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European Panorama of Clusters and Industrial Change



Emerging industries:
Driving strength in 10 cross-sectoral industries

2019 version

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URL: <https://www.clustercollaboration.eu/eu-initiatives/european-cluster-observatory>

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The European Observatory for Clusters and Industrial Change in Brief

The European Observatory for Clusters and Industrial Change (#EOCIC) is an initiative of the European Commission's Internal Market, Industry, Entrepreneurship and SMEs Directorate-General. The Observatory provides a single access point for statistical information, analysis and mapping of clusters and cluster policy in Europe, aimed at European, national, regional and local policy-makers, as well as cluster managers and representatives of SME intermediaries.

The aim of the Observatory is to help Europe's regions and countries design better and more evidence-based cluster policies and initiatives that help countries participating in the COSME programme to:

- develop world-class clusters with competitive industrial value chains that cut across sectors;
- support Industrial modernisation;
- foster Entrepreneurship in emerging industries with growth potential;
- improve SMEs' access to clusters and internationalisation activities; and
- enable more strategic inter-regional collaboration and investments in the implementation of smart specialisation strategies.

In order to address these goals, the Observatory provides a Europe-wide comparative cluster mapping with sectoral and cross-sectoral statistical analysis of the geographical concentration of economic activities and performance, made available on the website of the European Cluster Collaboration Platform ¹. The Observatory provides the following services:

- **Bi-annual "European Panorama of Clusters and Industrial Change"**, that analyses cluster strengths and development trends across 51 cluster sectors and 10 emerging industries and investigates the linkages between clusters and industrial change, entrepreneurship, growth, innovation, internationalisation and economic development;
- **"Cluster and Industrial Transformation Trends Report"**, which investigates the transformation of clusters, new specialisation patterns and emerging industries;
- **Cluster policy mapping** in European countries and regions as well as in selected non-European countries;
- **"Regional Eco-system Scoreboard for Clusters and Industrial Change"**, that identifies and captures favourable framework conditions for industrial change, innovation, entrepreneurship and cluster development;
- **"European Stress Test for Cluster Policy"**, including a self-assessment tool targeted at cross-sectoral collaboration, innovation and entrepreneurship with a view to boosting industrial change;
- **Customised advisory support services** to twelve selected model demonstrator regions, including expert analysis, regional survey and benchmarking report, peer-review meeting and policy briefings in support of industrial modernisation;
- **Advisory support service to European Strategic Cluster Partnerships**, in order to support networking between the partnerships and to support exchanges of successful practices for cross-regional collaborations and joint innovation investments;
- **Smart Guides** for cluster policy monitoring and evaluation and for entrepreneurship support through clusters that provide guidance for policy-makers; and
- **Brings together Europe's cluster policy-makers and stakeholders** at four European Cluster Policy Forum events in 2018 and 2019, European Cluster Days and at the European Cluster Conference in May 2019 in Bucharest (Romania) in order to facilitate high-level cluster policy dialogues, exchanges with experts and mutual cluster policy learning. Online presentations and publications, discussion papers, newsletters, videos and further promotional material accompany and support information exchanges and policy learning on cluster development, cluster policies and industrial change.

More information about the European Observatory for Clusters and Industrial Change is available at:

<https://www.clustercollaboration.eu/eu-initiatives/european-cluster-observatory>

¹ <https://www.clustercollaboration.eu/>

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Executive summary

Europe is home to some 2 900 specialised clusters, statistically defined regional concentrations of traded industries. Clusters matter: the effect of cluster specialisation is equal to approximately a 13.5% increase in average wage. Specialised clusters show higher average wage and employment increases. They inhabit also a higher number of innovative and high-growth firms and start-ups.

This report analyses **cluster strengths and development trends across 51 traded sectoral industries and 10 emerging industries** (that cut across different sectors) and investigates the linkages between clusters and industrial change, entrepreneurship, growth, innovation, internationalisation and economic development.

CLUSTERS MATTER

Europe is home to some **2 900 specialised clusters**, i.e. statistically defined regional concentrations of traded industries that have more than 500 employees in a specific industry. Economic activities that are located in **specialised clusters account for about 19% of European jobs and 22% of European wages**.

Traded industries are groups of related traded sectors. They tend to be geographically concentrated, sell their products and services across many regions and face competition from other regions. This excludes local sectors, such as local retail and other local services, that are geographically more spread and mainly serve local customers. In total, the traded

industries that are subject to international competition account for about half (46%) of all European jobs. Approximately 42 per cent of all employment in traded industries are located in specialised clusters.

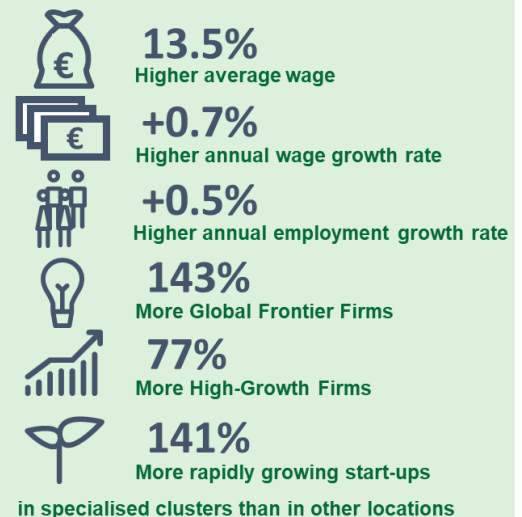
Wages in a specific regional cluster are driven by cluster effects and by location effects. The stronger the cluster and the better the location-specific business environment, the higher the cluster's productivity and wages. Controlling for regional and sectoral effects, i.e. taking into account varying wage levels between the countries, yields the effect of cluster specialisation is equal to approximately a **13.5% increase in average wage**.

Moreover, from 2014 to 2016, the average annual change in emerging industry wages in specialised clusters was 5.5% whereas in other locations it was 4.8%. The average annual changes in employment were, respectively, 0.8% and 0.3%. Comparing the difference, this shows that there were also **higher growth rates in clusters** than elsewhere: wage growth by 0.7% and employment growth by 0.5% annually.

Specialised clusters also inhabit a **higher number of innovative and high-growth firms**. As a proxy for innovation leaders, the number of global frontier firms is used, which are the top 5% of firms in terms of productivity (i.e. value added per employee) within any given sectoral or emerging industry and year. 78% of these global frontier

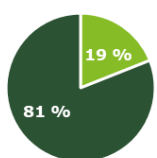
firms are actually SMEs. There are in specialised clusters almost three times as many such firms than in other locations. On average, **specialised clusters host a 2.4 times higher number of global frontier firms** compared to other locations. Creative, Blue Growth, Experience and Digital Industries are the emerging industries that occupy the most of these firms.

Clusters matter



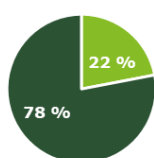
Research suggests that entrepreneurial activity drives economic growth and entrepreneurship policy in highly developed economies should focus on fast-growing new firms. A *high-growth firm* is a firm that initially possesses at least ten employees and that experiences average annualized turnover or employment growth of at least 20 per cent per annum, over a three-year period. On average, specialised clusters in emerging industries hosts 16 such high-growth firms, compared to 9 based in other locations. This means **specialised clusters hosts 77% more high-growth firms** than other locations. Most of these are located in Experience, Creative or Digital Industries or in Mobility Technologies emerging industry.

Employment



■ Specialised clusters

Wages



■ Other locations

The aforementioned four emerging industries possess most of the rapidly growing start-ups too. On average, specialised clusters inhabit 1.1 such start-ups, compared to 0.4 of those in other locations. This means **specialised clusters host a 2.4 times higher number of rapidly growing start-ups** than other locations.

THE CLUSTER LANDSCAPE IN TEN EMERGING INDUSTRIES

Emerging industries are understood as either new industrial value chains and sectors or existing industrial value chains and sectors that are evolving or merging into new ones. They reflect the industrial renewal and changes in which European companies are competing globally. Emerging industries are often characterised by having high growth rates and significant market potential. For this reason, they are important drivers of EU competitiveness and prosperity. Therefore, this report also analyses the cluster landscape across ten emerging industries that were previously identified as having strong cross-sectoral linkages.

Specialised clusters generate higher growth in jobs and wages for eight of the ten emerging industries. Similarly, they host a higher average number of global frontier firms, high-growth firms and rapidly growing start-ups compared to other locations (i.e. for 9, 8 and all 10 emerging industries respectively, see graphs in the next section).

The list of the regions with the most cluster stars in emerging industries is dominated by German regions. Five out of top eight regions come from Germany, those being Darmstadt, Upper Bavaria (Oberbayern), Stuttgart, Cologne (Köln) and Düsseldorf. Not surprisingly, several European capitals are present on the top 20 list also: Paris (Île-de-France), Oslo, Stockholm and Budapest (Central Hungary).

Advanced Packaging employs more than 4.9 million people in Europe. It is concentrated in Southern and Central

Germany and some of the neighbouring countries. The Transdanubia regions in Hungary employ almost 90 000 people and have the highest specialisation rates in this industry.

Europe's employment in the *Biopharmaceutical industry* is at 2.4 million people, which is the lowest figure among the emerging industries. However, both wages and gross value added (GVA) are significantly higher than in other industries (by 50%) or in the overall economy (by 90%), suggesting very high levels of productivity. The core of the Biopharmaceutical industry lies in southern and western Germany, Belgium, Ireland and Israel. In particular, the Israeli Central district has the highest number of employees, 110 000, and the highest specialisation rate.

With 13.3 million employees, *Blue Growth industries* are one of the largest among emerging industries and corresponds to about 6% of Europe's total employment. Blue Growth industries are predictably concentrated to the coastal areas: the highest specialisation rates can be found in Turkey, Norway, Ukraine, Kosovo, Iceland and Albania. The average wage level is relatively low, with only Logistical Services having a lower one.

Creative industries employ more than 15 million people in Europe. *Creative industries* are strongest in national capitals and large urban regions. In particular, Paris and London employ more than half a million creative workers each, remarkably both being among the most specialised regions. London is also the home of many of the Industry Leaders and High Growth Firms in this industry. Berlin has over 200 000 employees in Creative industries, and the third highest specialisation rate in Germany after Saarland and Hamburg.

The regions specialised in Creative industries perform well according to almost all economic indicators. They are characterised by strong concentrations of service innovation intensive industries,

marketing and organisational innovators, and high employment growth and low unemployment rates.

Digital industries have grown very rapidly during the past two decades, and employs 10.2 million people compared to 7.3 million in 1996. Despite some overlap with Creative industries, Digital industries exhibit a very different enterprise structure, with firms generally being larger when compared to the other emerging industries. The industry mostly employs skilled workers, which is reflected in high productivity numbers: the average wage is about 50% higher than in the economy at large. In addition, the average GVA is the second highest among the emerging industries, with only biopharmaceuticals having a higher one.

The specialised clusters in Digital industries are concentrated in Austria, Germany, Israel, Netherlands, Switzerland and the capital regions of the Nordic countries: Copenhagen, Helsinki, Oslo and Stockholm. The biggest regions are Lombardy, Stuttgart and Upper Bavaria (Oberbayern), with 270 000, 237 000 and 157 000 employees. On the other hand, Israeli districts claim the highest specialisation rates.

The regions specialised in Digital industries are characterised by having the highest business R&D expenditure, medium and high technology exports rate, 61% compared to the general average of 48%, and number of patent applications filed under the unified Patent Cooperation Treaty (PCT). Similarly, capital formation and scale-up rates are on a high level, whereas the start-up rate is the lowest among the specialised regions in other emerging industries. This suggests that these industries are capital intensive and have high entry barriers. Digital industries are the largest sector targeted by organised cluster efforts. There are 340 cluster initiatives related to Digital industries in the European Cluster Collaboration database.

The specialised clusters in *Environmental industries* are concentrated in Norway, with five out of its seven regions having a high location quotient in this area, and in southern Germany with 14 specialised clusters. Although the regions in the Netherlands do not show up as specialised clusters in this industry, a number of Industry Leaders are located there. Environmental industries are the second largest sector targeted by organised cluster efforts. There are 234 cluster initiatives related to Environmental industries in the European Cluster Collaboration database.

Experience industries employ 16 million people in Europe and have the highest employment growth rate among the emerging industries. The regions specialised in Experience industries include traditional touristic regions in France, Greece, Italy, Malta, Spain and Turkey, but also capital regions such as Paris and Stockholm, leading to somewhat mixed results in the Experience industries' economic indicators.

Logistical Services employ 7.9 million people in Europe. The regions specialised in Logistical Services include some weaker regions in Europe, and are located in the Baltic States, Iceland, Kosovo, Macedonia, Montenegro, Spain, Turkey and Ukraine. At 28 400 euros, the average wage is the lowest among the emerging industries, and Logistical Services is the only industry to have an average wage below the average of the economy at large. On the other hand, the average annual growth rate over the last five years, 2.3%, has been the highest among the emerging industries.

The *Medical Devices industry* employs 4.9 million people in Europe, with no growth during the past five years. The specialised clusters in the Medical Devices industry are in general in Czechia, Denmark, Germany, Hungary, Israel, Italy, Norway and Poland. The industry is concentrated in Germany, particularly in its southern part, with 23 specialised clusters. Stuttgart, Upper Bavaria (Oberbayern), Karlsruhe and Düsseldorf have more than 70 000

employees each. However, the region that employs the most people in the industry is Lombardy in Italy, with over 178 000 employees. The regions specialising in Medical Devices share similar economic characteristics with those specialising in Digital industries.

Mobility Technologies employs 10.9 million people in Europe and it is the fourth largest emerging industry in this respect. Not surprisingly, the specialised Mobility Technology clusters are located in areas of traditional automotive strength. Stuttgart is the largest cluster, together with a number of other German clusters. The specialised clusters outside Germany are located in Turkey, Romania, Sweden and Austria. The highest concentrations of high growth firms are found in Italy, Korea, Czechia and Sweden.

THE INTERNATIONAL CLUSTER LANDSCAPE

All studied five non-European countries (China, Israel, Japan, South Korea and USA) deliver cluster support in their countries, mostly as part of dedicated cluster programmes, but also through other programmes, which also cover support for cluster activities. The Asian cluster concept differs slightly from the European one. There, cluster support are often linked to pre-existing territorial industrial complexes and/or industry, science or technology parks.

