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## Innovations

“The Stone Age did not end because humans ran out of stones. It ended because it was time for a re-think about how we live.”

William MacDonough, American designer

Innovation has crucial importance for the industry competitiveness and it is recognized as the most important driver of economic growth. Nordic Innovation – an international institution promoting business sector innovations - defines innovation as new products, services, markets, processes or organizational models that create financial benefits or otherwise are of value to society. This chapter assesses innovative capacity of businesses within the BIN area. According to the Institute for Strategy and Competitiveness at Harvard Business School, the innovative capacity of a nation or region is heavily rooted in its microeconomic environment, in areas such as the intensity of scientists and engineers in the workforce, the degree of protection of intellectual property, and the depth of clusters. Patenting activity, associated with protection of intellectual property, is one of the key indicators of companies' innovative capacity for development of new competitive products. We use this indicator to measure the innovative capacity of companies operating in the BIN area. In our analysis, we utilize patent applications submitted to the European Patent Office (EPO) and national industrial property offices (patent offices) in Norway, Sweden, and Finland. We consider patent applications statistics over a long term from the early 1990's to 2014–15, look into the ownership structure of the patents, and trace their technical specifications. Our key findings are as follows:

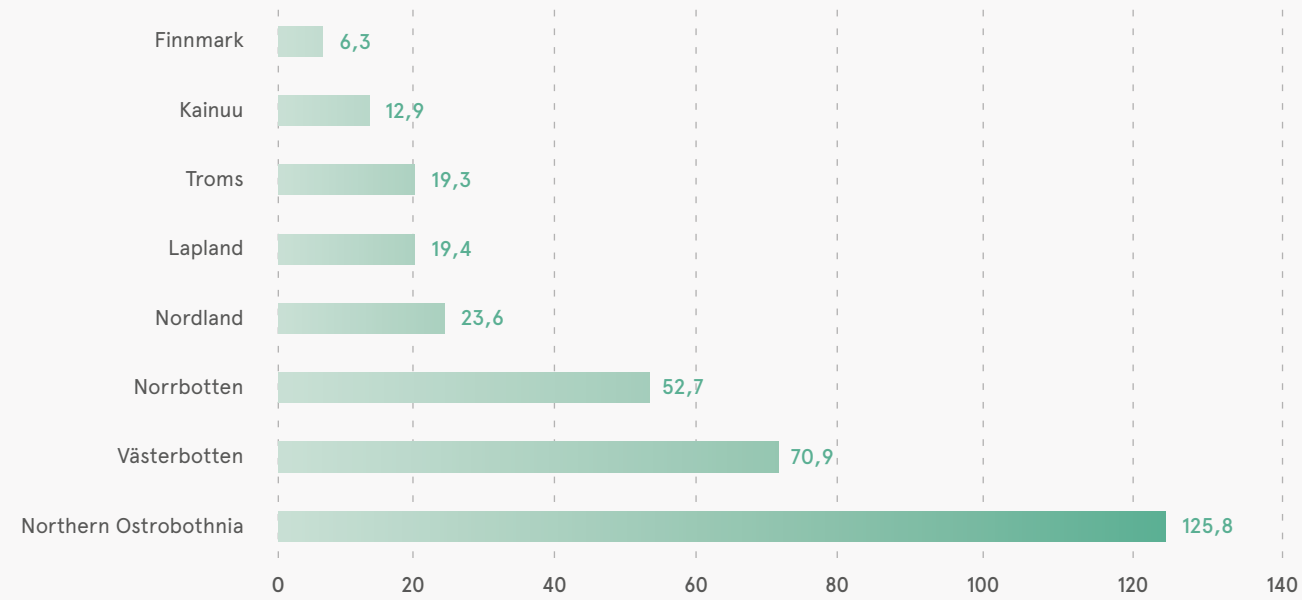
- Three of eight BIN counties - Northern Ostrobothnia, Norrbotten and Västerbotten have a relatively high level of patenting activity. The level of patenting activity in the five other counties (Nordland, Troms, Finnmark, Lapland, and Kainuu) is rather low.

- EPO patents made in Northern Ostrobothnia and Norrbotten have a low degree of local ownership. For each region, proprietors of around 80 % of patents applied for are companies headquartered outside. The degree of local ownership in Västerbotten is about 58%.
- Besides externally owned innovations, there is still a substantial number of local innovative companies and entrepreneurs in the BIN counties. These companies may benefit from cross-border cooperation and focused political support with a suitable degree of coordination by a third party.
- Potential areas for cooperation between the local BIN innovative companies are: electric communication, computing and calculating, measuring, electric elements, medical or veterinary science and hygiene, vehicle engineering and mechanics, handling and processing, construction engineering, and solutions to deal with human necessities.

The remainder of this chapter is structured as follows: We start with patenting trends overview and then move on to the analysis of the industrial property ownership in the BIN area. Further, we present our findings regarding common front-edge competence areas for the BIN companies. The chapter ends with an outline of possible practical implications of our analysis, as well as a note on its limitations and opportunities for further studies.

