	180 000				758 176	1 385 797	9 987 822	31 717 956		5 788 326	1 054 637	1 994 115	527 319		14 933 999	701 176	6 063 544	75 951 344
INFRA									4 409 411	17 436 344	3 630 648		5 213 332		683 437	562 290		2 124 001		1 600 038	35 659 501
ICT	393 790		1 643 314			453 125			4 507 482	4 301 001	32 792 120		1 918 510	1 697 765	2 381 625		3 006 065	14 460 222	3 291 049	3 677 802	74 523 869
NMBP	419 913	0	2 139 870	1 339 375	0	981 675	0	0	3 711 603	4 189 805	12 115 567	0	6 139 904	0	2 054 238	318 071	3 802 122	15 782 462	0	1 759 515	54 754 118
RYMD									314 213		3 991 062		670 060				100 118	1 833 919	170 369	620 930	7 700 669
SME			0			0	0		87 665	400 875	175 330				0		0	729 881			1 393 751
HÄLSA	893 125				324 875			355 025		17 836 753	50 702 605		8 376 769	1 446 511	2 669 463		50 000	4 667 910	1 540 210	2 944 194	91 807 439
BIOEKONOMI			0 2 518 080	58 875				1 842 198	444 315	3 014 262	9 925 036		5 481 885			5 204 211		4 471 449		520 735	33 481 045
ENERGI	987 361		401 520	114 250		251 062	0	831 032	13 372 836	7 961 278	25 568 451	5 117 712	2 025 968	0	2 995 942		637 875	8 007 967		919 550	69 192 802
TRANSPORT		4 240 860	50 000	0					4 590 358	4 087 578	11 140 462	738 850	214 750	151 878			3 491 611	24 229 766		5 945 174	58 881 287
KLIMAT	499 049		314 250					65 941	1 889 738	5 349 324	13 584 015	396 602	1 479 112		74 150	51 125	324 375	4 234 706		3 813 232	32 075 619
SAMHÄLLEN		98 221								738 254	4 477 043	232 618	1 232 691	141 516	883 791			1 736 012	419 718	463 250	10 423 115
SÄKERHET									487 313	469 022	4 860 971			717 375		640 188		2 798 582		1 267 717	11 241 167
BREDDAT DELTAGANDE	0	0	0	0	0	0	0	0	0	75 000	5 176 803	0	374 111	0	0	0	0	0	0	0	5 625 914
VETENSKAP MED OCH FÖR SAMHÄLLET	0	0	0	0	0	0	0	163 781	0	265 625	169 063	0	0	0	0	0	0	250 000	223 025	92 635	1 164 128
EURATOM											5 846 615		167 400				736 005	801 991			7 552 011
TOTAL SUMMA	3 984 215	4 339 081	7 134 534	1 692 500	324 875	1 685 862	0	5 473 806	35 701 978	106 913 320	276 788 413	6 541 043	66 897 213	5 209 683	18 956 426	8 006 178	12 288 171	132 065 832	6 345 546	31 785 549	732 134 225

Figure 53: Norrbotten's participation in the Horizon 2020 programme divided into programme areas.

Appendix 9 - Arctic Testing

Over the past 50 years, since the industry was established, car and component testing operations in Norrbotten have grown into a significant regional industry. A majority of the world's biggest manufacturers of car components and cars have localised their winter testing in the region.

What local parties offer is primarily the basic product of ice courses. Investments have also been made into land-based courses, garages, workshops, homes and offices. Aside from services like ploughed courses, maintenance of customers' workshops, and leasing of garages, a full service concept with accommodation, courses, certain technical competence, and drivers for long distance testing are also offered. Some entrepreneurs have fully equipped workshops, while others act largely as property managers for customers' premises and workshops.

The Luleå University of Technology's report Testing Industry in Norrbotten has identified 16 limited companies that could be said to constitute the vehicle testing industry in Norrbotten. Many of these companies are located in Arjeplog, where the biggest of the parties – Tjintokk Ltd – also has its operations. There are also operations in Arvidsjaur, Jokkmokk, Piteå, and Älvsbyn. Apart from the businesses that work directly with vehicle testing, there are a large number of businesses that offer vital societal services to people working with the car and component testing businesses, such as construction businesses, hotels and restaurants. Some of the suppliers offer services to the car and component testing businesses as well as room and board.