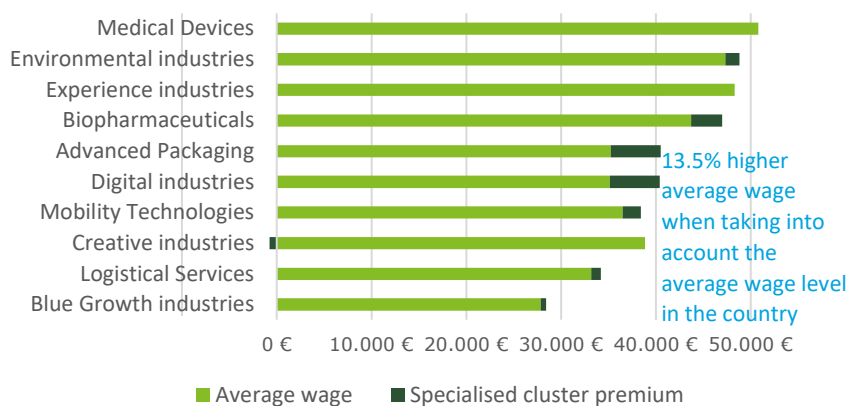
In the international clusters landscape, cluster programs tend to concentrate on those industry sectors where the nation and its companies are competitive on the global level. For example, Israel has Technology Clusters in the sectors in which Israeli firms have the highest share of global turnover and profits. The Japanese Innovation Network is based on close ties between corporations, government and industry. In South Korea, each Centre for Creative Economy and Innovation (CCEI) has different focus areas and company partners in order to maximise the resources, networks and markets already established in the surrounding region. The

CCEIs serve as regional innovation hubs in building a systematic start-up ecosystem for large companies, SMEs and start-ups by utilising the skills and expertise of local governments, related agencies and citizens in the region. In the United States, many of the 10 Innovative Economy Clusters of the US Small Business Administration funds are among the traded industry sectors where the United States claims the highest share of global turnover and profits.

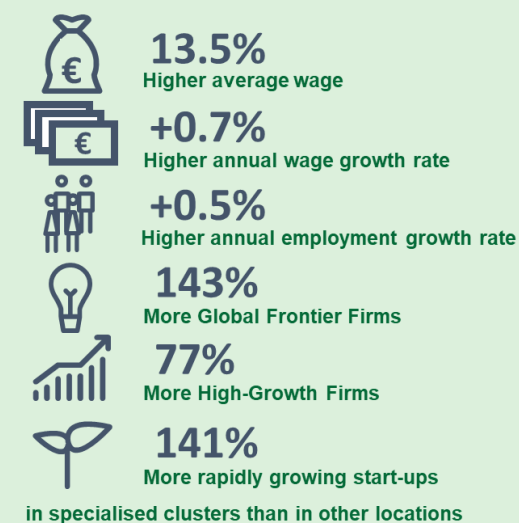
In most cases, success depends on creating specific qualities of a business environment that give a location a unique and lasting advantage. The aim of European cluster policy is to promote the development of world-class clusters with competitive industrial value chains that cut across sectors. Cluster policy is not only a tool for the EU industrial policy strategy, but foremost for regional and national innovation strategies. EU cluster policy functions as a sort of unifying catalyst to regional and innovation policies by addressing EU value-chains and respective positioning in global value-chains.

Measures for cluster strength

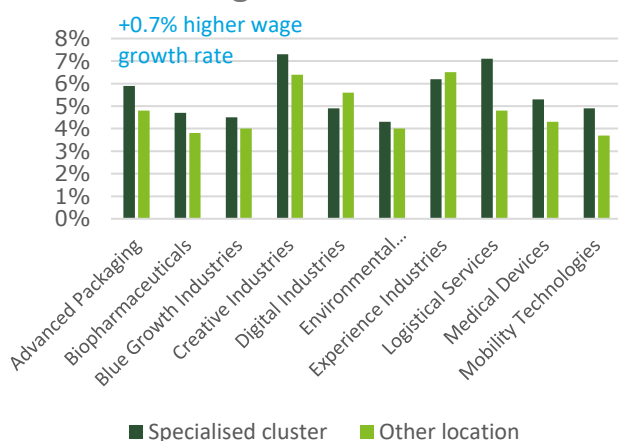
Average wages in emerging industries



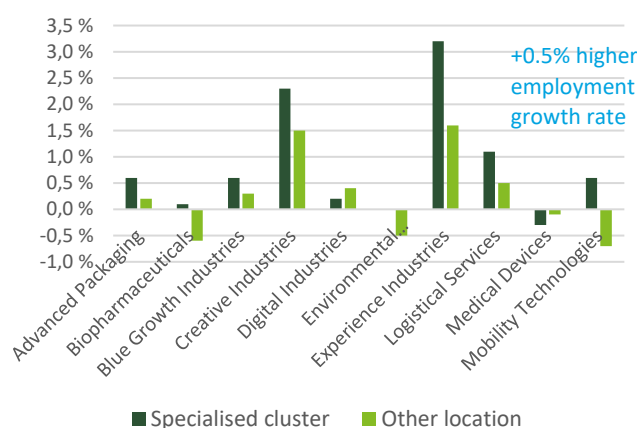
Clusters matter



Average annual change in wages 2014-2016

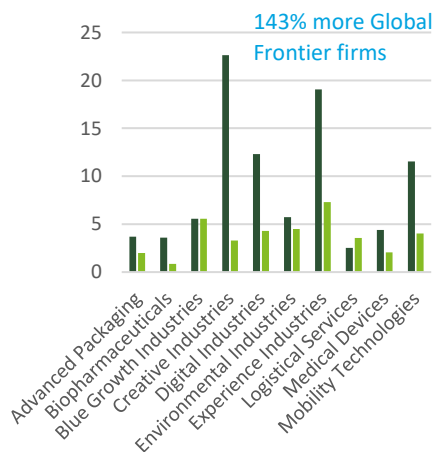


Average annual change in employment 2014-2016

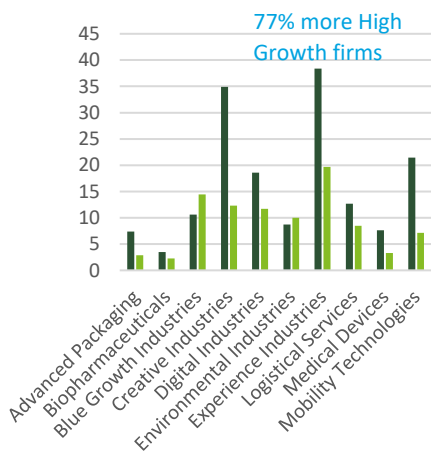


Average number of firms in a region

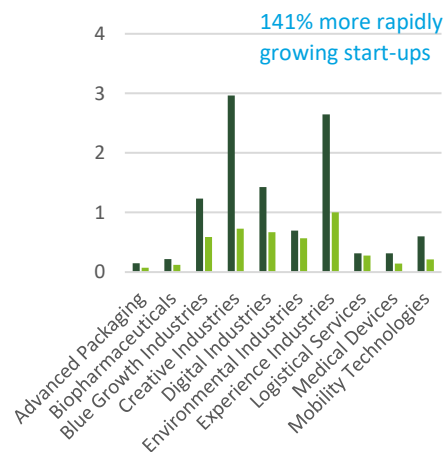
Global Frontier firms*



High Growth firms



Rapidly growing start-ups

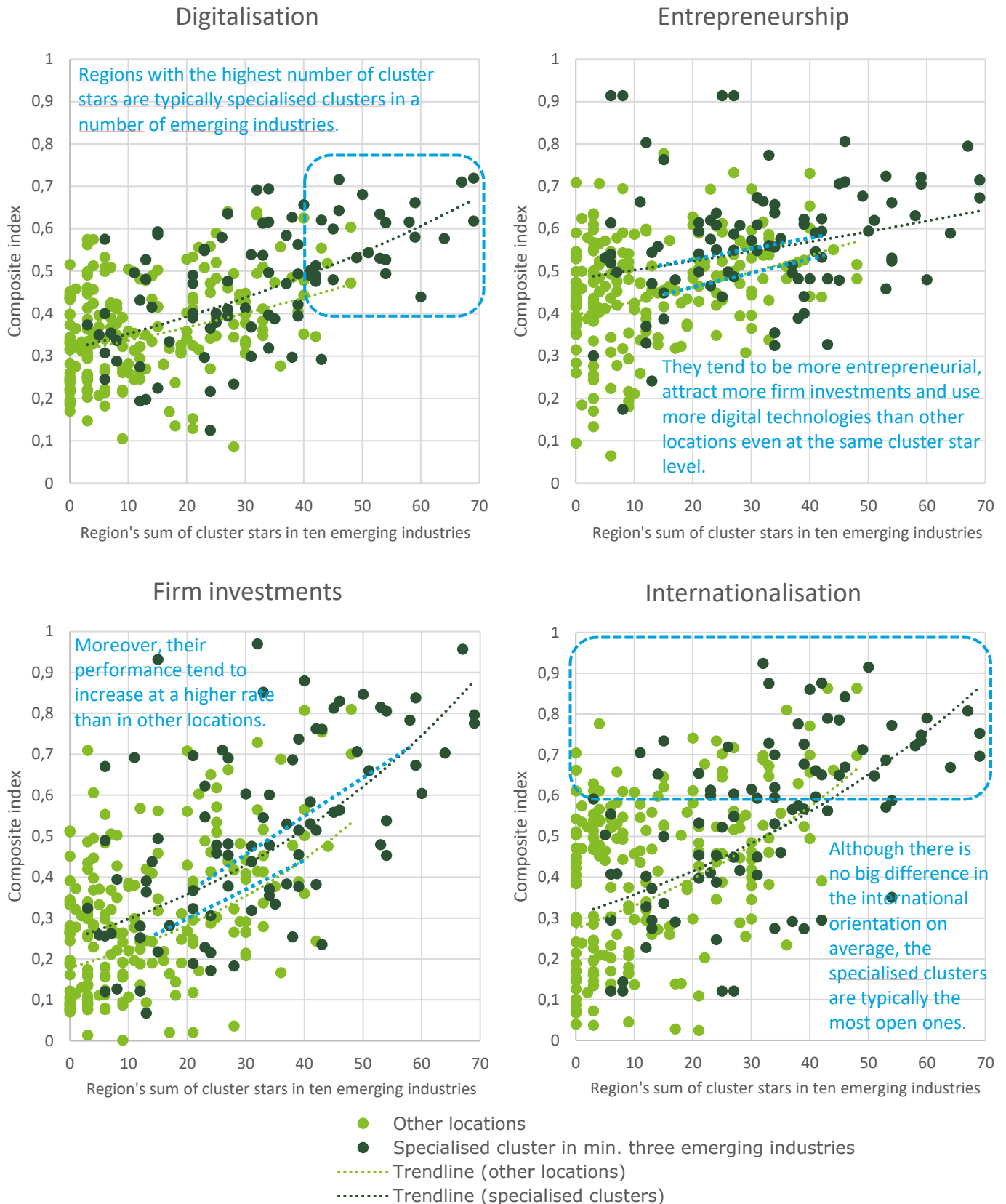


■ Specialised cluster ■ Other location

*can appear multiple times

Specialised clusters and other locations in emerging industries

Sums of cluster stars of specialised clusters and other locations and their performance with respect to the digitalisation, entrepreneurship, firm investments and internationalisation dimensions of the Composite Indicator of Industrial Change (CIIC).*



* The Composite Indicator of Industrial Change (CIIC) aims to characterise the structural change towards a more knowledge-intensive economy (for more information, please see the Glossary).

1. Introduction

The aim of the European Panorama of Clusters and Industrial Change is to help Europe's regions and countries in designing better and more evidence-based cluster policies and initiatives to accelerate industrial modernisation, boost entrepreneurship in emerging industries with growth potential and facilitate SMEs' access to clusters and internationalisation activities.

The purpose of the European Panorama of Clusters and Industrial Change is to summarise and analyse the picture of cluster strengths and development trends in Europe over time across the 51 cluster sectors and 10 cross-sectoral emerging industries. It also aims in particular to elaborate further on the linkages with industrial change, entrepreneurship/ SME growth, innovation, internationalisation and economic development. This publication is a follow-up to the European Cluster Panorama, of which there were two: a 2014 and a 2016 versions.² It presents results of correlation and other analysis to highlight patterns, offer a comparative snapshot of regional cluster strength and provide further insights into the strength and dynamics of clusters and their possible economic impact.

Clusters are defined as groups of firms, related economic actors and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills. Clusters are referred to both as a concept and a real economic phenomenon, such as the Silicon Valley, the effects of which, such as employment concentration, can be measured – as is done in this report.

Clusters should not be understood as fitting into the narrow sectoral view that most industrial policies have, but be considered

as regional ecosystems of related industries with a broad array of inter-industry interdependencies.³ These linkages tend to show, for instance, in terms of similar location patterns, occupational and technological needs and knowledge spill-overs and cross-sector investments. The interest towards clusters stems from the efficiency gains that firms can achieve from the proximity of other similar industries. Understanding how these linkages form and how best to facilitate their development is therefore an important aspect for strategies aiming to bolster regional innovation, competitiveness and growth.

The more companies there are in a certain set of industries, the more likely it is that higher levels of productivity and innovation will be achieved. This is partly due to specialisation. If there is a large local market, companies can focus more on being very good at a specific narrow activity and employees can focus more on acquiring very specialised skills.

The Panorama wishes to promote the development of more world-class clusters and business networks in the EU, with a view to accelerate industrial modernisation and the creation of jobs and growth. The ultimate goal is thereby that enterprises, particularly SMEs, are provided with more favourable regional ecosystems and better

support for innovation and entrepreneurship, in general, and adjusting to industrial change and reaping growth opportunities, in particular. This would help SMEs to take up advanced technologies, digitalisation, new business models, creativity, service innovation and eco-innovative, resource-efficient solutions in view of developing new, globally competitive advantages, including in new industrial value chains that cut across sectors and competences.

After explaining the methodology applied, this Panorama presents the European cluster landscape and its contribution to the competitiveness of the European economy. The statistical cluster mapping results presented demonstrate why clusters matter and describe further the dynamics across ten emerging industries.

We contribute by making information available on showcases on how regions can profit from sharing high-level expertise around Europe and achieve tangible progress in industrial modernisation, boosting their business growth and creating high-value jobs through modern cluster policy.