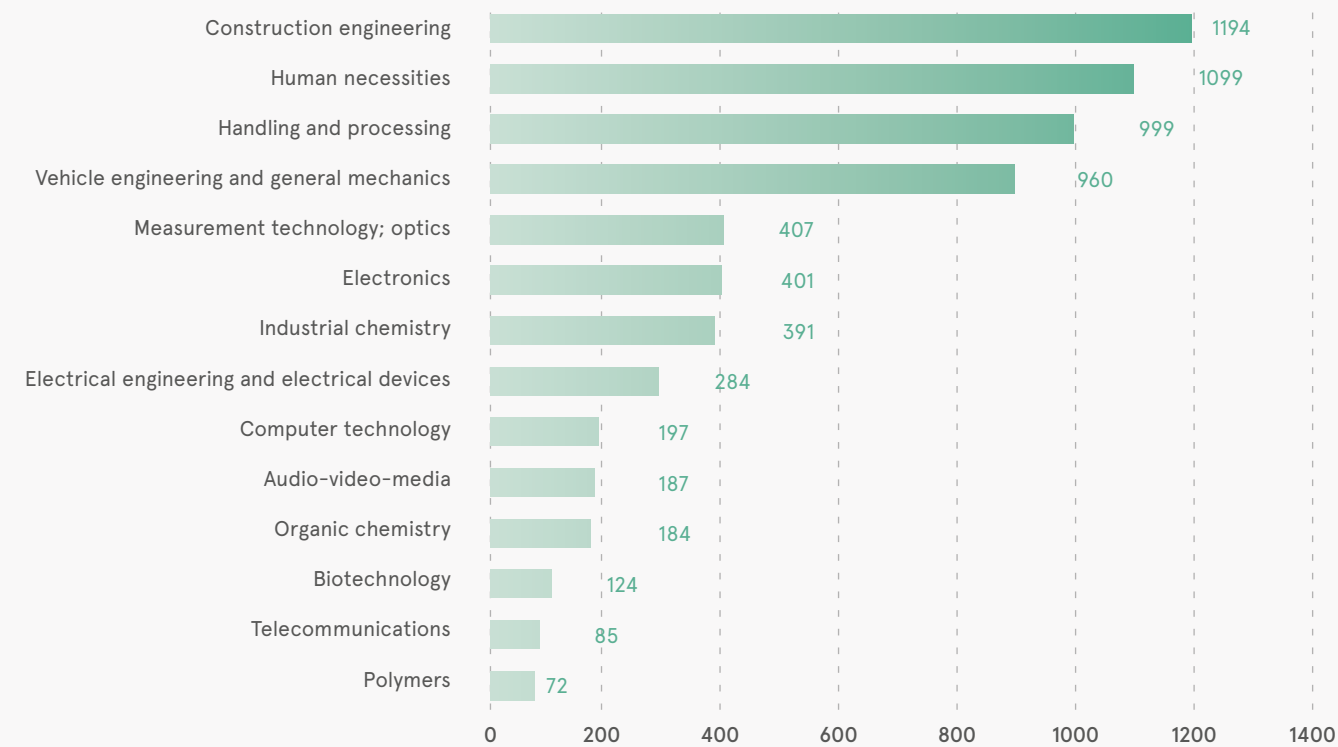
### Ranking – patenting activity in the BIN area

Average number of European and national patent applications per year



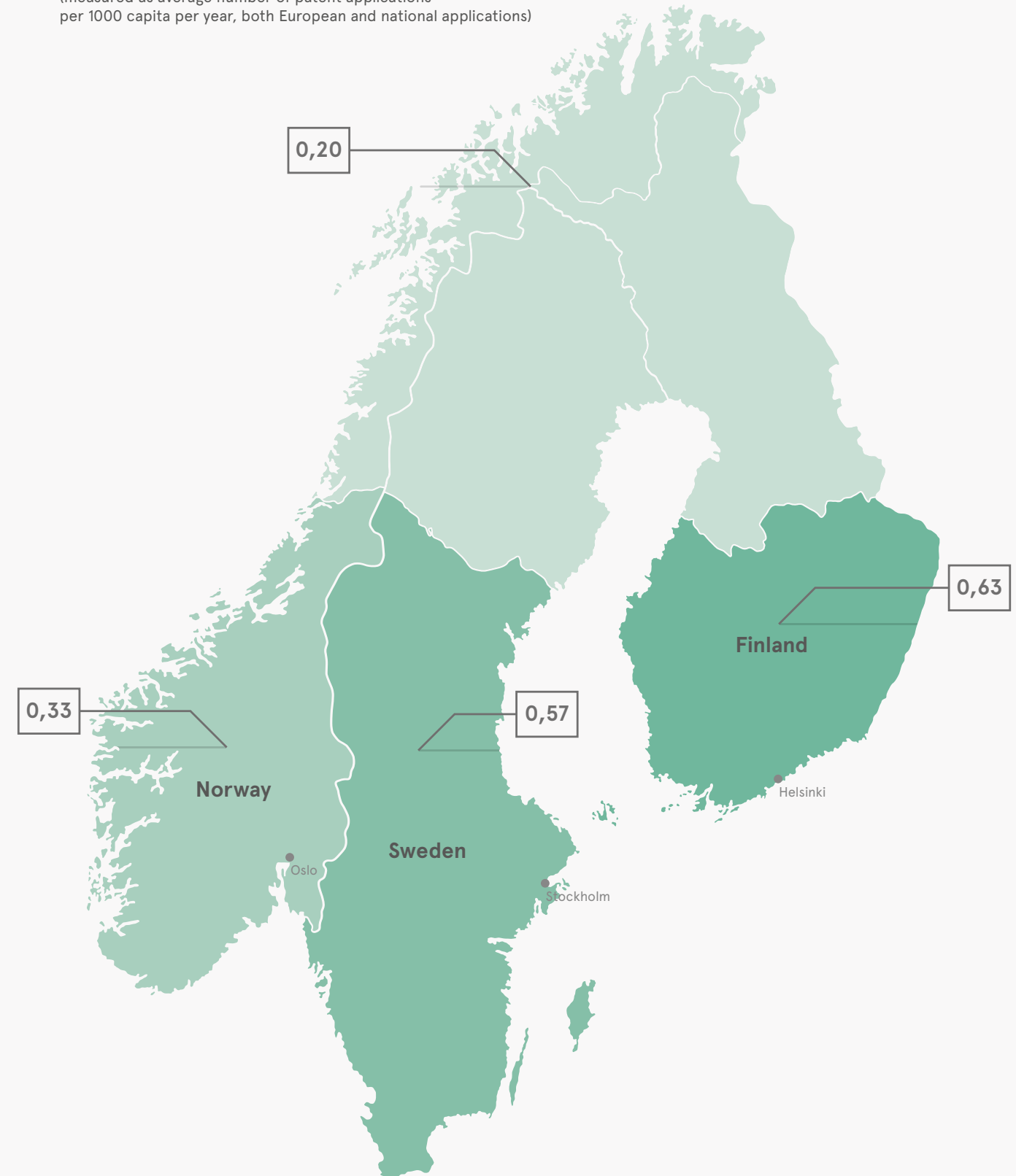
### Types of technology developed and patented – BIN area

Number of applications to national patent offices the last 25 years



### Intensity of patenting activity in the BIN area compared to countries averages.

(measured as average number of patent applications per 1000 capita per year, both European and national applications)