The Testing Industry in Numbers

In 2016, the businesses that work directly in the testing industry in the region employed 227 people. Employment is, however, in many cases concentrated to the testing industry's high season, which is during the winter months. During the 2007 – 2016 period, the number of employees increased by around 72 per cent, and development in the individual business Tjintokk Ltd was responsible for more than half of employment growth.

The businesses in the testing industry have a joint turnover of close to 450 million SEK per year according to the books of 2016. This can be compared to over 200 million SEK as a joint turnover in 2007. Tjintokk Ltd has doubled its turnover in the past five years, and is solely responsible for nearly half of the vehicle testing industry's turnover in 2016. The average profit margin in 2016 was around 16 per cent for the businesses in the testing industry, but variation was great.

The Effects of the Testing Industry

The vehicle testing industry's direct share of GRP in the regions that have the most testing operations in Norrbotten varies from 0.5 to 14.2 per cent. In both Arvidsjaur and Älvsbyn, the direct share of GRP is less than one per cent. In Arjeplog, however, the share is 14.2 per cent. It should be mentioned that these calculations don't include any indirect effects, only the direct effects that consist of identified car and component testing businesses.

One industry that is closely connected to the testing industry is the hotel industry. Testing businesses attract a large number of visitors every year, working with testing during the high season. Thereby, accommodation has, in some contexts, become a critical factor for further development of the testing industry. In total, the hotel industry in the testing municipalities (Älvsbyn, Arvidsjaur and Arjeplog) had an annual turnover of 200 million SEK over the past few years. The number of people employed in the hotel industry has been around 120 people. In 2016, the hotel industry in the testing municipalities generated an added value of a total of around 103.4 million SEK. The hotel industry's direct contribution to GRP for the municipalities is 0.9 per cent for Älvsbyn, 1.9 per cent for Arvidsjaur and 3.6 per cent for Arjeplog.

In the same way, there is a strong connection between the testing industry and retail in these so-called testing municipalities. Grocery retail has increased from close to 500 million SEK per year in 2007 to around 650 million SEK per year until 2016. These numbers are the figures for Älvsbyn, Arvidsjaur and Arjeplog put together.

The testing industry has great effects on trade and industry in the affected municipalities, especially Arjeplog. The car and component tests mean that a large number of international customers spend time in the testing municipalities during high season. These visitors need accommodation, food and services of different kinds[213]. Examples of different test beds in Norrbotten.

Below is an overall summary per municipality with the purpose of simply updating the view of the current situation of existing and future test beds per municipality.

Testing as an Industry

In terms of definition, an industry is a certain operational area, branch or section of business, trade and industry, or professional operations. There is, as most people will know, a formal industry division to use within economics statistics and stock trade; Statistical Classification of Economic Activities in the European Community (NACE).

If you search for 'testing' among the NACE codes at Statistics Sweden, you'll get some ten relevant codes, spanning areas like material testing and car inspection/testing to medical and dental tests. There is one code (71200) with the summarising headline 'Technical testing and analysis,' but among the SPGA members, it's just as common to find codes describing industry premises leasing, maintenance of courses, etc. In terms of definition, you could say, however, that testing operations is a branch of one area of trade and industry. In other words, it's not wrong to use the term 'testing industry,' even if it's hard to identify the group 'testing businesses' by searching for NACE codes. The issue of whether it should be up to the individual entrepreneur, their customer, or someone else to define what counts as part of the testing industry isn't really the focus of our pilot study. Nor do we have any ambition to try and influence different parties' choice of NACE code in it.

Testing as Process Support

Vinnova has been working with the term Technology Readiness Level (TRL) for a while. Put simply, TRL is a term for a technology's level of maturity, and it comes from the American aeronautics and space administration, NASA. An innovation is, per definition, an idea/invention that has progressed all the way to commercialisation.