² https://ec.europa.eu/growth/industry/policy/cluster/observatory/cluster-mapping-services/cluster-panorama_en

³ Delgado, M., Porter, M. E. and Stern, S. 2013. Defining Clusters of Related Industries, Working Paper 20375 of the National Bureau of Economic Research. Available at: www.nber.org/papers/w20375. [Accessed 25 October 2018]

2. Methodology

Traded industries are groups of related traded sectors. They are geographically concentrated, sell their products and services across many regions and face competition from other regions. Emerging industries build on traded industrial sectors. They can be understood as either new industrial sectors or existing industrial sectors that are evolving or merging into new industries.

EMERGING INDUSTRIES AND TRADED INDUSTRIES CLUSTERS

The analysis of this report follows the established definition of 10 (cross-sectoral) emerging industries and 51 traded (sectoral) industries developed under the previous European cluster mapping work (under the label of the European Cluster Observatory).⁴

Traded industries are groups of related traded sectors, connected through multiple types of linkages. They are geographically concentrated, sell their products and services across many regions and face competition from other regions. This definition thus excludes *local sectors*, such as local retail and other local services, that are geographically more spread and mainly serve local customers. The cluster mapping methodology does therefore not consider local industries as they are viewed as neither being exposed to direct competition across regions nor tending to cluster together.⁵

Traded clusters are geographic concentrations that result from the cluster mapping of traded industries, and hence are groups of closely located and related traded industries. The cluster mapping of traded industries – which follows traditional sectoral definitions – is

complemented by a cluster mapping for cross-sectoral emerging industries in order to better capture industrial change and take account of the increasing blurring of sectoral boundaries.

Emerging industries are either new industrial sectors or existing industrial sectors that are evolving or merging into new industries. They evolve in response to new technologies, market demands and value chain configurations. They are most often driven by key enabling technologies such as advanced manufacturing, new business models such as innovative service concepts and by societal challenges such as climate change and sustainability demands that industry must address as a matter of survival.

Emerging industries combine and build on traded industrial sectors. In order to reach this grouping, the previous European Cluster Observatory followed a data-driven approach and the most widely used algorithm developed by Delgado et alii.⁶ As this mapping tries to capture the cross-sectoral linkages of related industries, different emerging industries may host the same parts of traded industries. The therefore possible double-counting in the mapping of 10 emerging industries is something that is absent from the mapping of traded industries where all narrowly

defined subsectors are uniquely attributed to only one of the 51 traded industries.

Both types – traded industries and emerging industries – are important for the health of the European economy. However, they play different roles and are exposed to different types of dynamics, also in relation to the clusters they host.

According to Michael E. Porter, clusters affect competition in three ways: by increasing the competitiveness of companies based in the area; by driving the direction and rate of innovation, which underpins productivity growth; and by stimulating the formation of new businesses, which expands and strengthens the cluster itself.⁷

The report examines the strength of regional clusters in various emerging industries and traded industrial sectors along Porter's understanding of clusters. *First*, for comparability, cluster strength is measured along the lines of the European Cluster Observatory. *Second*, the region's competitiveness is measured by examining whether any industry leaders are locating there. *Third*, the region's productivity potential is examined by studying whether the region can populate firms at the global value added frontier. *Finally*, the region's ability to breed new businesses is analysed by calculating the region's share of high growth firms and start-ups in a given industry.

INDICATORS USED FOR MEASURING CLUSTER STRENGTH

Cluster strength has been calculated using the cluster mapping approach applied by the previous European Cluster Panorama, yet with an adapted approach for allocating

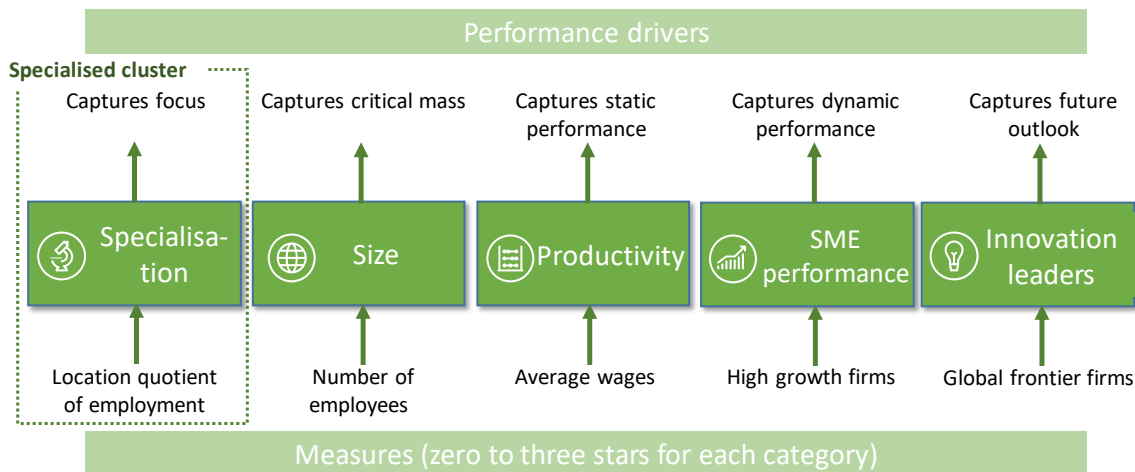
⁴ European Cluster Observatory. 2014. European Cluster Panorama 2014 and European Cluster Observatory. 2016. European Cluster Panorama 2016.

⁵ European Commission. 2008. The concept of clusters and cluster policies and their role for competitiveness and innovation: Main statistical results and lessons learned, Commission Staff Working Document SEC (2008) 2637.

⁶ Delgado, M., Porter, M., Stern, S. 2014. Defining clusters of related industries. NBER Working Paper 20375; Delgado, M., Porter, M., Stern, S. 2016. Defining clusters of related industries. Journal of Economic Geography, Vol 16, 1-38.

⁷ Porter, M. E. 1998. Clusters and the New Economics of Competition, Harvard Business Review. Vol. 76(6), November-December, 77-90.

Figure 1. Measuring cluster performance.



so-called cluster stars. It measures whether regional clusters have reached a “specialised critical mass” to develop positive spill-overs and linkages and aims to capture their dynamic performance. The measure is based on cluster size, specialisation, employee productivity in the relevant industries comprising the regional cluster (covering the established categories), complemented by two new categories of SME (high-growth) performance and innovation leaders.

The two newly added cluster star criteria aim to capture the dynamic part of the cluster performance (and thus replace the previous employment growth dimension).

While both dimensions are predominantly focussed on SMEs, the innovation leaders dimension also captures the role that large enterprise sometimes play as anchor firms. By including both the extent of presence of high-growth SMEs and the extent of presence of innovation leaders – both large firms and SMEs –, the right balance is found for better capturing the dynamic performance of clusters and the complementary role of firms of different sizes.

The extent to which regional clusters in traded sectoral industries or emerging industries have achieved this specialised

critical mass is shown by allocating them up to three so-called cluster stars for each of these following five categories:

- **Size:** total number of employees in full time equivalent units in the industry for a given region. This indicator captures general employment performance.
- **Specialisation:** degree of specialisation measured by a *location quotient*. The location quotient is calculated as the ratio between the industry’s share of total employment in a given region and the industry’s share of total employment in all the countries considered in the analysis. Values above unity imply high regional specialisation, with a location quotient of two corresponding to twice as many employees in an industry than would be expected if all employment was distributed evenly.
- **Productivity:** measured by the *average wage per employee* (in full time equivalent units) in the region as a proxy. Productivity levels vary across Europe and these differences are captured as part of the cluster strength measure.
- **SME performance:** measured by *number of high growth firms* (i.e. have annual growth rates of 20% for turnover or employment over 3 years

while respecting minimum employment and turnover size thresholds). Research suggests that entrepreneurial activity drives economic growth and entrepreneurship policy in highly developed economies should focus on potentially fast-growing new firms.

- **Innovation leaders:** measured by the *number of global frontier firms* (i.e. top 5% of firms in terms of productivity (value added per employee), calculated by adding up factor incomes going to employees (wages) and to capital owners (profits) within any given emerging industry or traded industry sector and year) as the relative strength of such firms probably reflects their capacity to innovate, rapidly diffuse and replicate cutting-edge ideas.

For the first three dimensions, a star is assigned to regions that are in the top 20 per cent in Europe. These stars are then summed up for the years 2014, 2015 and 2016 to arrive at the final star rating, with a maximum of three stars for each category. For the latter two dimensions, three stars are assigned to regions that are in the top 20 per cent in Europe in the years 2008 – 2016, two stars for those in the top 20-40 per cent range and one in the top 40-60 per cent range.

When calculating cluster strength, we thus deviate somewhat from the cluster mapping approach applied by the previous European Cluster Panorama. First, while the cluster stars measure continues to be based on cluster size, specialisation and employee productivity, as previously, it is now complemented by two new categories of SME (high-growth) performance and innovation leaders. Second, while previously only a maximum of one star was allocated to each dimensions, now up to three stars are allocated. This has raised the maximum total from 4 to 15 cluster stars. The increase results from extending from a one-year measurement period to a multiple year measurement period.

The advantage of this approach is its ability to capture clusters' dynamic performance in a wider and more graded picture. In addition, it captures the complementary role of firms of different sizes for cluster development. The use of firm-level data from the Orbis database by Bureau Van Dijk permits the construction of longitudinal panels of company information, and hence supports to better capture of the dynamic performance of clusters. Moreover, Orbis covers non-European countries, notably the United States, Japan and Korea.

The disadvantage of the new approach is that Orbis does not cover all variables equally well in all countries. The requirements for inclusion in the database differ from one country to another. This means that the coverage of certain sectors and especially of smaller companies may not be consistent between countries. Moreover, variables for obtaining measures of either labour or productivity may not be readily available, or only partially. These limitations had to be accepted in order to

allow for a different and new perspective on the cluster landscape.

The following sections describe in more detail the measuring of the SME high-growth performance and the innovation performance captured through the presence of industrial leaders or global frontier firms.

INDUSTRY LEADERS AND INDUSTRY FOLLOWERS

It pays to be large; leading firms easily have superior bargaining power over suppliers and customers, and if they are protected by mobility barriers, insulated from intergroup rivalry, their size would generate higher profitability. According to Porter, industry leaders are defined as the largest firms in the industry, accounting for approximately 30% of industry sales revenue; all other firms are defined as followers.⁸

For this report, *industry leaders* are defined as those companies that belong to the top 1% of companies having the highest turnover or the highest profits in any particular year in any given emerging industry or traded industry sector. In general, this leads to a much higher share of industry or cluster turnovers than the 30% used by Michael E. Porter. The reason to choose this approach was to apply a common logic for picking up the best performing firms and, hence used percentage cut off points for all our selections.

For example, the analysis for the emerging industries shows that **industry leaders typically earn two thirds of the industry's turnovers**, with Advanced Packaging Leaders having the smallest share of 49% and Mobility Technologies leaders having the highest share of 76%. Correspondingly, in many emerging industries, the industry leaders claim all of the industry's profits,

since a number of companies are accruing losses. The industry leaders in turnover and in profits need not be the same companies – and in many cases are not.

IMPORTANCE OF THE GLOBAL FRONTIER

Knowledge is nowadays translating into value, the key question being who can manage the use of resources in the most capable and efficient manner. It requires deep understanding of both the market and customers to know what to produce, when and where. Productivity is about “working smarter” rather than “working harder” and competition shifts from physical resources to capabilities because they can be scarce. This phenomenon can be described as competitive use of resources.⁹

One OECD research showed that the main source of the experienced productivity slowdown is not so much a slowing of innovation by the most globally-advanced firms, but rather a slowing of the rate at which innovations spread out throughout the economy. Labour productivity at the global technological frontier (i.e. the top 5% most productive firms) increased at an average annual rate of 3.5% in the manufacturing sector over the 2000s, compared to just 0.5% for non-frontier firms, while the gap was even more pronounced in the services sector. The gap between those high productivity firms and the rest has been increasing over time.¹⁰

The relative strength of such global frontier firms probably reflects their capacity to “innovate”, to optimally combine technological, organizational and human capital in production processes throughout global value chains and to harness the power of digitalization in order to rapidly diffuse and replicate cutting-edge ideas. Domestic firms that trade are put in touch

⁸ Porter, M. E. 1979. The Structure within industries and Companies' Performance. Review of Economics and Statistics, Vol 61, No 2 (May, 1979), 214-227.

⁹ Drucker, F. 1991. The new productivity challenge. Harvard Business Review. Nov-Dec; 69(6): 69-79.

¹⁰ Andrews, D., Criscuolo, C. and Gal, P. 2015. Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries, OECD Productivity Working Papers 2015-02.

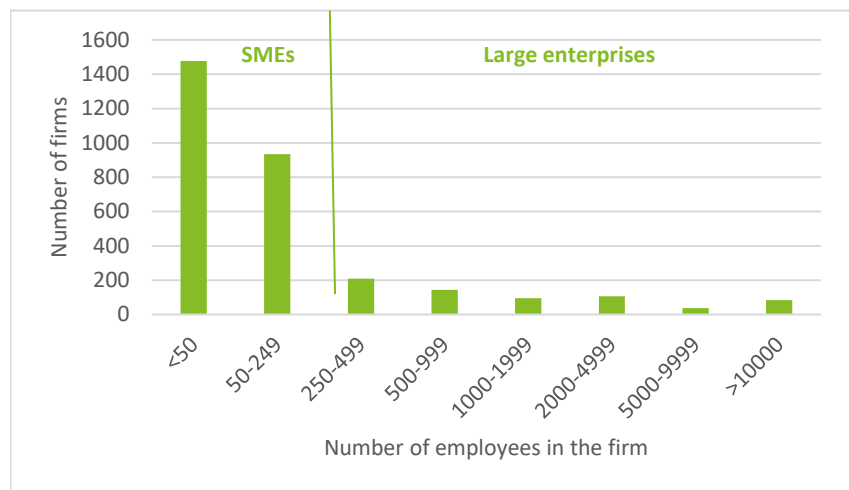
with the most efficient foreign and domestic producers that are able to compete on international markets and thus get them closer to the global frontier.¹¹

When examining the value addition of the various emerging industries and traded industry sectors, we follow the approach of Peter Gal, with some slight modification.¹² Gal presents an array of productivity measures: Gross output or total revenue-based labour productivity is the most widely available, but its most immediate problem is that it does not control for intermediate input usage. In other words, a company with a lot of reselling activity will probably rank very high in this measure. Value added-based labour productivity takes care of this problem, as value added itself is the difference between output (sales) and intermediate inputs (including resold goods, typical in retail trade). The value added is calculated in this report by adding up factor incomes going to employees (total wage bill) and to capital owners (profits).