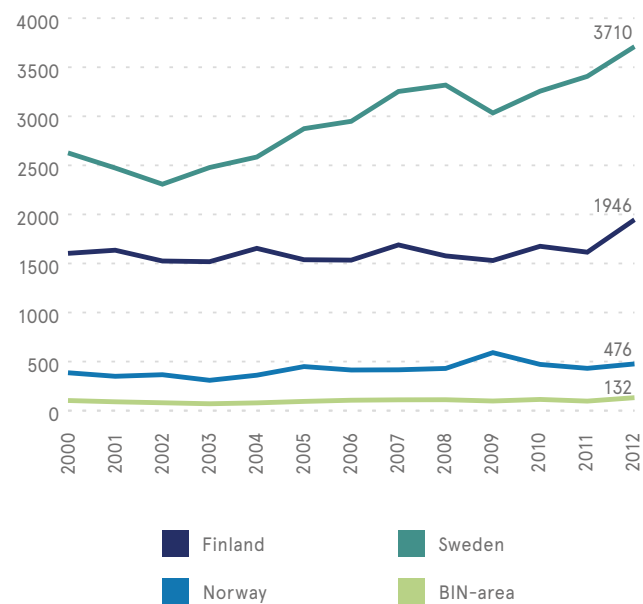


# Trends overview

Patenting can be done through either international, regional or national offices. The protection of property rights in the European region (through EPO patenting) is a characteristic way for local businesses to develop front-edge products and technologies demanded in markets far beyond their physical geographic location<sup>1</sup>. The protection of intellectual property rights in the European market by Nordic countries has gained importance since joining the EU Patent Convention in 1996. The annual number of European patent applications submitted to EPO after 2010 has increased nearly 4 times in Sweden and Finland and doubled in Norway compared to the early 1990s. In addition to this, Nordic applicants tend to use their national patent offices both as a point of destination for acquiring a national patent and as an entry to the filing rout towards international patent authorities in Europe and beyond. The number of applications to the national patent offices has declined during the recent decade in Finland and Sweden, but remained rather stable in Norway. Historically, the total number of patent applications (both European and national ones) has been highest in Sweden and lowest in Norway, with Finland placed in between.

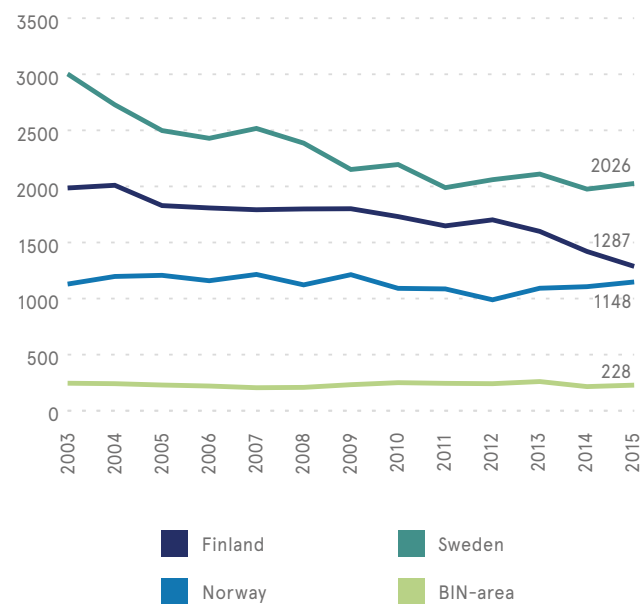
The total number of both EPO and national patent applications from the BIN area is significantly lower than the total for any Nordic country to which BIN counties belong (figures 1 and 2).

Figure 1 – Patent applications to the EPO (2000–2012)



The figure shows the sum of direct applications to EPO and international applications submitted to EPO (regional phase), based on priority date timescale (date of “conceiving” the actual invention). Background data source: OECD patent statistics.

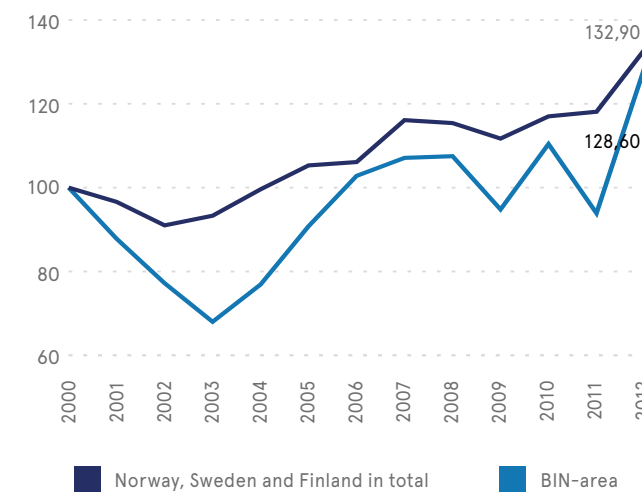
Figure 2 – Patent applications to national offices



The figure shows the sum of direct and PCT national phase applications by country residents, based on the year of filing. Background data sources: National industrial property offices in Finland, Norway, and Sweden.

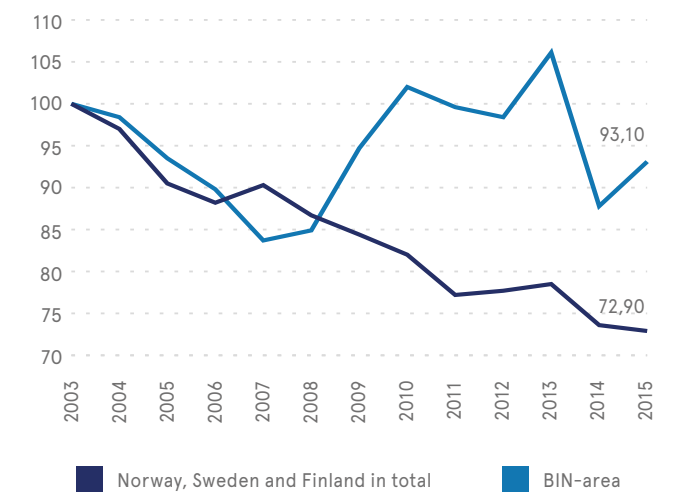
Figure 3 compares development in the number of applications to EPO in the BIN-area as well as the total for Norway, Sweden and Finland. The international orientation of the BIN area innovators is generally progressing along with the general trend for Sweden, Finland and Norway. Although the growth for the BIN area is not as steady<sup>2</sup> as for the three countries’ totals. Figure 4 shows that in 2003–2008, the number of national patent applications from the BIN area was declining along with the general trend for Norway, Sweden, Finland, while in 2009–2015 the BIN innovators were more oriented towards protecting property rights on the national markets than the three countries in general. A possible hypothesis for future research based on this last observation is whether the BIN innovators are companies with niche products seeing opportunities in the domestic markets.