To clarify which activities are needed to implement research results, for instance, in new products/processes, ten levels of technology maturity (TRL levels) are used:

1. Applied research, publication.
2. Formulated technology concept, first step of innovation.
3. Experimental testing, lab validation of theory.
4. Integration of basic technology, lab test of system solutions.
5. First tests towards actual environment (lab/simulator).
6. Prototypes for testing and demo in a controlled/simulated environment.
7. Prototype for testing and demo in the actual environment.
8. Testing and demo of a real system in the actual environment.
9. Evaluation of actual system in use.
10. Business.

213 Regionala effekter – Testnäring i Norrbotten, 2018, Ejdemo Thomas och Örtqvist Daniel.

Based on this, you could say, simplified, that you try/test your way through the whole development process, but with slightly different purposes. Initially in order to prove a theory on a very high technical/scientific level. Later on, to prove that you can meet future requirements for a product or service. The final steps (6 – 9) can be broadly divided into:

- **Testing towards a specification** of requirements with the purpose of clarifying that the internal requirements set by the organisation/business for the product are met.
- **Integration testing** (and demo) with the purpose of clarifying that the product works when it goes into normal use (sometimes also called beta testing). This part can also mean practical testing to prepare for introduction in society (including testing against laws and regulations, which may need to be upgraded).
- **Validation** with the purpose of clarifying that the product lasts for long-term usage in its actual environment. Often with measurements of accessibility, facility usage and life cycle costs.

The start-up timing and durability for the above steps is largely dependent on what type of product/service is involved. If you're selling an electrified bus, you'll have to take into account that the customer will have high demands when it comes to early and long-lasting testing and validation of how an automated energy transfer is worn down over time, for instance, and of what life cycle economy (cost per kilometre) it results in. If you develop a new kind of software for mobile consumer technology, on the other hand, the customer might offer to be a 'beta tester' as long as they get to be the first to have the latest product. In other words, very low requirements when it comes to validation.

Testing can, in some ways, be seen as a supporting process throughout the development phase, but with slightly different purposes (and needs for equipment and competence), depending on the level of maturity. So, there is testing in basically all industries.

Testing as a Key Activity

Regardless of whether you choose to call it testing, demo, integration or validation testing, you can generally say that without these activities, the risks are higher when a product is launched, with the result that it's harder to find people who want to finance the commercialisation step. Somewhere along the line, in one way or another, you have to perform the test, THE TEST, in order to pass through the eye of this financial needle.

Looking at the financing side of the process from idea to commercialised innovation, it's relevant to divide the TRL levels as follows:

A. Basic research (TRL 1 – 2).

B. Proving research (TRL 2 – 4).

C. Technological development (TRL 3 – 6).

D. Technology demonstration (TRL 5 – 7).

E. System development (TRL 6 – 9).

F. System testing and launch (8 – 10).

Testing operations in academia (A – D) are often included in a well-outlined research project, often financed through various R&D programmes. But the steps thereafter (especially E and F) can often be delayed due to problems finding private means to finance these final steps.

Page 8 refers to the term 'the valley of death,' such as in this text: 'Businesses need support with specific measures, activities and programmes to avoid ending up in "the valley of death".

Put simply, you could say that capital owners don't feel that they have enough proof for the product being ready for launch, which makes it hard to assess the total cost of getting to TRL 10.

On a national level, investments in testing have been identified, connected to this logic, as a strategic way to reduce this technological risk, and thus reducing the scope of the aforementioned 'valley of death.' In this sense, testing should be seen as a key activity, a turning point, where you go from a phase of costs to commercialisation and profitability.

With new technology comes new testing needs, which is why Vinnova is investing in programmes to develop test beds. Swedish industry needs test beds with high competence levels. The competence should be able to guide the customer, who wants to make money from their innovation, in successfully getting through the final steps in the above-mentioned TRL levels.