A typical approach to defining *the global productivity frontier* is to take the top 5% of firms in terms of productivity levels, within each industry and year. This practice is followed by first exploring which firms belong to the top 5% best performing firms in any given emerging industry or traded industry sector. Then, secondly, the number of firms in a regional clusters of a given industry that is within this top 5% group is calculated. Then, this number is used as an indicator of the economic strength of that region.

In addition, the average value added in each country in each emerging industry and traded industry sector for the years 2008 to

Figure 2. Number of Global Frontier firms within different size classes



2017 is calculated. Although labour productivity does not control for differences in capital intensity between firms, it is assumed that within an industry, capital intensities do not vary sufficiently between firms to distort the analysis.

COMPLEMENTARY ROLES OF FIRMS OF DIFFERENT SIZES

The relation between size and profitability need not be positive. Large firms may face difficulties in trying to enter the segments occupied by small firms if these are inconsistent with quality images, distribution arrangements or other aspects of the large firms' strategies in their existing segments. Large firms may have initially chosen the now less profitable strategies because of differences in initial assets, structural change in the industry, differing goals, etc.¹³

Many findings emphasise the complementary roles of firms of different

sizes. Large established firms appear to succeed in traditional technological fields already based on large innovative activities, whereas new firms explore new technological areas. Especially, small entrepreneurial firms introduce many of the radically new innovations, while risk-averse large firms provide "cumulative incremental improvements".¹⁴

Michael Fritsch concluded that although entrepreneurship research is mostly based on a small number of countries, these studies clearly suggest that entrepreneurial activity, particularly in the form of ambitious high-technology start-ups, drives economic growth.¹⁵ Based on this and similar studies, Sternberg and Wennekers suggested that entrepreneurship policy in highly developed economies should focus primarily on potentially fast-growing new firms and not on new enterprises (i.e. start-

¹¹ Alvarez, F., Buera, F. and Lucas, R. 2013. Idea Flows, Economic Growth and Trade, NBER Working Paper Series, No. 19667.

¹² Gal, P. 2013. Measuring Total Factor Productivity at the Firm Level using OECD-Orbis, OECD Economics Department Working Papers, No. 1048.

¹³ Porter, M. E. 1979. The Structure within industries and Companies' Performance. Review of Economics and Statistics, Vol 61, No 2 (May, 1979), 214-227.

¹⁴ Acs, Z. and Audretsch, D. 2005. Entrepreneurship, innovation and technological change. Foundations and Trends in Entrepreneurship. Vol 1(4), 1-49.

¹⁵ Fritsch, M. 2008. How does new business formation affect regional development? Introduction to the special issue. Small Business Economics, Vol 30, 1-14.

ups) in general.¹⁶ This message is reflected in the “Smart guide to entrepreneurship support through clusters”¹⁷. Also, 78% of global frontier firms are small and medium-sized firms as can be seen in Figure 2.

HIGH GROWTH FIRMS

In the Eurostat-OECD Manual on Business Demography Statistics, it is recommended that in studying high-growth enterprises, both employment and turnover are observed. In order to remove the distortion caused by the growth of micro enterprises, the authors also recommended employment and turnover thresholds to ensure that only economically relevant growth is observed, while the threshold must be low enough to avoid excluding too many firms. They recommended the following definitions for *high-growth firms*:¹⁸

- A firm that initially possesses at least ten employees *or* has at least four times the national per capita income in annual revenues *and* that experiences *average annualized turnover growth* of at least 20 per cent per annum, over a three-year period.
- A firm that initially possesses at least ten employees *or* has at least four times the national per capita income in annual revenues *and* that experiences *average annualized employment growth* of at least 20 per cent per annum, over a three-year period.

In practice, the Eurostat-OECD definition requires that a company's turnover or number of employees must increase by 73% over a three-year period. This report follows this Eurostat-OECD definition for high-growth firms but require that, in order to be listed as one, the company must also have total assets of at least 500 000 euros,

without though making any restrictions regarding the turnover. With this approach, the aim is to include also those well capitalised firms that are developing some new product or service but have not really started selling it yet.

In addition, the regions' shares of rapidly growing start-ups are also examined. Here, the requirement is that a company must have between 3 and 20 employees and experience such a high average turnover, employment or asset growth over a one-, two- or three-year period that it belongs to the top 10% of firms within any given emerging industry or traded sector cluster. Firms also need to have the same minimum of 500 000 euros in total assets, but not necessarily any turnover (for the same reason as indicated for high-growth firms).

ORBIS BUSINESS DATABASE

Business demography statistics by Eurostat do not include information on individual SMEs. In our analysis we use firm-level data from the Orbis database by Bureau Van Dijk. The Orbis database includes information on more than 200 million firms globally, of which more than 90 million are European firms. The database includes information on enterprise name, turnover, number of employees, sector of activity (NACE Rev.2 4-digits) and regional level (NUTS 3-digits) for 10 years. The Orbis database can be used to enrich the existing Cluster database, not only by adding data for more indicators, but also by covering more COSME countries and regions.

In terms of geographic scope, this report covers all the countries participating in the EU's COSME programme, namely all 28 EU Member States, as well as Iceland, North Macedonia, Montenegro, Turkey, Albania, Serbia, Moldova, Armenia, Bosnia &

Herzegovina and Ukraine. With the inclusion of Ukraine, the number of regions has been expanded by 25, increasing the total number of regions to 351.

For comparative purposes, OECD member states are covered too. They include Australia, Canada, Chile, Israel, Japan, Korea, Mexico, New Zealand, Norway, Switzerland and United States. Wherever possible, firm-level data at the NACE 4-digit and NUTS 3-digit level are used. The data for the administrative boundaries for the maps are from EuroGeographics.

To summarise, the European cluster database covers the European Union, COSME and OECD countries.

To be included in the established and growth business list of the database, a company needs to have at least 20 employees or between 3 and 20 employees to feature in the start-up analyses. The requirement is added that a company must have turnover, net income (profit/loss) and total assets values for at least for one year in the Orbis database. With these restrictions, **the European cluster mapping database includes around 840 000 companies** with at least 20 employees and 168 000 companies with 3 to 20 employees.

¹⁶ Sternberg, R. and Wennekers, S. 2005. Determinants and effects of new business creation using Global Entrepreneurship Monitor data. Small Business Economics, Vol 24(3), 193–203.

¹⁷ European Observatory for Clusters and Industrial Change. 2019. Smart Guide to entrepreneurship support through clusters, European Commission, Brussels

¹⁸ Eurostat and OECD. 2007. Eurostat-OECD Manual on Business Demography Statistics. Paris: OECD Publishing.

3. European cluster strength and competitiveness

There are some 2 900 specialised clusters in Europe that account for about 19% of European jobs and 22% of European wages. They are strong in innovative and high growth firms. There are almost three times as many global frontier firms in specialised clusters than in other locations. Also, on average, specialised clusters inhabit 16 high-growth firms and 1 rapidly growing start-ups in emerging industries, compared to 9 and 0.4 respectively in other locations. Experience, Creative and Digital Industries and Mobility Technologies are particular strong in this regard.

TRADED CLUSTERS

Economic activities that are located in traded industries account for about 46% of European jobs and 55% of European wages. *Traded industries* are groups of related traded sectors. They tend to be geographically concentrated, sell their products and services across many regions and face competition from other regions. This excludes *local sectors*, such as local retail and other local services that are geographically more spread and mainly serve local customers. *Traded clusters* are geographic concentrations that result from the cluster mapping of traded industries, and hence are groups of closely related traded industries.

Europe is home to some 2 900 specialised clusters, i.e. statistically defined regional concentrations of related traded industries that have more than 500 employees in any of the 51 given traded industries.^{19,20}

Cluster effects become visible when the presence of related industries in a specific location reaches critical mass. Approximately 46 per cent of all employment in traded industries are located in specialised clusters. Economic activities that are located in specialised clusters account for about 19% of European jobs and 22% of European wages.

Wages in a specific regional cluster are driven by cluster effects and by location effects. The stronger the cluster and the better the location-specific business environment, the higher the cluster's productivity and wages.²¹

In some cluster categories, specialised clusters tend to be in locations with weak business environments; the negative location effect then results in a relatively low wage in specialised clusters. Apparel, coal mining, and transportation and

logistics are some examples of such traded clusters.

A more appropriate comparison is to look at the wages in specialised clusters considering regional and sectoral effects.²² Controlling for these effects indicates that the effect of a specialised cluster is equal to approximately a 13.5% overall increase in average wage. Specialised clusters have a wage premium in 36 of the 51 traded clusters. In particular, it tends to appear in high-tech industries and in knowledge intensive business services. For example, specialised clusters in Business Services; Financial Services; Insurance Services; and Marketing, Design and Publishing tend to pay higher average wages than similar businesses in other locations. A detailed presentation of the profile and performance of specialised clusters and clusters in other locations is given in the Annex B.

EMERGING INDUSTRIES BUILD ON TRADED INDUSTRY SECTORS

Emerging industries can be understood as either new industrial sectors or existing industrial sectors that are evolving or merging into new industries.²³ They are defined as "the establishment of an entirely new industrial value chain, or the radical reconfiguration of an existing one, driven by a disruptive idea (or convergence of ideas), leading to turning these ideas/opportunities into new products/services

¹⁹ A specialised cluster has a specialisation rate of over 1.5 – measured by the location quotient – and has more than 500 employees in the given industries. Values above unity imply high regional specialisation, with a location quotient of 1.5 corresponding to 1.5 times as many employees in an industry than would be expected if all employment was distributed evenly.

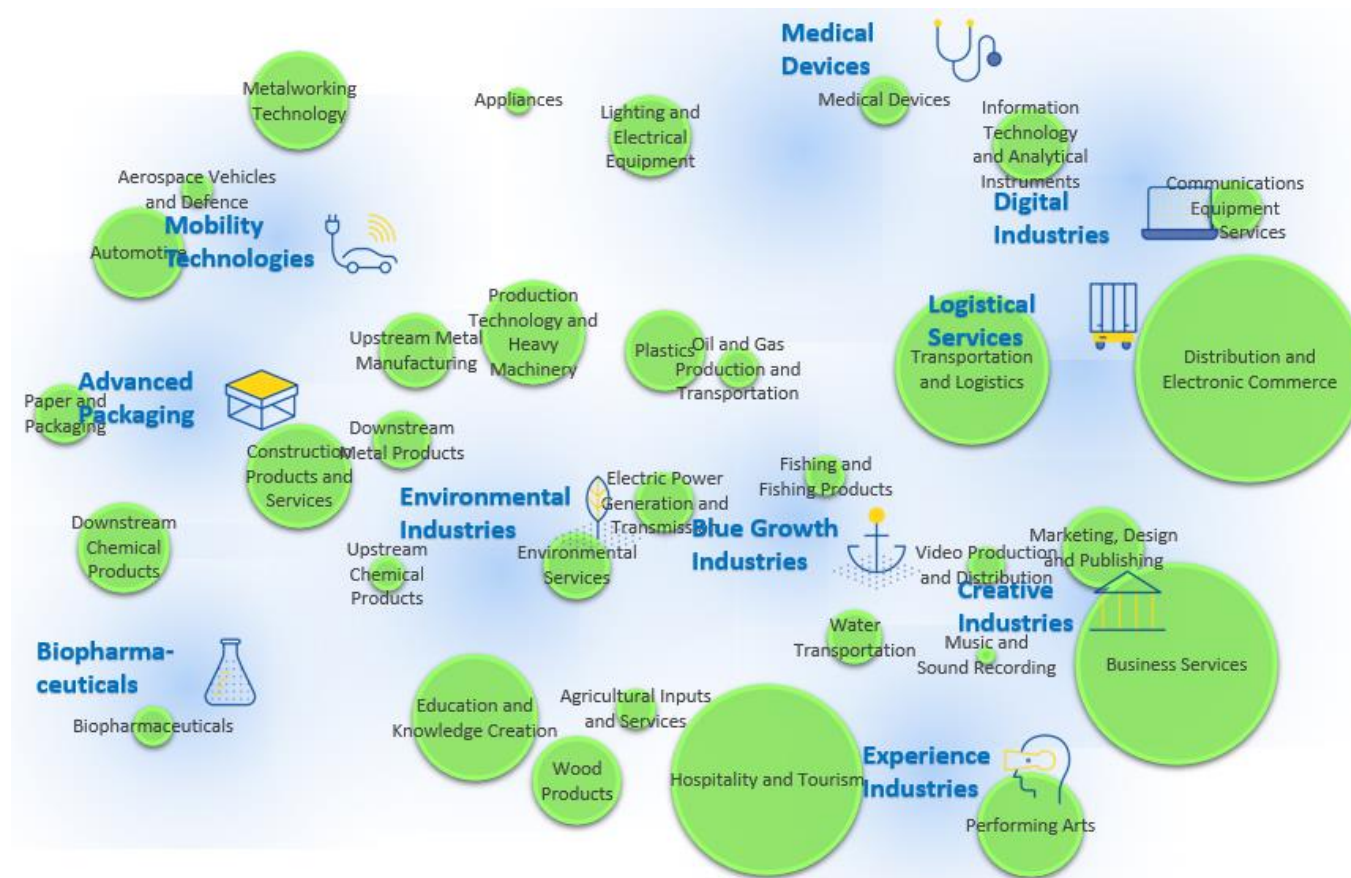
²⁰ This report covers all the countries participating in the EU's COSME programme, namely all 28 EU Member States, as well as Iceland, North Macedonia, Montenegro, Turkey, Albania, Serbia, Moldova, Armenia, Bosnia & Herzegovina and Ukraine. The number of regions in these countries is 351.

²¹ Delgado, M., Porter, M. E. and Stern, S. 2013. Defining Clusters of Related industries, Working Paper 20375 of the National Bureau of Economic Research. Available at: www.nber.org/papers/w20375. [Accessed 25 October 2018]

²² This is done by taking into account the average wage level in the country. First, a traded cluster's wage level in a region is compared to the region's average wage level and the possible premium is calculated. These premiums for specialised clusters and other locations in a country are then summed up. This wage premium calculation does not, however, take into account the varying employee profiles different regions may have. For example, creative industries show a negative wage premium for specialised clusters (Table 2). This can be because most of the cultural and creative actors, such as performing artists, are attracted to specialised cluster regions and their co-location drives wages down, whereas cultural and creative actors in other locations may hold more managerial positions.

²³ European Commission, 2016, Smart Guide to Cluster Policy.

Figure 3. The Traded Industries and the Emerging Industries Economy.