Figure 3 – Development in number of applications to EPO: BIN-area and total for Norway, Sweden and Finland (2000–2012). Index 2000 = 100%



The figure shows the sum of direct applications to EPO and international applications submitted to EPO (regional phase), based on priority date timescale (date of “conceiving” the actual invention). Background data source: OECD patent statistics.

Figure 4 – Development in number of applications to national patent offices: BIN-area and total for Norway, Sweden and Finland (2003–2015). Index 2003 = 100%



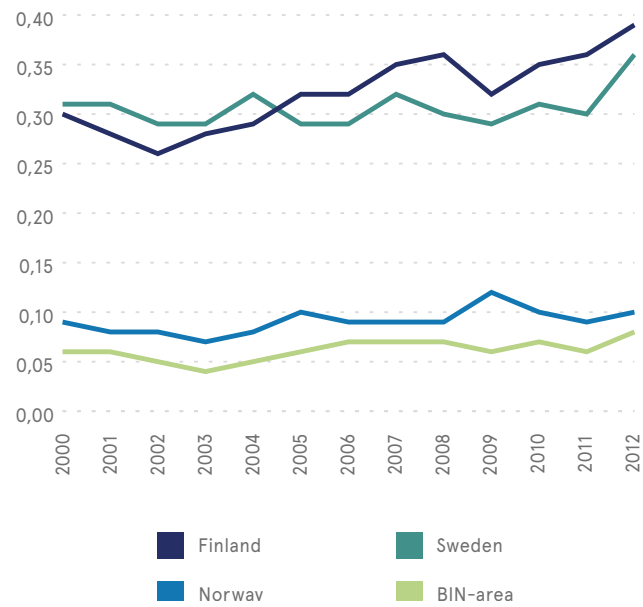
The figure shows the sum of direct and PCT national phase applications by country residents, based on the year of filing. Background data sources: national industrial property offices in Finland, Norway, and Sweden.

<sup>1</sup> The number of EPO applications is used here as an indicator of international orientation of companies. However, only the national validation figures would give a precise measure of in which countries patents are actually entering into force.

<sup>2</sup> Consider “drops” for the BIN area in 2003, 2009, 2011 shown on the figure 3. Relatively low volume of total patenting activity may be a reason for less smooth shape of the development line.

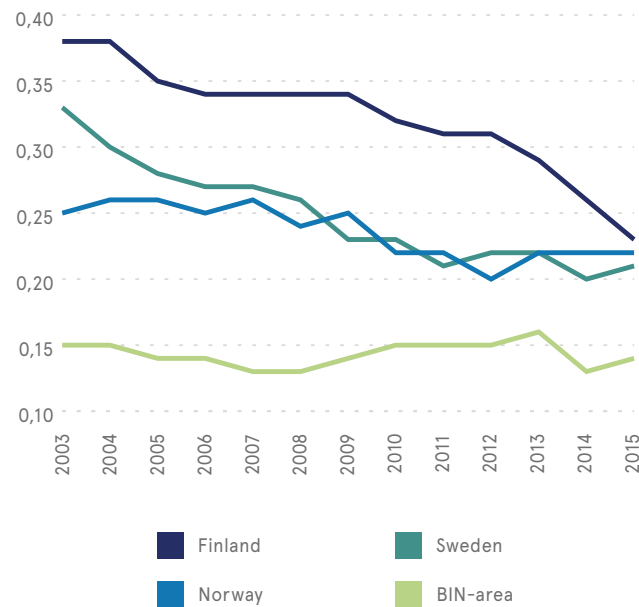
Intensity of patent applications is measured as patent applications to EPO or national offices per thousand capita. Figure 5 shows that patent intensity in the BIN area is below any Nordic country represented, compare 0.08 in the BIN area in 2012 with Finland close to 0.4. Patent intensity to EPO for Sweden and Finland is at least three times higher than in Norway. Low patent intensity in the BIN area is observed for both EPO and national patent applications (figures 5–6). Lower intensity of patent application can be attributed to a lower population in the BIN area compared to Norway, Finland, and Sweden in general. For inventions patented at the national offices, intensity in Finland has generally been higher than in Norway and Sweden (those two have been at approximately the same level) but seems to have dropped since 2012 (figure 6).

Figure 5 – Patent applications to EPO per 1000 capita



Data sources: OECD, national patent offices and statistics offices in Finland, Norway, Sweden

Figure 6 – Patent applications to national offices per 1000 capita



Analysis at the county level demonstrates that Northern Ostrobothnia, Norrbotten and Västerbotten are leaders within the BIN area in terms of patent applications (Figure 7). The intensity of patent applications from these three counties put together is still lower than total for Norway, Sweden, and Finland, but higher than for Norway (Compare these three regions presented in figure 7 with the same indicator for Norway shown on the figures 5 and 6). The intensity of EPO applications grew in these three BIN regions along with the trend for Norway, Sweden, and Finland. The intensity of national patent applications for the three countries is clearly declining (perhaps due to increased internationalization of businesses).

Data sources: OECD, national patent offices and statistics offices in Finland, Norway, Sweden

Figure 7 – Patent applications to national offices and to EPO per thousand capita, 2000–2012, total for Norway, Sweden, Finland and total for Northern Ostrobothnia, Norrbotten and Västerbotten