Testing as an Authority Function

The Vinnova authority wants to see test beds that both assure the quality of future innovations, and guide parties when it comes to reaching the market. The test bed programme is thus a kind of test of test beds. The hope is that an initial investment in a test bed will lead to commercial durability and a profiling of Sweden as a test country, with slogans like 'Tested in Sweden' as a kind of mark of quality. There is a logic, connected to this, to us talking about test beds while simultaneously using the term 'the testing industry' when we are running development in the region. The test bed helps Swedish businesses to succeed in their commercialisation. The testing industry creates export values through its international character.

If you add a historic perspective to the phenomenon, however, testing can also be described as a function for exercising authority, where society tries to improve environment, efficiency, safety and confidentiality, for instance. If this is the case, there are completely different motives than creating competent test beds that reduce the risk of businesses getting stuck in 'the valley of death'. Taken to the extreme, we are debating control functions and the exercising of authority, and a balance between a constant striving to act commercially (with profitability as the guiding star) and a need to provide means to steer and control (with societal development and sustainability as the guiding star). This means that the authority for innovations, Vinnova, is far from the only authority that might need help to find the right areas for investing in national testing environments and test beds.

Different Testing Environments in Norrbotten

Kiruna

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
Arena Arcica,	Maintenance and testing.	Testing opportunities for planes and land vehicles.	Hangar of 6,500 m² that has space for a Boeing 747.		Owner: Swedavia Location: Kiruna airport.
Essrange		Tests using sounding rockets and high-altitude balloons.	One of the world's biggest civil land stations for satellite communication from where SSC's global antenna network is run.		Owned by state company SSC, the Swedish Space Corporation.
NEAT North European Test range	Testing of airborne technology above land.	Testing in a corridor between RFN and Esrange.	Telemetry, radar, traffic control, etc.	Global parties in flight and space.	FMV och SCC
LKAB	Test bed in the area of mining.	Self-driving cars and electrification of heavy vehicles.		LKAB's partners and suppliers.	LKAB

Gällivare

TOD ENVIRONMENT	TTECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
Aitikgruvan	Test bed for Boliden.	Testing opportunities in automation, IT and telecoms, etc.	5G network.	Boliden's suppliers.	Boliden

Jokkmokk

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
JPG, Jokkmokk Proving Groound	Testing of vehicles.	Testing on primed courses in the winter.	Own airfield and workshops.	Testing groups with Volvo.	Owner: Luftfartsverket? Location: Jokkmokk
Hägglund och Granström	Testing of winter tyres.	Testing on primed courses in the winter.	Three-point tum + dynamic surfaces.	Conti tyres.	Owner: AB Granströms Location: Jokkmokk
Porjus	Testing of hydropower technology.	Testing of turbines, ste-ering, generation, etc.		Vattenfall, ABB, Siemens?	Owner: Vattenfall Location: Porjus
”Jokkmokk simulatorn”	Testing of complete electrical grids.	Testing and training in the running of complete (countrywide) electrical grids.	Equipment for efficiency testing and all sorts of things.	Vattenfall	Owner: Vattenfall Location: Jokkmokk
”Vindmannen”	Testing of wind power.	Testing facilities for mountain-based wind power.		Vattenfall/Suorvavind	Owner: Suorvavind Location: Suorva-magasinet

Övertorneå

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	APARTIES, TESTING CUSTOMERS	OWNER, LOCATION
ABCD	Business models for CO2 emissions.	Trading systems for carbon credits.	Business models and a journey plan towards cost-effective carbon neutrality.	Global parties with CO2 emissions	Stakeholders from: Övertorneå kommun, Svea skog, LKAB, SLU, LRF, etc.