Note: The graphs illustrates the relationship between emerging industries and traded industries. Traded industries are presented in circles: size is relative to the number of employees, position shows the proximity to the related emerging industry indicated in blue colour.

with higher added value".²⁴

They enable industrial renewal by fostering the development of robust and sustainable industrial platforms from which European companies can compete globally. In addition, they will unlock the innovation required to allow Europe to shift towards a low-carbon, resource-efficient and knowledge-based economy.

Many emerging industries, such as Creative, Digital and Environmental industries, have in common that they grow out of existing industries and traded

clusters, and hence cut across different, traditionally defined sectors in response to new technologies, market demands and value chain configurations. This builds new industrial landscapes and value chains that encompass cross-sectoral competences and linkages.

Emerging industries are most often driven by key enabling technologies such as advanced manufacturing, new business models such as innovative service concepts, and by societal challenges such as climate change and sustainability demands that industry must address as a matter of

survival. They are characterised as having high growth rates and significant market potential. For this reason, they are important drivers of EU competitiveness and prosperity.

CLUSTER STARS PER REGION

Results for the regions with the most cluster stars in emerging industries are shown in Table 1. Not surprisingly, several European capitals are present on the list: Paris (ile-de-France), Oslo, Stockholm and Budapest (Central Hungary).

²⁴ Heffernan, P. and Phaal, R. 2009. The emergence of new industries, University of Cambridge Institute for Manufacturing emerging industries Programme.

Table 1. Top 20 regions with the highest overall total of cluster stars across 10 emerging industries.

Rank	Region	Size	Specialisation	Productivity	SME performance	Innovation leaders	Total
1	DE71 - Darmstadt	30	15	24	25	30	124
2	FR10 - Ile-De-France	30	8	21	30	30	119
3	DE21 - Oberbayern	30	15	22	24	28	119
4	DE11 - Stuttgart	30	18	21	21	25	115
5	ITC4 - Lombardia	30	24	0	30	30	114
6	DEA2 - Koeln	30	4	30	21	28	113
7	NO01 - Oslo og Akershus	15	15	30	24	25	109
8	DEA1 - Duesseldorf	30	12	12	24	30	108
9	FR71 - Rhone-Alpes	30	6	12	30	30	108
10	SE11 - Stockholm	18	12	16	29	30	105
11	ITC1 - Piemonte	30	12	0	30	29	101
12	ES30 - Madrid	30	7	3	30	30	100
13	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	15	9	21	26	29	100
14	DE12 - Karlsruhe	30	20	9	14	26	99
15	ITH3 - Veneto	27	12	0	30	30	99
16	ITH5 - Emilia-Romagna	27	10	0	30	30	97
17	BE21 - Antwerp	6	6	30	24	30	96
18	ES21 - Pais Vasco	21	12	2	29	30	94
19	HU10 - Central Hungary	30	9	0	30	25	94
20	FR82 - Provence-Alpes-Cote D'Azur	13	5	21	27	28	94

Note: The top 3 values for each category for the top 20 regions with most cluster stars are highlighted in bold.

This report follows the previous used definition for the ten emerging industries (by the European Cluster Observatory).²⁵ The overall results for these ten emerging industries and their key characteristics are presented in Table 2 and further below.

Separate sections for each emerging industries go further in detail by describing which related sectors are part of the

specific emerging industry, while further details can be found in the methodology report of the previous European Cluster Observatory that was followed.²⁶ Each sections shows a European cluster map and a list with those regions that host the top 10 clusters. This list covers the regions with the most cluster stars in the emerging industry and those that exhibit the highest performance for high-growth SMEs and of

the industry leaders – which are two of the five cluster star categories.

More detailed figures can be found in the cluster mapping tool at https://ec.europa.eu/growth/smes/cluster/observatory/cluster-mapping-services/mapping-tool_en.

²⁵ Ketels, C. and Protsiv, S. 2014. Methodology and Findings Report for a Cluster Mapping of Related Sectors. Center for Strategy and Competitiveness, Stockholm School of Economics.

²⁶ *ibid*.

Table 2. Key economic characteristics of the ten emerging industries

Emerging industry	Employment 2016	Average change	Average wage 2016 (PPP)	Average change	Wage premium (specialised clusters)	Average Gross Value Added (GVA) 2014 (PPP)	Value added of Global Frontier firms 2016	Average change
Advanced Packaging	4 917 000	0.4 %	38.400 €	1.2 %	13 %	63.700 €	121.000 €	3.2 %
Biopharmaceuticals	2 364 000	0.6 %	50.800 €	0.9 %	7 %	114.800 €	233.000 €	3.4 %
Blue Growth industries	13 290 000	0.9 %	34.200 €	0.6 %	2 %	70.300 €	138.000 €	1.4 %
Creative industries	15 043 000	2.2 %	48.300 €	1.2 %	-2 %	89.300 €	169.000 €	1.0 %
Digital industries	10 196 000	0.9 %	48.800 €	1.1 %	13 %	85.000 €	171.000 €	1.8 %
Environmental industries	8 931 000	1.1 %	40.400 €	-0.2 %	3 %	59.500 €	194.000 €	2.4 %
Experience industries	15 989 000	2.7 %	38.100 €	0.9 %	0 %	84.300 €	142.000 €	1.3 %
Logistical Services	7 879 000	0.8 %	28.400 €	2.3 %	3 %	46.100 €	109.000 €	0.3 %
Medical Devices	4 852 000	-0.1 %	47.000 €	0.4 %	0 %	76.100 €	161.000 €	2.7 %
Mobility Technologies	10 921 000	0.2 %	40.500 €	0.3 %	5 %	68.800 €	127.000 €	2.2 %

Note: The top three performing emerging industries are indicated in bold in each column. Average change is the average annual change over a five-year period, typically 2011 – 2016.

The two emerging industries that employ the most people in Europe are Experience and Creative industries with 16 and 15 million employees, respectively. These two industries also have the highest employment growth rates among the emerging industries. At the lower end of the spectrum, Europe's employment size of Biopharmaceuticals is at 2.4 million people. However, both wages and gross value added are significantly higher compared to other emerging industries, suggesting very high levels of productivity. Creative and Digital industries have the second and third highest average wage and gross value added levels after Biopharmaceuticals.

Digital industries have grown very fast during the past two decades and employs 10.2 million people compared to 7.3 million in 1996. Despite some overlap with Creative industries, Digital industries

exhibit a very different enterprise structure, with firms generally being larger compared to the other emerging industries. The specialised clusters in Digital industries, together with those of Advanced Packaging, show the highest wage premium with 13% over other locations in these emerging industries.

For each emerging industry, The competitive landscape is examined for its traded clusters. Therefore, contrary to the usual practice of exclusive focus on the regional level, different nations' absolute shares of industry leaders and high-growth firms are presented too.

The high-growth firm analysis is somewhat hampered by the lack of data. Both the United States and Japan appear to be under-represented in the data. Therefore, the best performing nations with respect to

rapidly growing start-ups are not listed as those listings would depend too much on the availability of each nation's data.²⁷

For each emerging industry, the statistical analysis is complemented by presenting the development of one successful region and cluster organisation(s) working in that region, while for Biopharmaceuticals and Creative industries, an example of national innovation policy setting is also sketched out as regions' developments are heavily rooted in those. In addition, one case company that operates in the emerging industry of the region is presented each time to allow a better understanding of the emerging industries.²⁸ These companies can be either successful, established businesses with long roots in the region, or young entrepreneurial start-ups.

²⁷ In addition, in order to be presented as a high value adding nation, the requirement is set that gross value added data is available for at least 1 000 employees in the given cluster and nation, and that the cluster employs at least 10 000 people in that nation.

²⁸ It should be noted though that just because regions perform well in terms of their economic performance or cluster development, this does not necessarily means that the policies or cluster organisations are performing well.

Advanced Packaging



Employment	4 917 000 (8th/10)	Wage premium (in clusters)	13% (1st/10)
Average change	0.4% (8th/10)	Average Gross Value Added	63 700 € (8th/10)
Average wage	38 400 € (7th/10)	Value added at Global Frontier firms	121 000 € (9th/10)
Average change	1.2% (2nd/10)	Average change	3.2% (2nd/10)

Advanced Packaging is perceived as an increasingly important input to many other activities, from food processing to automotive supply chains, and has meaningful size. It includes the paper and packaging traded industry, complemented with packaging-related clusters from plastics, automotive, downstream metal products and other clusters that are often significantly larger in overall employment. It employs more than 4.9 million people in Europe.

The Advanced Packaging emerging industry comprises conventional packaging industry complemented by stakeholders creating and providing additional value added products and services to fulfil or expand the scope of the core functions of the packaging. There are trends towards sustainable packaging, i.e. less use of material and manufacturing with a smaller carbon footprint, increased focus on reuse, recyclability and packaging using biodegradable materials; lightweight packaging; and integration of packaging

and functionalities of the product. Packages may contain information regarding the packaged goods themselves, as well as regarding restrictions in storage and handling, or any other information related to the enclosed goods or their purpose of use. Packaging and its materials and design are used for marketing purposes, to display identity and brands or to attract potential buyers. In addition, it has been used to support any issues of security, reducing or hindering risks of theft, misuse, copying or any other non-foreseen action.

Table 3. Key regions in Advanced Packaging

Cluster stars							Cluster performance in detail: SME performance driven by high-growth firms						Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms				
Region	Size (0-3)	Specialisation (0-3)	Productivity (0-3)	SME performance (0-3)	Innovation leader (0-3)	Total stars (0-15)	Region	Turnover	Employees	Assets	Start-ups	Avg	Region	Turnover	Profit	Value Add	Avg
DEA5 - Arnsberg	3	3	3	2	3	14	Korea	0.6	0.4	0.6	1.2	0.7	AT34 - Vorarlberg	1.4	1.7	1.4	1.5
DE11 - Stuttgart	3	3	3	2	2	13	BG42 - Yuzhen Tsentralen	0.9	1.1	0.7	0.1	0.7	SE32 - Middle Norrland	2.0	1.2	1.1	1.4
DE12 - Karlsruhe	3	3	3	1	3	13	ITC4 - Lombardia	0.3	0.4	0.3	1.7	0.7	FI20 - Åland	0.2	0.1	3.4	1.2
DE27 - Schwaben	3	3	3	1	3	13	PT16 - Centre	0.7	0.8	0.7	0.1	0.6	SE31 - North Middle Sweden	0.5	1.6	1.3	1.1
DE13 - Freiburg	3	3	3	1	2	12	BG41 - Yugozapaden	0.6	0.8	0.5	0.3	0.6	UKI3 - Inner London - West	1.4	1.3	0.4	1.0
DE14 - Tuebingen	3	3	3	1	2	12	BG32 - Severen Tsentralen	0.7	1.0	0.6	0.0	0.6	BE21 - Antwerp	0.9	0.4	1.6	0.9
ES21 - Pais Vasco	3	3	0	3	3	12	CZ07 - Central Moravia	0.7	0.9	0.6	0.0	0.6	LU00 - Luxembourg	0.8	1.2	0.6	0.8
FR10 - Ile-De-France	3	0	3	3	3	12	CZ05 - Northeast	0.7	0.9	0.6	0.1	0.5	FI1B - Helsinki-Uusimaa	0.9	0.8	0.5	0.8
ITC1 - Piemonte	3	3	0	3	3	12	SK02 - Western Slovakia	0.6	0.7	0.5	0.3	0.5	SE33 - Upper Norrland	0.1	0.8	1.3	0.7
ITC4 - Lombardia	3	3	0	3	3	12	BE21 - Antwerp	0.1	0.1	0.1	1.7	0.5	SE11 - Stockholm	0.7	0.7	0.5	0.7

There are 2 other 12 star regions: ITH3 – Veneto and PT16 - Centre

Advanced Packaging is concentrated in Southern and Central Germany and some

of the neighbouring countries: Hungary, Romania, Poland, Czechia, Austria, Slovakia

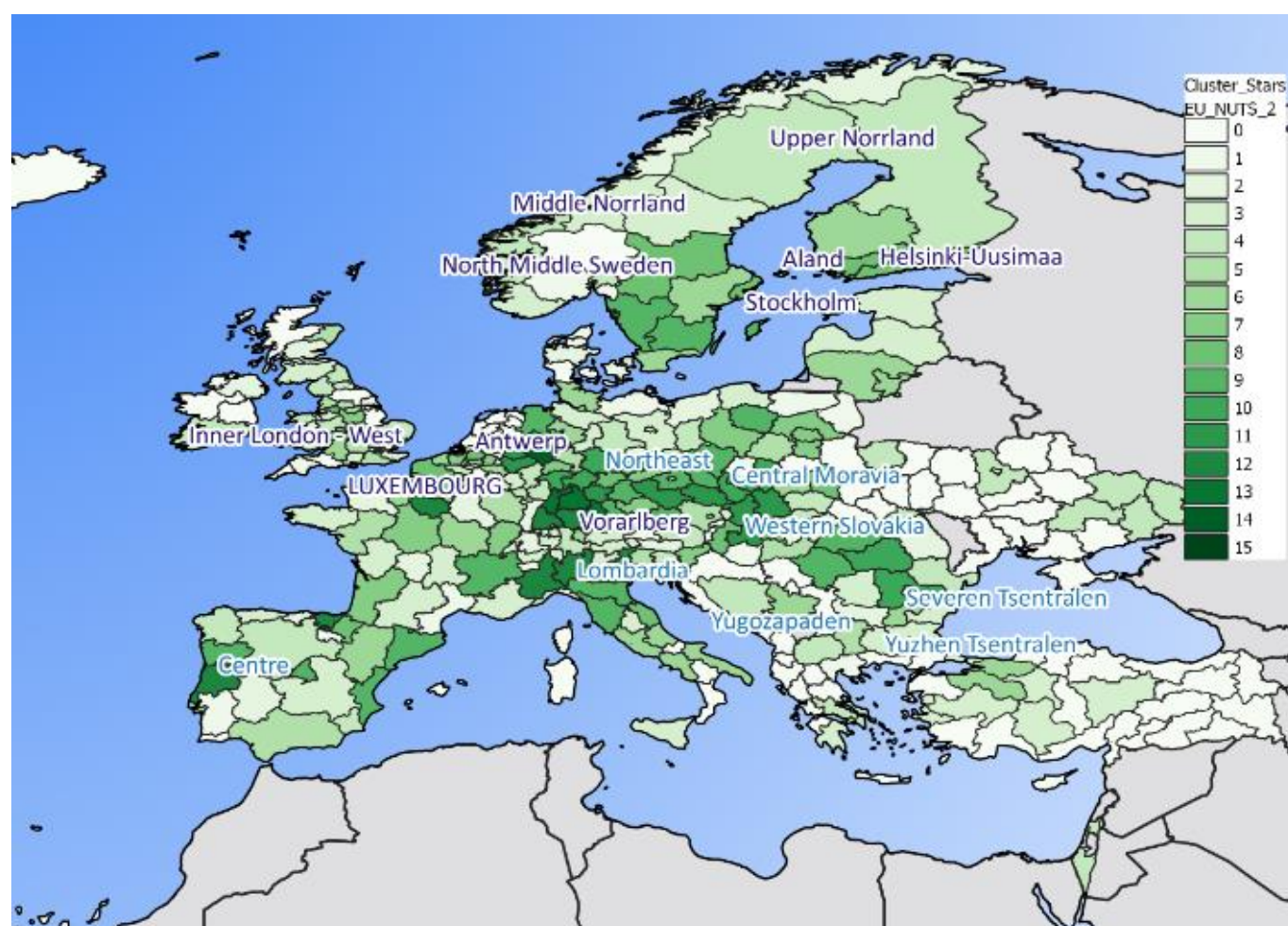
and Northern Italy (see Table 3 and Figure 4). The biggest specialised clusters are

Lombardia, Stuttgart and Slaskie in Poland, with 139 000, 108 000 and 89 000 employees in this industry. The Transdanubia regions in Hungary employ almost 90 000 people and have the highest specialization rates in this industry. Being a member of the Advanced Packaging emerging industry correlates with

measures for medium high tech exports, patent applications for key enabling technologies and firm investments. Yet, regions specialised in Advanced Packaging have the lowest labour productivity when they are compared with regions that have specialised in some other emerging industry. Moreover, these specialised

regions are characterised as having few marketing and organisational innovators, and low employment growth and high-technology employment. The new start-up rate is also low, but the scale-up rate is reasonably high.