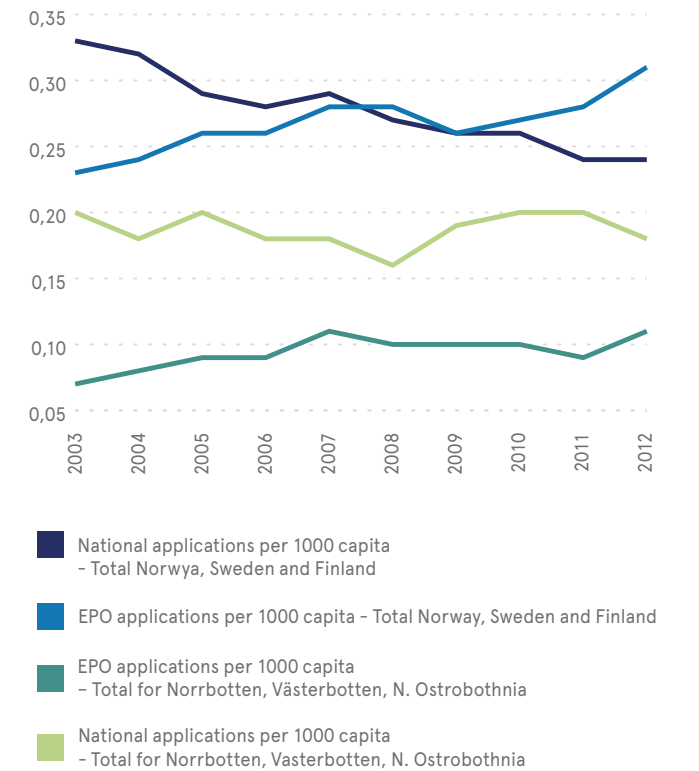
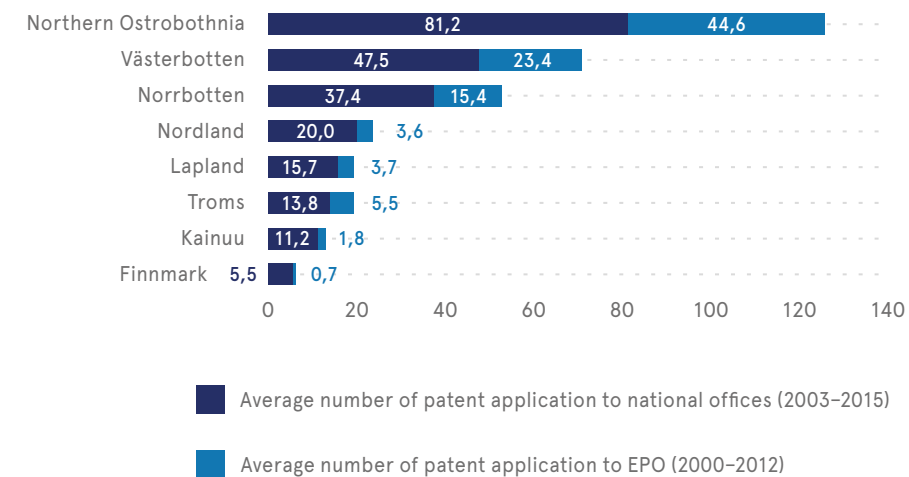


Figure 8 – Average number of patent applications per year – BIN-regions



Northern Ostrobothnia has the highest average number of applications per year in the BIN area, followed by Norrbotten and Västerbotten; the level of patenting activity in the rest of the BIN area (Nordland, Troms, Finnmark, Lapland, and Kainuu) is rather low.

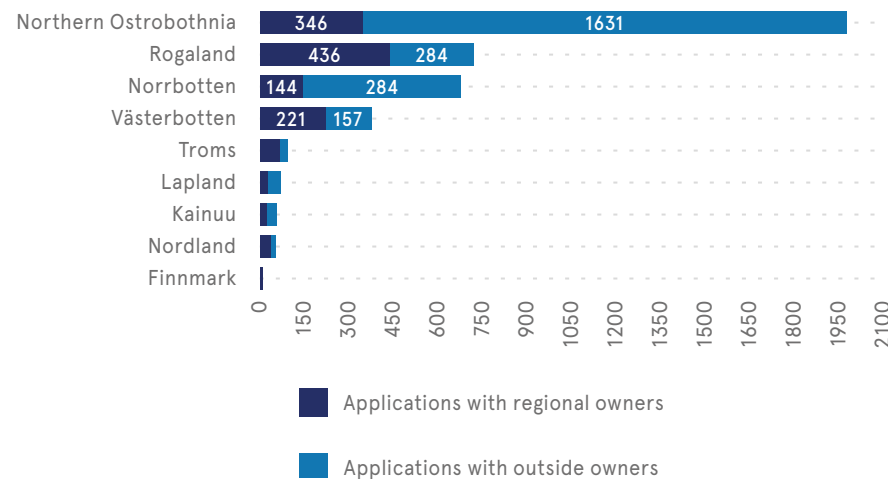
About 75 % of BIN patent applications (total for EPO and national offices) come from Northern Ostrobothnia, Norrbotten and Västerbotten. In these regions, the share of EPO applications in total number of applications (sum of EPO and national ones) is at least 30% (in the rest of the BIN area it is less than 20%).

The figure shows averages for both EPO and national patent applications. Data sources: OECD, national industrial property offices in Finland, Norway, Sweden. Average numbers of applications per year are calculated for a 13 years period (2003–15 for national applications, and 2000–2012 for EPO applications).

# Intellectual property ownership in the BIN-area

According to the EPO classification, the applicant is proprietor - owner of the invention. The owner can be either a company(/ies) or an individual(s). The inventor is an individual(s) who conceived the invention. In our analysis, we focused on the EPO applications during 1996–2014 assigned to the BIN counties, and traced those with inventor and owner (applicant) from the same county and those with regional inventor but an outside owner.

Figure 9 – EPO patent applications (1996–2014) with inventors from BIN counties and owners – residents and non-residents to BIN counties



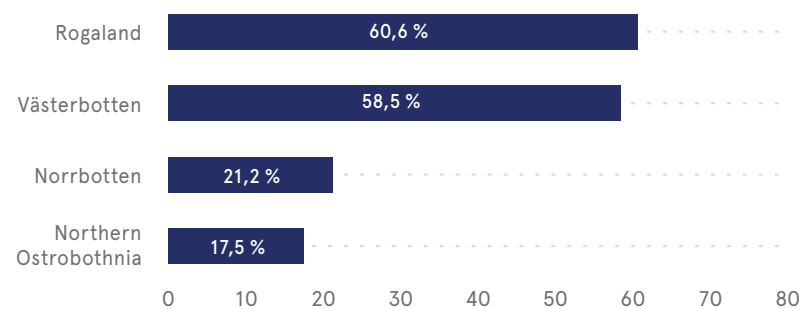
The figure shows the total number of applications to EPO from each BIN region in 1996–2014. The inventors assigned to the applications are residents of the BIN counties. The applications are classified into having regional and outside owners respectively (residents and non-residents). Data source: EPO database EPAB with statistics.

The figure illustrates the ownership structure of the patented inventions from the BIN counties. For comparison, we also include Rogaland from South Norway, which is a key region in the Norwegian oil and gas cluster, a good example of a county with rapid economic growth.

Compared to Rogaland (720 applications in total), there is a very high level of invention activity among local entrepreneurs or company employees residing in Northern Ostrobothnia (1,997 applications in total) and a rather good level in Norrbotten (678 applications). Total number of EPO applications with a local inventor in Västerbotten was 378.

The relatively low level of patenting activity in 5 out of 8 BIN regions (Troms, Lapland, Kainuu, Nordland and Finnmark) may put local businesses in danger in the course of global production systems extending to the north.