Arjeplog

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
Tjintokk	Vehicle tests.	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For complete car verification: Split friction, action, dynamics tests + workshops and cooling garage.	VAG-koncernen	Owner: Norrlands Marknads Idéer, NMI Location: Slagnäs
ATM	Vehicle tests.	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	Facilities on land and frozen lakes.	Open to the car industry.	Owner: Norrlands Marknads Idéer, NMI Location: Arjeplog
Vaitoudden SIS	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture),	For complete car verification: Split friction, action, dynamics testing, workshops.	Bosch + customers.	Owner: Bosch Location: Arjeplog
IceMakers	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For complete car verification: Split friction, action, dynamics testing, workshops and cooling garage.	Open to the car industry.	Owner: IceMakers AB Location: Arjeplog
Nåtti	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For complete car verification: Split friction, action, dynamics testing, workshops and cooling garage.	BMW	Owner: BMW Location: Arjeplog
Colmis	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For complete car verification: Split friction, action, dynamics testing, workshops and cooling garage	Open to the car industry	Owner: Colmis AB Location: Arjeplog
Galtis	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For complete car verification: Split friction, action, dynamics testing, workshops and cooling garage.	Open to the car industry.	Owner: Galtis AB Location: Arjeplog
Överget, Cartest	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For brake system testing: Split friction, action, dynamics, workshops and cooling garage.		Owner: Cartest Location: Arjeplog
Kurrokvejk: Porsche	Vehicle tests	Testing of vehicles above land, frozen lakes and country roads (mileage capture).	For brake system testing: Split friction, action, dynamics, workshops and cooling garage.	Porsche	Owner: Porsche
Skeut: Lappland Cartest	Vehicle tests	Testing of vehicles above land.		Daimler	Owner: Lappland Cartest AB Location: Skeut

Boden

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
Winternet	Test bed for man and physique.	Tests of physical ability and calibration of testing equipment.	Treadmills, oxygenation, cardiograph, etc.	Athletes.	Boden

Haparanda

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
WiM E4'an	ITS-solutions.	Testing of weigh in motion (weighing while driving).	Sensors in roads.	Trafikverket/ Swarco	Trafikverket

Älvsbyn

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
RFN	Field testing of military technology.	Tests of flying materials above land, and equipment for land testing.	Own airfield and own testing area. Radar, phone network and telecoms centre.	Weapons industry and military forces.	Owner: FMV Location: Vidsel
Arctic Falls (däck)	Testing of winter and summer tyres.	Tests on primed courses in the winter, and on wet and dry tarmac.	Simpler measuring technology like Vbox + technology for measuring wear and tear of spikes.	Many big tyre manufacturers + car magazines and institutes.	Owner: Arctic Falls AB Location: Vidsel (plantskolan/RFN)
Vidsel Proving Ground, Bridgestone	Testing of winter tyres.	Tests on primed courses in the winter.	Simpler measuring technology like Vbox + weather station.	Bridgestone	Owner: Arctic Falls AB Location: Vidsel
Lillkorsträsk, Pirelli	Testing of winter tyres.	Tests on primed courses in the winter.	Simpler measuring technology like Vbox.	Pirelli	Owner: Arctic Falls AB Location: Älvsbyn
Nattberg, Yokohama				Yokohama	Owner: Arctic Falls AB Lo: Vitberget
Vitberget, Arctic Falls	Testing of vehicles and components + complete car verification.	Tests on primed courses in the winter.	Simpler measuring technology like Vbox.	Many big vehicle manufacturers and component suppliers.	Owner: Arctic Falls AB Location: Vitberget
Höghedens biltest och Motorsport	Testing and optimisation of engines and competition vehicles.	Programming of engine systems and advanced driver support for racing (reduced mobility).	Country road simulator.	Primarily regional customers in racing.	Owner: Höghedens biltest & Motorsport Location: Sågfors

Luleå

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
Swera Mefos	A global, independent leader in metallurgic pilot research and development.	Reduction and smelting to warming and processing. Also waste product management and recycling.	Equipment for reduction, smelting and moulding. Processing technology. Environmental equipment for purifying powder and gas.	Industry and SMEs.	Ägare: Swerea AB Lokalisering: Luleå
Metasphere	Research & development in the field of powder technology with reference to spherical powders.				
LKAB	The research and development unit comprises research areas mining technology, environment and mineral technology, pelletisation, metallurgy, production development, and energy and climate systems.	Mining technology, pelletisation, environment and mineral technology, metallurgy, production development, energy and climate systems.	Much of research is run in LKAB's experiment furnace in Luleå.	LKAB collaborates with external parties, nationally and internationally.	LKAB
ITS Miljö Antnäs	Traffic safety	Ghost driver detection.	Camera unit and road sensors.	Trafikverket	Owner: Trafikverket
Arctos labs	Experience covers mobile and core systems, software technology, services development.	Yes	Yes		