Figure 4. Cluster stars in Advanced Packaging²⁹



Note: Regions which name is displayed in dark blue colour indicate those with the highest concentration of industry leaders while regions displayed with a name in light blue colour highlight those with the highest concentration of high-growth firms. Source: EuroGeographics for the NUTS 2 administrative boundaries

²⁹ The depth of the green colour indicates the region's star rating on a scale from 0 to 15. Dark blue text indicates the regions that have the highest concentrations of established businesses, Industry Leaders and Global Frontier firms, per unit population. Light blue text indicates that the regions that have the highest concentrations of High Growth firms and rapidly growing start-ups per unit population.

Key traded clusters in Advanced Packaging

Advanced Packaging includes the paper and packaging traded cluster, with the highest complementation from packaging-related clusters in plastics and downstream metal products clusters.

Being a member of the paper and packaging traded cluster correlates with measures for digitalisation, design

applications and with business R&D expenditure. In the paper and packaging traded cluster, the specialised region with the highest number of employees is the Istanbul sub-region, with over 38 000 employees. Three Italian regions, Toscana, Lombardy and Veneto, stand out as specialised regions, each having about 25 000 employees. These can also claim

strong presence in the global gross value added frontier. However, three Swedish regions, North Middle Sweden, Middle, and Upper Norrland maintain a leading position. In addition, the Finnish regions Helsinki-Uusimaa and Southern Finland are also performing well. This reflects the strong tradition of these two countries in paper-related products (see table 4).

Table 4. Strong nations in the Paper and Packaging traded cluster, industry leaders³⁰

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 21%	United States, 22% ↓	Finland, 13.2‰ ↘	Finland, 19.1‰ ↑	Sweden, 154 k€ ↑
Japan, 16% ↗	Japan, 11% ↑	Sweden, 6.8‰	Sweden, 9.5‰ ↓	Finland, 120 k€ ↑
United Kingdom, 9%	Finland, 11% ↑	Ireland, 4.5‰	Ireland, 5.4‰	Austria, 95 k€ ↗

Table 5. Strong nations in the Paper and Packaging traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 17%	Italy, 11%	South Korea, 16%	Bulgaria, 9.9‰	Bulgaria, 12.6‰	Bulgaria, 8.7‰
Italy, 11%	Spain, 10%	Italy, 10%	Lithuania, 7.4‰	Lithuania, 5.3‰	Lithuania, 6.7‰
Romania, 8%	Bulgaria, 9%	Poland, 7%	Estonia, 4.7‰	Czechia, 5.1‰	Estonia, 4.2‰

In the plastics traded cluster, five out of the six specialised regions with the highest numbers of employees are from Northern Italy, namely, Lombardy, Veneto, Piemonte, Emilia-Romagna and Toscana. Polish regions are also well represented, with the Slaskie, Dolnoslaskie and Wielkopolskie

regions making their way to the top ten. However, on a global level, the plastics trade cluster is dominated by American and Japanese companies, which claim more than a third of the industry turnover (27%) and profits (23%). On the other hand, South Korea is the leading country in the number

of high growth firms. Being a member of the plastics traded cluster correlates with – i.e. makes it more likely to have – high values for medium high tech exports, patent applications for key enabling technologies and firm investments.

³⁰ Change over a five-year period:

↓ >20% decline ↘ 10-20% decline ↗ 10-20% increase ↑ >20% increase

Table 6. Strong nations in the Plastics traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 30% ↘	United States, 34% ↓	Luxembourg, 23.4‰ ↑	Luxembourg, 28.8‰ ↑	Belgium, 115 k€ ↗
Japan, 14% ↑	Japan, 15% ↑	Czechia, 1.7‰ ↓	Czechia, 2‰ ↑	France, 98 k€ ↑
France, 9%	France, 8% ↑	Finland, 1.7‰ ↑	Switzerland, 1.7‰ ↑	Germany, 92 k€ ↑

Table 7. Strong nations in the Plastics traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 24%	South Korea, 16%	South Korea, 22%	Bulgaria, 7.5‰	Bulgaria, 9.7‰	Lithuania, 7.1‰
Italy, 8%	Spain, 9%	Poland, 7%	Lithuania, 6.9‰	Czechia, 8.4‰	Bulgaria, 6‰
Poland, 7%	Czechia, 9%	Italy, 7%	Estonia, 5.4‰	Lithuania, 6.6‰	Estonia, 5.5‰

Advanced Packaging development examples

The advanced packaging cluster of the Central Moravia region features amongst the top 10 regions for high-growth firms. The region is considered as part of a broader automotive cluster that includes Czechia, Poland, Slovakia and Hungary. This region has been referred to as the “New Detroit” or “East Detroit.”

CLUSTER ORGANISATIONS IN CENTRAL MORAVIA SUPPORTING THE ADVANCED PACKAGING INDUSTRY

At the beginning of the 2000s, Central Moravia in the Czechia was considered as a problematic region, in need of structural change. The unemployment rate was high and the regions depended on the mining industry, which was decreasing. Therefore, the region received substantial support from the government and also from EU funds.

Although the linkages in the broader Eastern European automotive cluster are weaker than in the regional cluster, it is safe to assume that the Moravian-Silesian cluster also benefits from the existence of the broader automotive cluster.

Moravskoslezský automobilový klastr, z.s.



The Moravskoslezský automobilový klastr cluster organisation was established in 2006 in the Central Moravia region. The cluster has 77 members including 50 SME and 12 larger company members. It is an integrator of companies, educational and research institutions and other stakeholders whose activities support the development of the automotive industry in the region. Its technology fields include plastics, polymers and automotive engineering. It has engaged in benchmarking and efforts towards improving its cluster management (Cluster Excellence Bronze Label) and was selected Cluster of the Year in 2014 and 2017.

National wood processing cluster (NDK)



The National wood processing cluster (NDK) promotes the wood processing and construction industry and participates in

the popularization of technical professions. It aims to promote wood as an ecological material in the construction industry. NDK organises events for the public, where visitors can become acquainted with the cluster's operation and its activities and they can test their professional skills through workshops and competitions.

The cluster organisation was established in 2005 and has 26 members, including 16 SME and 6 larger company members. Biocel Paskov is one of the cluster's major players. NDK has also engaged in efforts to improve its cluster management (Cluster Excellence Bronze Label) Case cluster firm: Biocel Paskov

Biocel Paskov is a joint-stock company situated in Paskov, in the North Moravia region of the Czechia. The production of pulp in this region dates back to the end of the 19th century. Biocel Paskov became part of the multinational Lenzing Group, the world's largest producer of viscose fibres used mainly in the textile industry, in 2010. With investments of more than two and a half billion crowns (ca. 100 million euros), the company changed the technology used to produce paper to

viscose pulp, improved the company's economic performance and took further steps to improve environmental protection. The production technology switch enables flexible meeting of the market requirements and makes it possible to produce either viscose pulp or paper pulp.

The company purchases spruce wood especially from domestic sources. Imports are from Slovakia, Poland and Belorussia.

Biocel Paskov has international certification for its quality control, ISO 9002, and has been certified for conforming to

environmental management according to the standards of ISO 14001. Biocel Paskov was among the first companies to receive the "Safe Company" certificate from the Czech Institute for Occupational Safety.

Biopharmaceuticals



Employment	2 364 000 (10th/10)	Wage premium (in clusters)	7% (3rd/10)
Average change	0.4% (8th/10)	Average Gross Value Added	114 800 € (1st/10)
Average wage	59 800 € (1st/10)	Value added at Global Frontier firms	233 000 € (1st/10)
Average change	0.9% (5th/10)	Average change	3.4% (1st/10)

The Biopharmaceuticals emerging industry is an expansion of the biopharmaceutical cluster with upstream and downstream chemical products and other core activities, such as research and development. Biopharmaceuticals form the scientific basis of the life science industries, and employ some of the most educated and productive employees.

Europe's employment is at 2.4 million people, which is the lowest figure among the emerging industries. However, both wages and gross value added are significantly higher than in other industries (by 50%) and in the overall economy (by 90%), suggesting very high levels of productivity.

The core of the Biopharmaceutical industry lies in Southern and Western Germany,

Belgium, Ireland and Israel (see Table 8 and Figure 5). In particular, the Israeli Central district has the highest number of employees, 110 000, and the highest specialisation rate. Other regions specialised in Biopharmaceuticals are those with strong universities, such as Oxford, Paris, Lyon, Copenhagen, Dublin, but also Albania and the Attica region in Greece.

Table 8. Key regions in Biopharmaceuticals

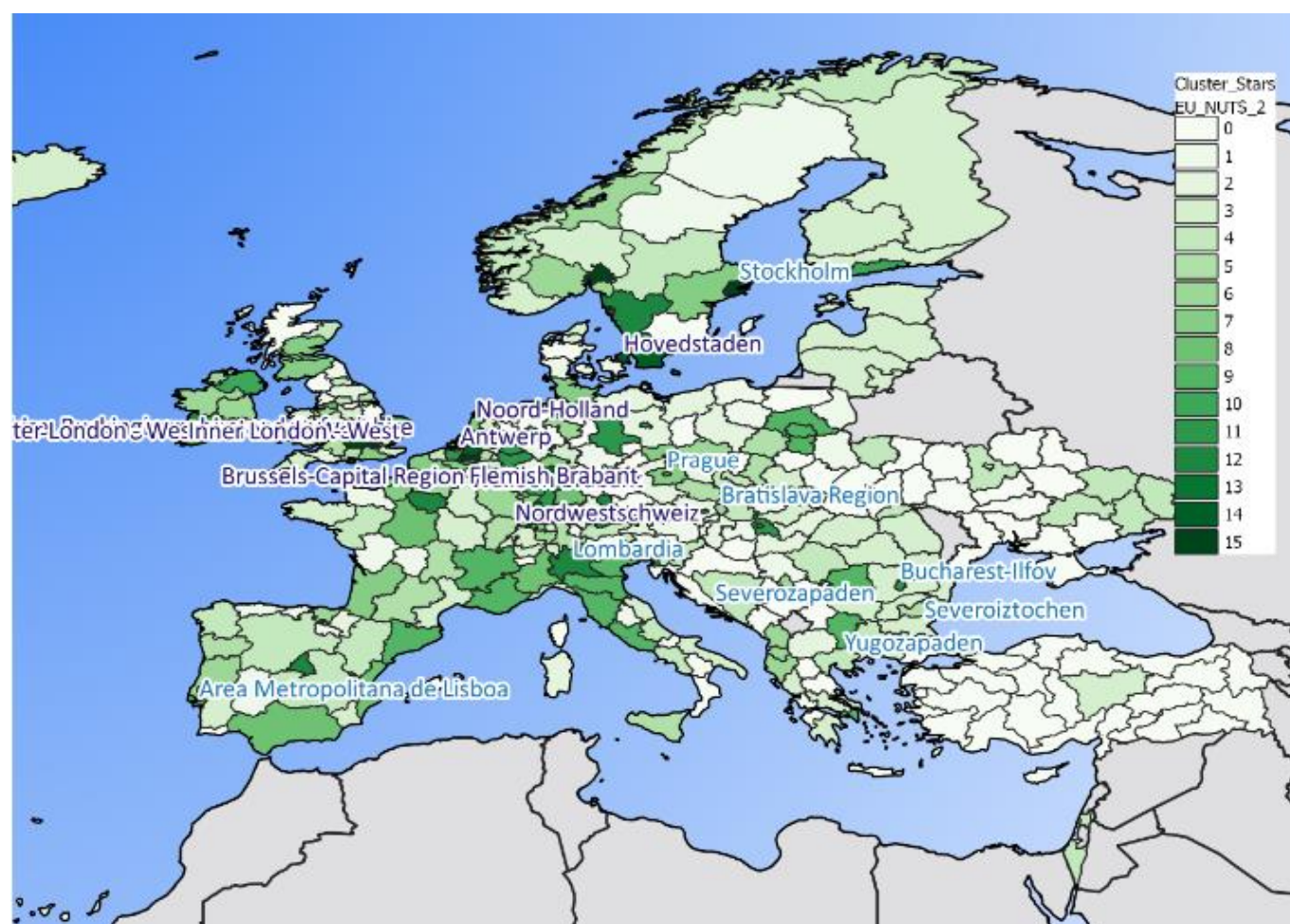
Cluster stars													Cluster performance in detail: SME performance driven by high growth firms					Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms				
Region	Size (0-3)	Speciali- sation (0-3)	Produc- tivity (0-3)	SME perform- ance (0-3)	Innova- tion leader (0-3)	Total stars (0-15)	Region	Turnov- er	Emple- yees	Assets	Start- ups	Avg	Region	Turnov- er	Profit	Value Add	Avg					
BE24 - Flemish Brabant	3	3	3	3	3	15	BG41 - Yugozapaden	1.6	1.8	1.4	0.4	1.3	BE31 - Walloon Brabant	1.9	1.3	2.2	1.8					
NO01 - Oslo og Akershus	3	3	3	3	3	15	BG33 - Severoiztochen	1.8	1.9	1.3	0.0	1.2	BE10 - Brussels-Capital Region	1.6	1.5	1.8	1.6					
SE11 - Stockholm	3	3	3	3	3	15	RO32 - Bucharest-Ilfov	1.2	1.3	1.3	0.7	1.1	BE21 - Antwerp	0.9	0.7	1.5	1.0					
UKI7 - Outer London - West and North West	3	3	3	3	3	15	SE11 - Stockholm	0.6	0.5	0.6	1.3	0.8	UKI3 - Inner London - West	1.0	0.8	1.2	1.0					
UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	3	3	3	3	3	15	ITC4 - Lombardia	0.3	0.4	0.3	1.9	0.7	BE24 - Flemish Brabant	0.4	0.1	2.1	0.9					
BE10 - Brussels-Capital Region	3	3	3	2	3	14	CZ01 - Prague	0.8	0.9	0.6	0.2	0.6	DK01 - Hovedstaden	0.5	1.3	0.7	0.8					
BE21 - Antwerp	3	3	3	2	3	14	UKI3 - Inner London - West	0.6	0.7	0.7	0.4	0.6	NL32 - Noord-Holland	1.2	1.0	0.1	0.7					
DE71 - Darmstadt	3	3	3	2	3	14	PT17 - Area Metropolitana de Lisboa	0.4	0.4	0.5	0.8	0.5	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0.4	0.9	0.7	0.7					
DK01 - Hovedstaden	3	3	3	2	3	14	SK01 - Bratislava Region	0.5	0.7	0.6	0.2	0.5	CH03 - Nordwestschweiz	0.7	1.3	0.0	0.6					
SE22 - South Sweden	3	3	3	3	2	14	BG31 - Severozapaden	0.6	0.7	0.6	0.1	0.5	UKI7 - Outer London - West and North West	0.7	0.7	0.4	0.6					