Figure 10 – Degree of local ownership (%) in Northern Ostrobothnia, Norrbotten, Västerbotten compared to Rogaland



Degree of local ownership is defined as number of patented inventions with proprietors - regional residents divided by total number of inventions made in the county.

Degree of local ownership for the inventions made in Northern Ostrobothnia and Norrbotten is low: 17,5 % and 21,2 % respectively; while it is relatively high in Västerbotten - 58,5% (close to the reference county Rogaland - 60,6%).

The low degree of local ownership signals that commercial results of the inventions (materialized as innovations) are not retained locally.

The other five BIN regions are not included due to rather low total volume and the sparse character of the patenting activity. Although the degree of regional ownership there would be close to 100%, which means lack of R&D investments by larger companies from the outside.

Table 1 – Top owners of the EPO patented inventions and location of their headquarters (HQ)

| Norrbotten                              |              |              | Västerbotten                          |              |                                   |
|---|--------------|--------------|---------------------------------------|--------------|-----------------------------------|
| Top Owners, 72,4% Of Total Applications | HQ           | Applications | Top Owners, 31% Of Total Applications | HQ           | Applications                      |
| Telefonaktiebolaget Lm Ericsson Publ    | Non-Resident | 398          | Swetree Technologies AB               | Resident     | 15                                |
| Gestamp Hardtech AB                     | Subsidiary   | 30           | Telefonaktiebolaget L M Ericsson Publ | Non-resident | 13                                |
| Telia AB                                | Non-Resident | 25           | Sqs Security Qube System AB           | Resident     | 8                                 |
| Operax AB                               | Resident     | 14           | Sekab E Technology AB                 | Non-resident | 7                                 |
| Accra Teknik AB                         | Non-Resident | 13           | Stock Of Sweden AB                    | Non-resident | 7                                 |
| Telia AB Publ                           | Non-Resident | 11           | Bioendev AB                           | Resident     | 6                                 |
| Northern Ostrobothnia                   |              |              | Abbott Laboratories                   |              |                                   |
| Top Owners, 72% Of Total Applications   | HQ           | Applications | Non-resident                          | 5            | Bae Systems Haggblunds Aktiebolag |
| Nokia Corporation                       | Non-resident | 730          | Non-resident                          | 5            | Betagenon AB                      |
| Nokia Siemens Networks Oy               | Non-resident | 186          | Resident                              | 5            | Fumex AB                          |
| Nokia Solutions And Networks Oy         | Non-resident | 152          | Resident                              | 5            | Komatsu Forest AB                 |
| Nokia Networks Oy                       | Non-resident | 144          | Non-resident                          | 4            | Bergteamet AB                     |
| Nokia Telecommunications Oy             | Non-resident | 104          | Resident                              | 3            | Airgrinder AB                     |
| Nokia Mobile Phones Ltd                 | Non-resident | 37           | Resident                              | 3            | Alimak Hek AB                     |
| Kemira Oyj                              | Non-resident | 23           | Resident                              | 3            | Alo AB                            |
| Nokia Technologies Oy                   | Non-resident | 22           | Resident                              | 3            | Ascom Network Testing AB          |
| Polar Electro Oy                        | Resident     | 21           | Non-resident                          | 3            | Ascom Network Testing Inc         |
| Pulse Finland Oy                        | Resident     | 20           | Non-resident                          | 3            | Element Six Pty Ltd               |
|   |              |              | Resident                              | 3            | Konftel AB                        |
|   |              |              | Resident                              | 3            | Li Haibo                          |
|   |              |              | Resident                              | 3            | Omnio Healer AB                   |
|   |              |              | Non-resident                          | 3            | Outotec Oyj                       |
|   |              |              | Resident                              | 3            | Umecrine AB                       |

Data source: EPO database EPAB & Statistics

The top owners (close to 70 % of total applications) in Norrbotten and Northern Ostrobothnia are multi-national telecommunication companies headquartered in Stockholm (Ericsson) and Espoo in the Greater Helsinki metropolitan area (Nokia). Although these companies are non-residents to the regions in focus, they are originally from the same countries as the regions (Nokia is Finnish and Ericsson is a Swedish company, respectively).

Local innovative companies worth mentioning are Polar Electro and Pulse Finland, both based in Kempele (Northern Ostrobothnia, Finland). A Norrbotten-based innovative company, Gestamp Hard-Tech AB (30 applications), manufactures safety components for car manufacturers in Europe, North America, and Asia.

Today this company operates as a subsidiary of a Spanish-based group. However, the company was established locally, in Luleå (Norrbotten), in 1990.

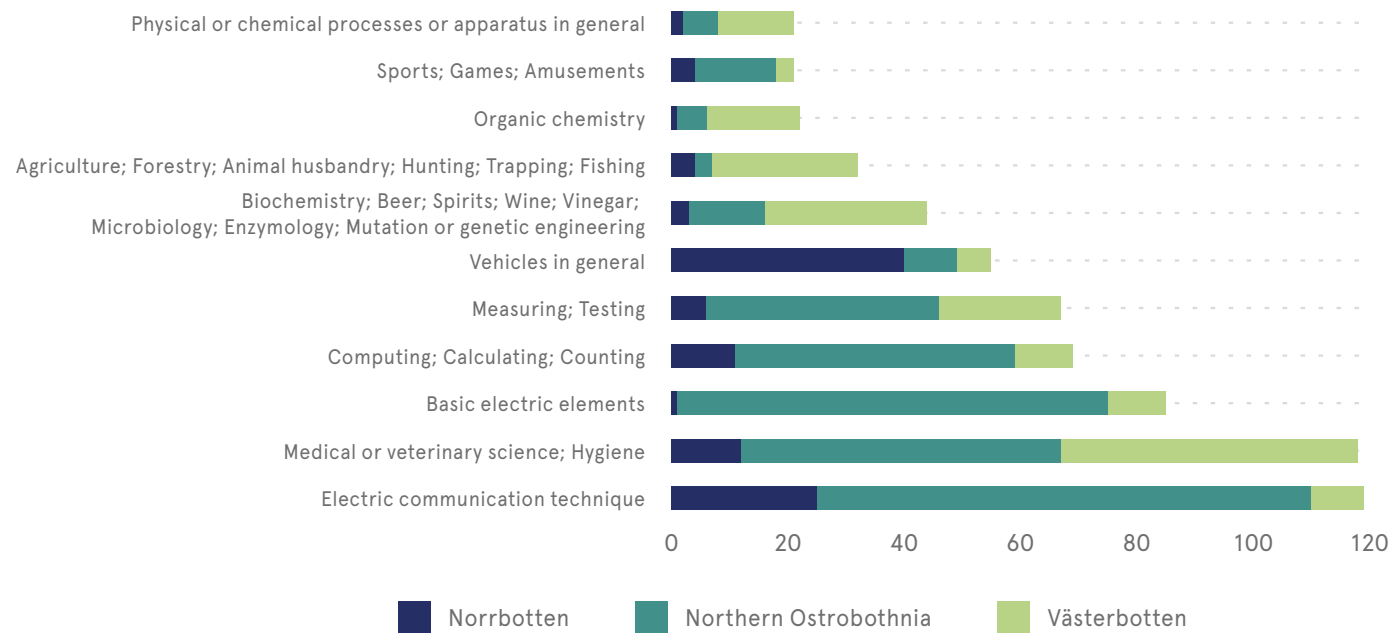
The region of Västerbotten has a dispersed ownership profile. There, top owners of inventions (with 3 or more patent applications per company) cover 30 % of the total and are either resident or non-resident companies. The largest innovator is a resident company, Swetree Technologies (15 applications), specializing on forest biotechnology innovations. 70 % of the EPO patent applicants in the region of Västerbotten had 1 or 2 EPO applications during the period extending from 1996–2014.