Arvidsjaur

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
Conti Teves (vid flygfältet)	Testing of vehicles and components.	Tests on primed courses in the winter.	Own testing field and workshops.	Testing groups at Continental.	Owner: Continental Location: Flygfältet Arvidsjaur
Conti Tyre (EAL)	Testing of winter tyres.	Tests on primed courses in the winter.	Hills, split courses, dynamic surfaces.	Conti tyres	Owner: Icemakers Location: Arvidsjaur
CCT, Storberg	Vehicle testing.	Tests on primed courses in the winter.	Own test field and workshops.		Owner: Olof B/Hotell E Location: Storberg
CCT, Kikkejaur	Testing of brake systems.	Tests on primed courses in the winter	Own test field and workshops.	ZF TRW	Owner: Olof B/Hotell E Location: Kikkejaur
TRW automotive Sweden	Testing of brake systems.	Tests on primed courses in the winter.	Own test field and workshops.	ZF TRW	Owner: TRW Location: Kikkejaur
Arvidsjaursjön, Lapland Cartest AB	Vehicle testing.	Tests on primed courses in the winter.	Own test field and workshops. Runs two facilities; one in Arvidsjaur and one in Arjeplog (where Icemakers is the service provider).	Daimler	Owner: Daimler
Conti Tyre (Nordlunda/ Asphaltwerk)	Testing tyres.	Land courses.			Continental
Arméns jägarbataljon	Defence Materiel Administration test bed Man in cold climates.	Man and materials.	Arctic climate/K4 military area.	National & international parties.	Försvarsmakten

Piteå

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES	TESTING EQUIPMENT	PARTIES, TESTING CUSTOMERS	OWNER, LOCATION
KallaTunneln	Ski tests and tyre tests.	Ski wax, skis, tyres, etc.	Controlled climate hall.	Swix, Pitelli, Yokohama, Bridgestone	Darkathlon AB
Träpulver-förgasaren	Carburation of black liquor and pulverised wood. Burning most of it.	Tests and modelling.	Pulverised wood carburettor and associated analysis equipment.	BioGreen, LKAB, etc.	SP ETC
Plastkompositer	Polymer composites.	20 different testing facilities.	Advanced testing and modelling.	Rolls Roys	Swerea Sicomp
Digitala ljud i varierade miljöer	Sound environments in control rooms, and sound for electrical cars.	Both in labs and on site.	Tools for sound design.	Scania	Interactive Institute/ Swedish ICT
Förgasning och bioraffinaderier	Carburation of black liquor and manufacture of DME and Methanol.		Black liquor carburettor and DME pilot.	Haldor Topsoe	LTU Holding/ LTU Green Fuels

Luleå University of Technology

Below is an overview of academia's test beds. The inventory was taken with the help of LTU, and does not include testing environments at Umeå University and the Swedish University of Agricultural Sciences.

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATION	TESTING OPPORTUNITIES/TESTING EQUIPMENT	LOCATION
ETS	Human work science/industrial design.	• Eye movements – eye tracking • Driving simulator • Sound studio and usability • Echo-free room • Multi-studio – multifunctional room • Prototyping – 3D models	
SRT	Systems and space technology	• Information security lab • Bothnia Living Lab • IoT Innovation Lab – Skellefteå • Sense Smart Region – Skellefteå • Control engineering – experiment arrangements, such as electricity machines • The SBU lab – Sequential Build Up, electronics production, technology in early development • The robotics lab workshop and experiment platform for sensors and actuators • The EMC lab – completely dampened chamber for measuring antennae • Ultrasound lab • Photo acoustics lab • Microelectronics lab – evaluation of integrated circuits • Space Innovation Forum – meeting point for academia and industry • Space Lab – develops and produces small-scale satellites – nanosatellites • Computer rooms for students (Kiruna, Luleå and Skellefteå) • Electronics labs for students (Kiruna, Luleå and Skellefteå) • Field robotics (research) • Optoacoustics lab (research lab) • Flow lab (research lab) • Receiver station (Kiruna) • Mobile systems lab (research lab)	
	Health science	• Testing homes for aid equipment • Outside environment for testing aid equipment • Care environments • Pharmaceutical and biomaterials lab • Movement lab	
	Art, communication and learning	• Media equipment • Radio centre (for journalists, technicians and musicians) • Media centre	