The regions specialised in Biopharmaceuticals perform well in a number of economic indicators. As one can imagine, labour productivity is on a high level, second only to regions that have

specialised in Creative industries. These regions have numerous products and processes, and marketing and organisational innovators, and score high on high-technology employment. Labour force participation rate as well as digital

engagement are on a high level. On the other hand, both start-up and scale-up rates are relatively low among these specialised regions.

Figure 5. Cluster stars in Biopharmaceuticals



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded cluster in Biopharmaceuticals

The biopharmaceuticals emerging industry is an expansion of the biopharmaceutical cluster with upstream and downstream chemical products and other core activities, such as research and development.

Being a member of the biopharmaceuticals traded cluster correlates with high values for high tech exports, firm investments and digitalisation. In the biopharmaceuticals

traded cluster, the most specialised regions are Northwest Switzerland, Walloon Brabant, Northern Ireland, Copenhagen, and Southern and Eastern Ireland. Each of these regions employs somewhat over 10 000 biotech persons, except for Walloon Brabant with just over 2 000. On the other extreme, in Southern and Eastern Ireland, there are over 26 000 biotech employees. This is the second highest employment

figure among the specialised biopharmaceuticals region, behind the Istanbul Sub-region and ahead of Lombardy and Darmstadt. Walloon Brabant, Southern and Eastern Ireland, and Copenhagen are the leading regions when we consider the number of this traded cluster's industry leaders and global frontier firms per capita.

Table 9. Strong nations in the Biopharmaceuticals traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 31%	United States, 44% ↗	Switzerland, 10.8‰ ↘	Switzerland, 14.4‰ ↘	Ireland, 473 k€ ↗
Germany, 9%	Switzerland, 12% ↘	Ireland, 6.4‰ ↗	Ireland, 12‰ ↗	Switzerland, 315 k€ ↗
Switzerland, 9% ↘	Japan, 7% ↗	Netherlands, 3.9‰ ↗	Denmark, 7.6‰ ↗	United States, 292 k€ ↗

Table 10. Strong nations in the Biopharmaceuticals traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
United States, 18%	United States, 21%	United States, 22%	Ireland, 3.7‰	Ireland, 4.2‰	Ireland, 4.5‰
South Korea, 14%	United Kingdom, 11%	South Korea, 12%	Latvia, 2.7‰	Estonia, 3.3‰	South Korea, 2.4‰
United Kingdom, 11%	South Korea, 9%	United Kingdom, 12%	South Korea, 2.7‰	Latvia, 2.9‰	Sweden, 2.1‰

Biopharmaceuticals development examples

The Copenhagen region (DK01 – Hovedstaden) is a 14 cluster star region and the home for some of the biopharmaceuticals industry leaders. The industry has grown very rapidly during the 2000s in Denmark (for the two companies with the highest value add, see Figure 6 below)³¹. This positive development can be hypothesised to have occurred, at least partly, because of a coherent national innovation policy.

DANISH INNOVATION POLICY

In Denmark, the 2000s saw the establishment of a number of strategic or innovation-oriented research funding channels, including the Danish Council for Technology and Innovation, the Danish Council of Strategic Research and the Danish National Advanced Technology Foundation. These changes in the funding system were dominated by three tendencies: a shift from institutional funding towards project funding, a shift

from basic research towards strategic research and finally a shift from the funding of many small projects towards fewer and larger projects.³² Particularly from 2006 and onwards, these changes were followed by a significant increase in total public R&D investments.

The so-called *Danish Globalisation Strategy* from 2006 stated that the number of graduated PhDs by 2010 should be doubled from the 2004 level. The increase in volume was highly selective, as 90 per cent of the

³¹ In 2000, Novo Group was split into two – one for health care, which retained the name Novo Nordisk A/S, and one for the enzyme business, which became Novozymes A/S. Other high value adding companies in the Danish life science cluster include Coloplast A/S, H. Lundbeck A/S and Chr. Hansen A/S.

³² Aagaard, K. 2011. Kampen om basismidlerne, PhD thesis, Aarhus University, Denmark.

increase was to take place within the natural, medical and technical sciences as these areas were perceived to contribute the most to innovation and growth. Denmark has 182 public-private co-publications per million of population compared to 29 for the EU-28. In Denmark, the strongest fields are pharmaceuticals, chemical engineering, biochemistry and neuroscience, on average over the period 2003-2013.³³

The framework for knowledge transfer is provided in the *innovation strategy "Denmark – Nation of solutions"*.³⁴ It contains 27 individual policy initiatives implemented since 2013 and targeting knowledge transfer and open innovation activities of Danish scientific institutions and companies. Within this framework, public-private collaboration occurs mainly between firms and the eight Danish universities as well as the nine public research institutes. Although the

universities are the main research performers, the research institutes are the main collaboration partners of the private sector. The strategy stresses the importance of increased cooperation between knowledge institutions, companies and other stakeholders to foster growth and employment; a higher focus on utilizing research results, commercialization and market maturation; and an active participation in the global knowledge and innovation network.

Figure 6. Development of Novo Nordisk's and Novozymes' added value (million €).

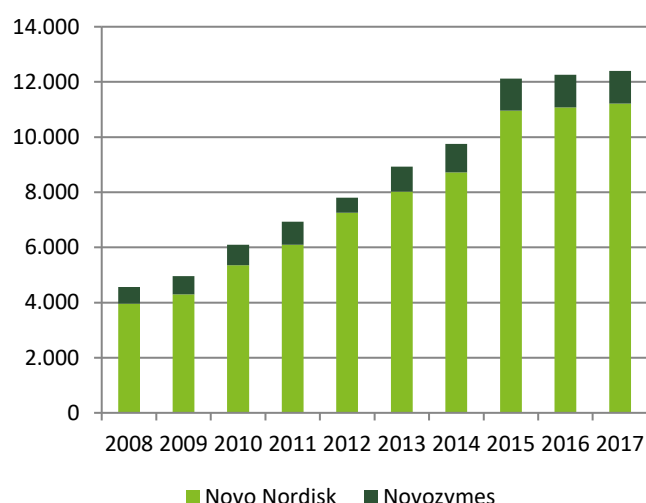
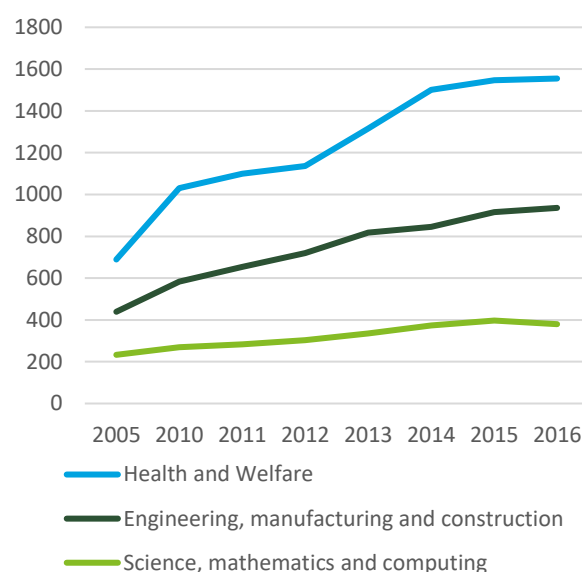


Figure 7. Number of Danish doctoral graduates in selected fields.



BIOPEOPLE, DENMARK'S LIFE SCIENCE CLUSTER



Biopeople is Denmark's Life Science Cluster, located at the University of Copenhagen with particular focus on pharmaceuticals, biotechnology and biomedical technology.

It is part of the Danish infrastructure for innovation, established and co-funded by the Ministry of Higher Education and Science.

Biopeople is a neutral catalyst for collaboration between companies and public research. Its strategic priority is to support the paradigm shift in the health care sector, implying a strengthened focus on biomarkers, companion diagnostics,

precision/personalized medicine, regulatory science and stakeholder involvement, including patient and investor communities. Biopeople has 500 members including 150 SME and 25 larger company members. There are 25 research organisations/universities/technology centres.

Biopeople was established in 2005 and was the first international Life Science cluster in

³³ Grimpe, C., and Mitchell, J. 2016. RIO Country Report 2015: Denmark. JCR Science for Policy Report, No. JRC101183.

³⁴ <http://ufm.dk/en/publications/2012/denmark-a-nation-of-solutions>

2013 to achieve the Gold Label of the European Secretariat for Cluster Analysis.

CASE FIRM: NOVO NORDISK FOUNDATION

Novo Nordisk is a global healthcare company from the Biopole Life Science cluster with more than 90 years of innovation and leadership in diabetes care. Novo Nordisk employs approximately 43 100 people in 79 countries and markets its products in more than 170 countries. Novozymes account for 2/3 of the entire global investment in developing enzymes and the company dedicates 13-14% of its total revenue to R&D.

Novo Nordisk Foundation initiated the Copenhagen Bioscience Cluster in 2007 with the establishment of the first major

research centre: the Novo Nordisk Foundation Center for Protein Research at the University of Copenhagen. The foundation has awarded grants of more than 830 million euros for establishing and expanding the Copenhagen Bioscience Cluster, adding three more centres and two infrastructures in the Greater Copenhagen area.

With Denmark as its centre of gravity, the foundation is pursuing a three-pronged mission: to enable the foundation Novo Nordisk and the firm Novozymes to create world-class business results and contribute to growth; to develop knowledge-based environments in which innovative and talented people can carry out research of the highest quality and translate

discoveries into new treatments and solutions; and to inspire and enable children and young people to learn. Since 2010, the Foundation has donated more than 16 billion Danish Krona (2.1 billion euros), primarily for research within biomedicine and biotechnology and diabetes treatment and prevention, at universities and hospitals in Denmark and the other Nordic countries.

The Cluster and other Novo Nordisk Foundation initiatives are surrounded by a rich life science environment that provide multiple opportunities for interaction and collaboration.

Blue Growth industries



Employment	13 290 000 (3rd/10)	Wage premium (in clusters)	2% (7th/10)
Average change	0.9% (4th/10)	Average Gross Value Added	70 300 € (6th/10)
Average wage	34 200 € (9th/10)	Value added at Global Frontier firms	138 000 € (7th/10)
Average change	0.6% (7th/10)	Average change	1.4% (7th/10)

Blue Growth industries includes all sectors and industries related to a maritime environment as well as sectors producing, making use of and treating fresh-water sources. Blue Growth industries has been the focus of European policy during the past several years and is an area in which interesting new islands of activity might emerge.

Blue Growth is here defined as the development and exploitation of the

potential of oceans, seas and related infrastructures as well as of inland freshwater sources. Therefore, Blue Growth industries include all sectors and industries related to a maritime environment as well as sectors producing, making use of, and treating fresh-water sources: exploitation of water resources as an environment for fish and other water-based resources; water-based energy production; off-shore mining; marine biotechnology; tourism; water transport

and related civil engineering and infrastructures; and water management.

With 13.3 million employees, Blue Growth industries are one of the largest among the emerging industries and corresponds to about 6% of Europe's total employment. The average wage level is relatively low, with only Logistical Services having a lower one.