# Front-edge areas of the local companies

Besides externally owned innovations, there is a substantial number of local innovative companies and entrepreneurs - residents of the three high performing BIN counties. Through our analysis of the EPO patent applications filed by residents of these counties, we identified 11 front-edge competence areas<sup>3</sup> common for the applicants (Figure 12).

Figure 12 – Common front-edge competence areas in Norrbotten, Northern Ostrobothnia and Västerbotten

The most intensive areas of European patenting are related to electric communication, basic electric elements, computing, calculating, counting and measuring techniques. A probable historical reason for this is the presence of large telecommunication and IT companies such as Nokia and Ericsson. Another common competence area is medical and veterinary science<sup>4</sup>.



The figure shows the total number of mentions of different areas of technology in EPO patent applications filed in 1996-2014 from Northern Ostrobothnia, Norrbotten, Västerbotten. The areas of technology are classes from the International Patent Classification (IPC). Data source: EPO EPAB database and statistics.

Table 2 – Medical or veterinary science or hygiene – an example of a common front-edge area of competence accumulated by local companies in the BIN counties<sup>5</sup>

| Region                | Number of companies | Total number of EPO patent documents (A1, A2 type) | Examples of companies <sup>6</sup>  |
|-----------------------|---------------------|--|---|
| Västerbotten          | 50                  | 51   | <b>Umecrine AB</b> – R&D of pharmaceutical agents against negative mental and physical symptoms. <a href="http://www.umecrine.se">www.umecrine.se</a>   |
| Northern Ostrobothnia | 35                  | 55   | <b>Polar Electro Oy</b> – a well-known manufacturer of sports training computers. <a href="http://www.polar.com">www.polar.com</a>  |
| Troms                 | 16                  | 39   | <b>Lytix Biopharma</b> – a life science company developing technology for cancer immunotherapy that activates the patient’s own immune system. <a href="http://www.lytixbiopharma.com">www.lytixbiopharma.com</a>   |
| Norrbotten            | 12                  | 12   | <b>Arctic City Counting House AB</b> – a manufacturer of sport goods for outdoor nature activities. <a href="http://www.acc-ab.com/">http://www.acc-ab.com/</a>   |
| Nordland              | 5                   | 3  | <b>Slaateng AS</b> – A company aiming at development, production and sales of solutions for disposal of materials (e.g. solid pharmaceuticals) in the health care sector. <a href="mailto:Seponett@www.slaateng.no">Seponett@. www.slaateng.no</a>            |
| Lapland               | 3                   | 4  | <b>Aromtech (Arctic Omega Technology)</b> – a berry oil innovator to provide people with natural, clinically tested solutions that improve health at any age. <a href="http://www.aromtech.com">www.aromtech.com</a>  |
| Kainuu                | 3                   | 2  | <b>HighRoller® Finland LTD</b> – development and production of product for personal muscle care, a company owned by five entrepreneurs who all have background in sports. <a href="https://highrollerofficial.com/eng">https://highrollerofficial.com/eng</a> |
| Finmark               | 0                   | 0  | N/A   |
| <b>Totals</b>         | <b>124</b>          | <b>166</b>   |   |

Data source: EPO EPAB database and statistics, companies’ websites

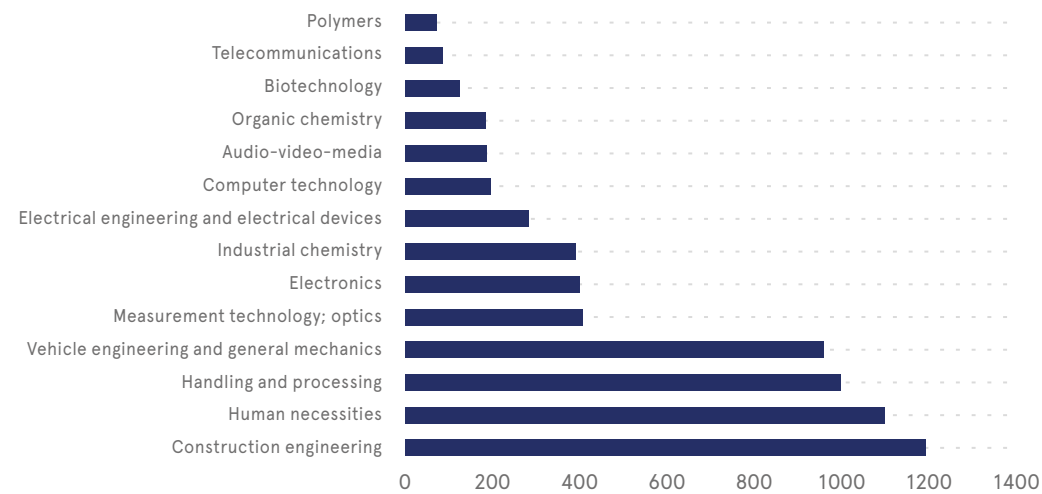
<sup>3</sup> These 11 competence areas correspond to different types of technology called classes in International Patent Classification (IPC). The 11 IPC classes were mentioned 653 times in the patent applications from the three regions (which constitutes 64 % in total number of 1015 analyzed applications).