TOD ENVIRONMENT	TECHNOLOGY AREA, INDUSTRY, OPERATIONS	TESTING OPPORTUNITIES/TESTING EQUIPMENT	LOCATION
	The built environment and natural resources	• Architecture lab • CBM lab – a railway lab with miniature trains and rail for condition-based maintenance • Echo-free room – lab for measuring and listening tests where there is no acoustic effect from the room • eMaintenance Lab • Sound quality studio – studio for creating and evaluating products' sounds, for instance • Step sound lab – construction-acoustic measurements of joists • Semi-echo-free vehicle lab – semi-echo-free lab where vehicles' sound and vibration characteristics can be evaluated • Equipment in lab and bench scale for studies of hydro- and pyrometallurgical reaction processes, kinetics and balance conditions • High resolution scanning electron microscope for the analysis of nanoparticles and porous structures, such as zeolite membranes • Equipment for the analysis of interfaces between phases on a molecular level, such as surfaces between mineral particles and water, tribological surfaces and wooden surfaces • Bioprocessing lab – bioreactors for microbial production of chemicals, materials and fuels, as well as analysis and separation equipment • Equipment for particle analysis: chemical composition, measurement of particle size distribution, particle density, specific surface (BET), contact angle, surface tension, zeta potential • Equipment in particle technology and physical separation methods: fragmentation, particle size separation, density separation, separation in electrical and magnetic fields, flotation • CompLab – mechanical testing of steel, wood and concrete; geomechanical testing, field measurements; analyses and evaluations • The environment laboratory whose research largely takes place through trials and in the field	
	Engineering technology and mathematics	• Wood physics lab (CT centre, visualisation lab, Scannerlab, chemistry and materials lab) • Wood production development lab • Strengths learning lab – CompLab • Tribolab • Material technology lab – electron microscopes and analysis instruments (x-ray analysis) scanning tunnelling microscopes, high resolution spectroscopy lab • The John Field laboratory – experimental mechanics • Experimental mechanics lab • Laser lab • ECO-Lab – the laboratory for energy transformation processes • Chemical-technical lab • Experiment studio – virtual product development	

Appendix 10 - Internal Learning

Examples of internal learning

1. The situation report that arrives every four months; the official responsible for a thematic area summarises the situation report and the most important aspects of it in a document. The procedure is repeated three times per year.
2. Once per year, there is a meta-summary based on the three summaries previously created by the official. The data can also be used for Region Norrbotten's annual report to the government.
3. Once per year, the administrators have a full day meeting about important things they've learnt throughout the year.


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Titel: Strategy Smart Specialisation in Norrbotten

Production: Regional Development, Region Norrbotten

Photography: Francescoch/iStock (cover), Carl-Johan Utsi (p. 44), Ian Schneider/Unsplash (p. 58), Linnéa Hådén (p.73), Scandinav/Plattform (p. 74), SpaceIL (p. 75), Stina Gränfors (p. 76), Håkan Hjort (p. 77), Samuel Zeller/Unsplash (p. 83), Asaf Kliger (p.141).

Process manager: Per Erik Andersson, Department for Regional Development, Region Norrbotten

Layout: Anne Kling, Department for Regional Development, Region Norrbotten

Print: Luleå Grafiska 2020:2

ISBN: 978-91-986069-0-4

ISBN: 978-91-986069-0-4

REGION NORRBOTTEN