<sup>4</sup> Mentioned 118 times in patent applications by 97 local companies or entrepreneurs.

<sup>5</sup> Companies for this presentation are not selected as a result of ranking or any kind of benchmark. Our aim was only to show some examples of innovating companies from the BIN area, ranging from globally established companies like Polar to small local companies with niche products.

Figure 13 – Common fields of patented technology<sup>6</sup>, BIN area, 1990-2015

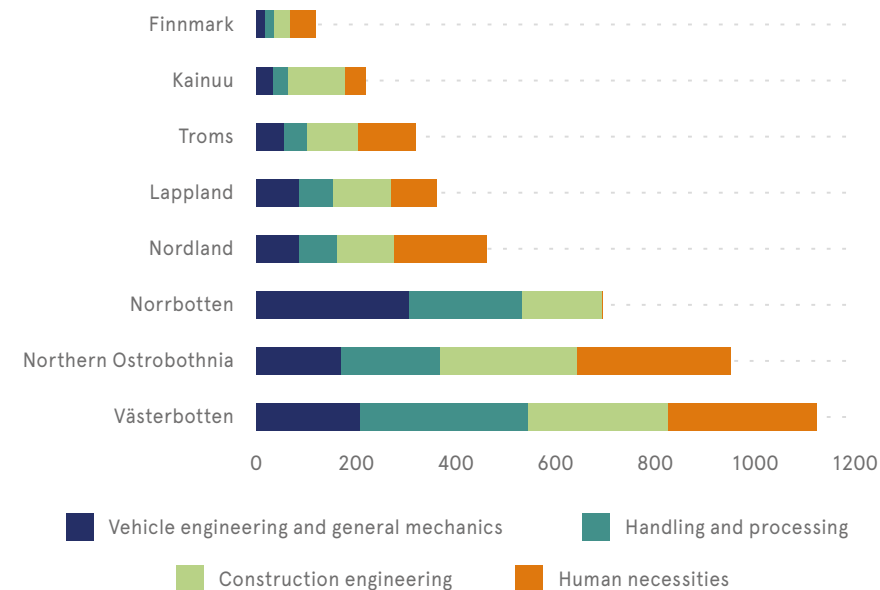
An analysis of patent applications filed by BIN residents to national patent offices showed that the biggest innovative potential common for the BIN area is accumulated in the following technology areas: construction engineering, human necessities, handling and processing, vehicle engineering and mechanics.



The figure shows 14 fields of technology and the total number of patent applications, classified for each field, filed by residents of the BIN area to domestic patent offices in 1990-2015. Data sources: national industrial property (patent) offices in Finland, Norway, and Sweden.

Figure 14 – Top 4 common fields of patented technology by BIN county, 1990-2015

Figure 14 demonstrates a rather balanced composition of the four top fields throughout the BIN area: construction engineering; human necessities; handling and processing; vehicle engineering and mechanics. Norrbotten has quite high vehicle engineering and general mechanics. The county of Västerbotten has the highest total number of applications.



The figure shows four fields of technology and total number of patent applications, classified for each field, filed by residents of the BIN area to domestic patent offices in 1990-2015. Data sources: national industrial property (patent) offices in Finland, Norway, and Sweden.

## Implications and further studies

Based on the analysis presented, our policy recommendation is to stimulate cross-border cooperation on innovation in the BIN territory, aiming at further development of the identified competence areas and fields, as well as nurturing the underdeveloped ones. The goals of such cooperation would be to increase the volume and specter of BIN innovations, as well as to increase in the regional invention ownership rate. The innovation policy for the BIN territory has to be developed through collaboration between national, international, regional authorities and involve representatives of both the industry and academia. The first step in this direction could be a more detailed study (a feasibility study) with the following objectives.

- Mapping of the BIN companies with innovation, looking for potential technical and technological complementarities<sup>7</sup>
- Assessment of market for cooperative solutions
- Identification of common challenges for innovating companies
- Mapping of the existing instruments supporting innovations
- Development of more detailed/focused policy recommendations

The next step could be the establishing of a third-party organization to foster cooperation on innovation in the BIN area. The strategy, structure, legal form and resources required of this organization are to be defined based on the results of the proposed feasibility study. The organization may serve as a platform for exchange of knowledge and experience between innovative companies, provide informational support on market and cooperation opportunities, and offer legal advice and administrative resources associated with patenting and commercialization of inventions. Apparently,

the latter can be crucial for SME's, as the cost of development and maintenance of a patent is rather high. Maybe the aforementioned third-party organization would be needed to provide brokerage for establishing new innovation consortia.

This work has to be coordinated with and correspond to principles of such institutions as the Nordic Council of Ministers (Nordic Arctic Program), the governments of the BIN counties, the Arctic Economic Council and the Arctic Council, Nordic Innovation, the Norwegian-Russian Cross-Border Commission, regional industry-related multiplying organizations in the BIN area (for example Business Oulu and Petro Arctic and others), as well as national, regional and international patent offices.

Patenting data used in our analysis is just one possible way of highlighting regional activities in innovation. We recognize that patents are suitable indicators for certain types of industries, however, not for all. The lack of patent applications suggests a lack of companies characterized by patent-intensive production and innovation, but one still may have healthy enterprises and industries with other types of innovation. In the future, our analysis of regional innovation could be extended with mapping of new emerging technologies and fields, e.g. health sector innovation (Oulu Health), iHealth movement and food sector innovation. Furthermore, since patenting does not, by and large, cover innovation in the service sector, it would be beneficial to develop a database of trademarks for the BIN area. According to OECD, "trademarks could contribute to measuring relevant aspects of innovation, especially non-technological innovation and innovation in the service industries". Other opportunities to study innovation considered for the next issues of the BIN report are the role of universities in development of innovations, the university-industry interlink, innovations in public sector and mapping of industrial clusters in the Arctic.

<sup>6</sup> Here we used classification of patents by 14 fields of technology (the classification provided by World Intellectual Property Organization). Each field includes a combination of various IPC sub-classes. An IPC sub-class is a particle of an IPC class. For more details on IPC classifications, please refer to the website of the World Intellectual Property Organization - <http://www.wipo.int/classifications/ipc/en/>

<sup>7</sup> By technical complementarity, we mean joining forces of several companies to increase production volume in the same technical field towards larger orders by big customers. Technological complementarity is about cooperation on development of new product.