Table 11. Key regions in Blue Growth industries

Cluster stars													Cluster performance in detail: SME performance driven by high growth firms					Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms				
Region	Size (0-3)	Speciali- sation (0-3)	Produc- tivity (0-3)	SME perform- ance (0-3)	Innova- tion leader (0-3)	Total stars (0-15)	Region	Turnov er	Empl oyees	Assets	Start- ups	Avg	Region	Turnov er	Profit	Value Add	Avg					
NO01 - Oslo og Akershus	3	3	3	3	3	15	BG41 - Yugozapaden	1.0	1.2	0.8	0.2	0.8	UKI3 - Inner London - West	3.1	2.5	1.9	2.5					
NO04 - Agder og Rogaland	3	3	3	3	3	15	SK01 - Bratislava Region	0.9	1.3	0.8	0.2	0.8	FI20 - Aland	0.1	1.2	3.2	1.5					
NO05 - Vestlandet	3	3	3	3	3	15	LV00 - Latvia	0.9	1.2	0.7	0.3	0.8	NO04 - Agder og Rogaland	1.0	1.8	0.9	1.2					
ES11 - Galicia	3	3	0	3	3	12	NO07 - Nord-Norge	1.2	0.0	1.1	0.7	0.8	NO05 - Vestlandet	1.1	1.5	0.9	1.2					
ES21 - Pais Vasco	3	3	0	3	3	12	LT00 - Lithuania	1.3	1.2	0.5	0.0	0.7	NO01 - Oslo og Akershus	1.3	1.4	0.6	1.1					
FR30 - Nord-Pas-De-Calais	3	0	3	3	3	12	NO05 - Vestlandet	1.1	0.0	0.9	0.9	0.7	UKM5 - North Eastern Scotland	1.1	1.0	1.0	1.0					
FR51 - Pays-de-la-Loire	3	0	3	3	3	12	SE11 - Stockholm	0.5	0.6	0.5	0.9	0.6	DE50 - Bremen	1.5	1.0	0.6	1.0					
FR82 - Provence-Alpes-Cote D'Azur	3	0	3	3	3	12	UKI3 - Inner London - West	0.6	0.6	0.7	0.5	0.6	BE21 - Antwerp	0.4	0.8	1.5	0.9					
DE60 - Hamburg	3	3	0	2	3	11	RO32 - Bucharest-Ilfov	0.7	0.8	0.6	0.2	0.6	NO06 - Trondelag	0.6	1.2	0.6	0.8					
ITC3 - Liguria	2	3	0	3	3	11	FI20 - Aland	0.9	0.8	0.6	0.0	0.6	LU00 - Luxembourg	0.8	1.1	0.5	0.8					

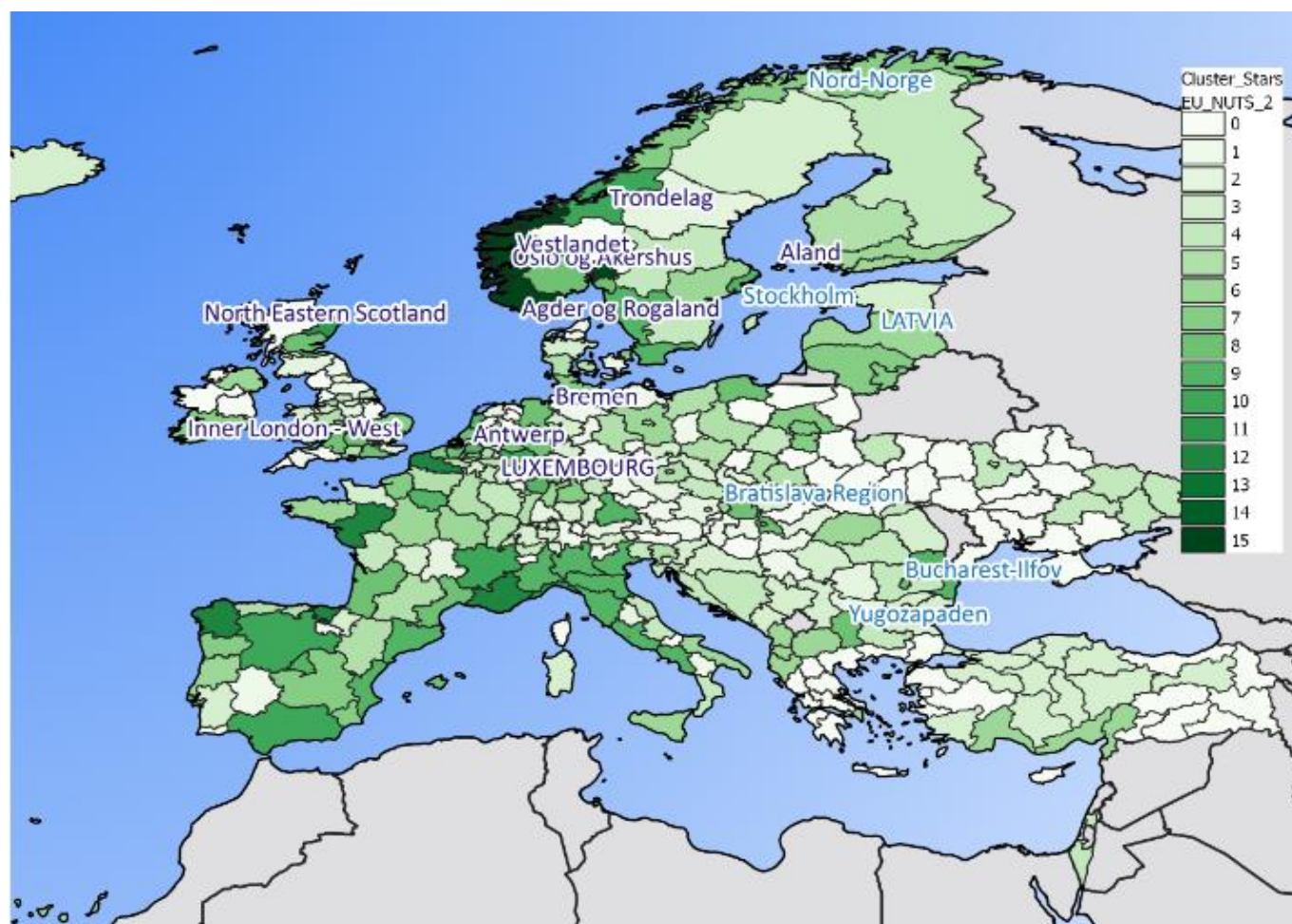
UKM5 - North Eastern Scotland is an 11 star region also.

Blue Growth industries are predictably concentrated at the coastal areas, although since the cluster also includes related and support industries, there are also some inland clusters. Blue Growth industries' share of total employment is the highest in Turkey, Norway, Ukraine, Kosovo, Iceland and Albania.

Overall, regions that have specialised in Blue Growth industries are not doing very well according to a number of economic indicators. They have the lowest employment growth, low labour force participation and high-technology employment, and medium and high technology exports. In addition, business

R&D expenditure and Patent Cooperation Treaty (PCT) patent applications are on a low level and there are few product and process innovators, or marketing and organisational innovators. However, the business start-up rate is higher than in regions that have specialised in some other emerging industry.

Figure 8. Cluster stars in Blue Growth industries



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded clusters in Blue Growth industries

Blue Growth industries include the fishing and fishing products, and electric power generation and transmission traded clusters, with the highest complementation

from maritime-related clusters in water transportation and environmental services.

In the fishing and fishing products traded cluster, four out of the five most specialised regions employ the highest numbers of persons, and the fifth one, Iceland, is not

far behind. These highly specialised regions are Albania, Galicia in Spain, and Nord-Norge and Vestlandet in Norway. The two

Norwegian regions are the leading regions, when we also consider the number of this

traded cluster's industry leaders and global frontier firms.

Table 12. Strong nations in the Fishing and Fishing Products traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
Japan, 28% ↑	Norway, 39% ↑	Norway, 41.5‰	Norway, 73.4‰ ↑	Norway, 107 k€ ↑
Norway, 22%	Denmark, 12% ↑	Iceland, 24.8‰ ↑	Iceland, 43.3‰ ↓	United Kingdom, 51 k€ ↗
Spain, 8% ↓	Japan, 11% ↑	Denmark, 9.1‰ ↑	Denmark, 21.1‰ ↑	Spain, 49 k€ ↑

Table 13. Strong nations in the Fishing and Fishing Products traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Norway, 17%	Spain, 19%	South Korea, 17%	Norway, 32.4‰	Latvia, 45.7‰	Norway, 29.8‰
South Korea, 15%	Portugal, 17%	Norway, 16%	Latvia, 28.3‰	Portugal, 16.4‰	Latvia, 24‰
Spain, 15%	South Korea, 13%	Italy, 14%	Estonia, 16.2‰	Estonia, 11.8‰	Estonia, 16.3‰

Cataluna, Piemonte and Western Finland have twelve stars for the electric power generation and transmission traded cluster. Kosovo and Ankara Sub-region have the highest number of employees, 44 000 and 30 000, respectively, among the specialised

regions in this cluster. Other than that, activities in this cluster are dispersed throughout the continent, although Ukrainian regions generally have high specialisation rates. On a global level, the profitability of the best American

companies appears to be on a level of their own: they collect over 70 per cent of the global profits in the cluster and have an average gross value added per employee of over 1.5 million euros.

Table 14. Strong nations in the Electric Power Generation and Transmission traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 34% ↑	United States, 71%	Germany, 1.9‰ ↓	Denmark, 4.2‰ ↑	United States, 1519 k€ ↑
Germany, 16% ↓	Spain, 8% ↓	Norway, 1.6‰	Norway, 2.9‰ ↑	Portugal, 447 k€
Japan, 10%	Japan, 6% ↑	Denmark, 1.6‰ ↑	United States, 2.1‰	Canada, 437 k€

Table 15. Strong nations in the Electric Power Generation and Transmission traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Italy, 12%	Spain, 13%	Germany, 13%	Bulgaria, 8.4‰	Bulgaria, 9.2‰	Latvia, 9.1‰
United Kingdom, 11%	Italy, 12%	Italy, 11%	Latvia, 7.6‰	Latvia, 8.7‰	Bulgaria, 8.6‰
Spain, 10%	United Kingdom, 12%	United Kingdom, 9%	Finland, 5.4‰	Finland, 6.9‰	Finland, 5.8‰

Similar to the fishing and fishing products traded cluster, the most specialised regions in water transportation also employ the highest numbers of persons. These

specialised regions are Vestlandet, Hamburg, South-East Romania, Agder og Rogaland and Adriatic Croatia. The two Norwegian regions, Vestlandet and Agder

og Rogaland, also have a high share of industry leaders and global frontier firms.

Table 16. Strong nations in Water Transportation traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
Japan, 26%	United Kingdom, 114% ↑	Norway, 9.2‰ ↓	Estonia, 33.2‰ ↑	Sweden, 245 k€ ↑
United Kingdom, 17% ↑	Sweden, 29% ↑	Switzerland, 6.1‰	Sweden, 29.1‰ ↑	Denmark, 106 k€
South Korea, 7% ↓	Switzerland, 21% ↑	Estonia, 5.5‰ ↓	Luxembourg, 27.8‰ ↑	Germany, 96 k€ ↗

Table 17. Strong nations in Water Transportation traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 24%	South Korea, 19%	South Korea, 26%	Norway, 16.7‰	Estonia, 12.2‰	Norway, 17.9‰
Italy, 14%	Italy, 16%	Italy, 13%	Estonia, 9.5‰	Lithuania, 8.9‰	Estonia, 9.1‰
Spain, 11%	Spain, 15%	Norway, 9%	Lithuania, 7‰	Bulgaria, 7.7‰	Lithuania, 6.7‰

Blue Growth industries development examples

Norway is a clear powerhouse of Blue Growth industries. Norway is the home of three 15 cluster star regions in the industry, Oslo og Akershus, Agder og Rogaland and Vestlandet. Moreover, Norwegian regions populate both the SME performance, industry leader and global frontier firm listings.

CLUSTER ORGANISATIONS SUPPORTING BLUE GROWTH INDUSTRIES IN NORWAY

NCE Seafood Innovation Cluster



The NCE Seafood Innovation Cluster was established in 2014 and is based in Bergen,

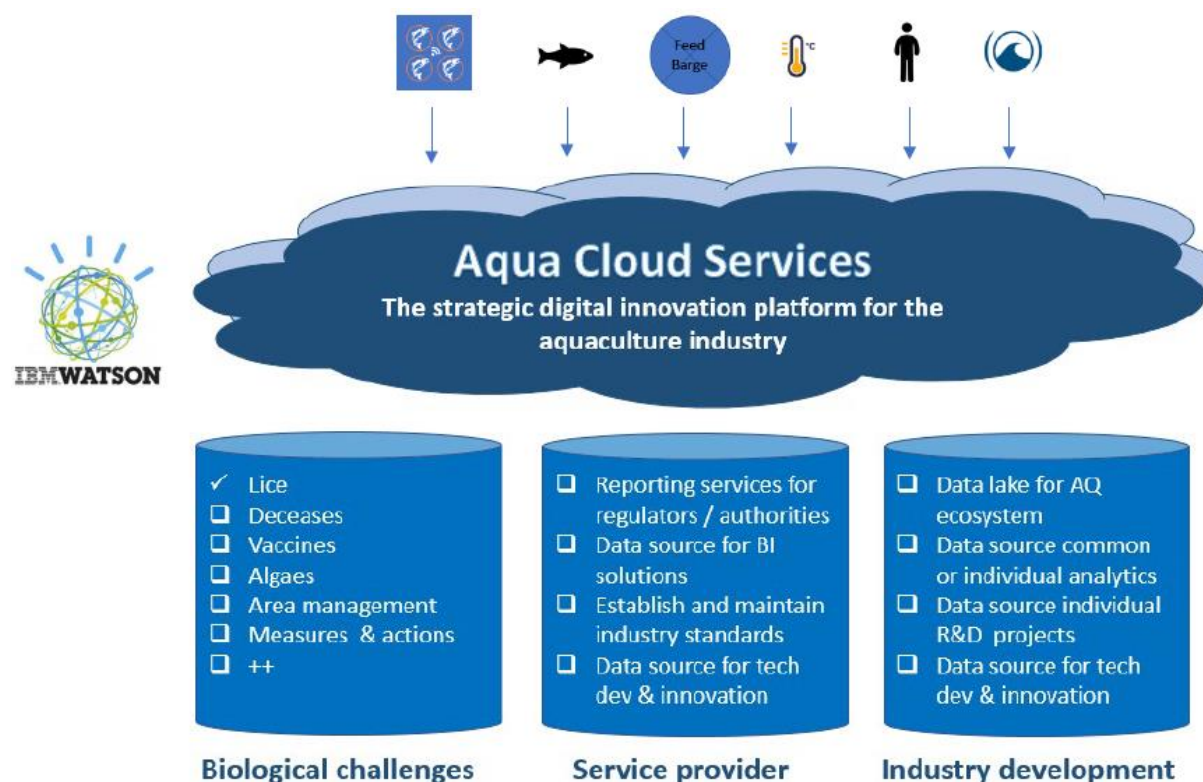
but its members represent the whole seafood value chain. It is a Norwegian Centre of Excellence (NCE) and has received the Cluster Excellence Bronze Label for its efforts towards improving its cluster management. The cluster has 37 members, including 20 SME and 17 larger company members.

The NCE Seafood cluster's goal is to improve its partners' environmental performance in the entire seafood value chain. Its focus is on ensuring better coordination and dissemination of R&D initiatives and strengthening collaboration within the cluster and between cluster actors and external partners. To support the cluster's partners, a new Innovation manager and R&D & Innovation Resource Group has been established. The cluster collaborates with a number of related clusters through a cluster to cluster program, a cooperative effort between EEA

and EU: Iceland Ocean Cluster, Scottish Aquaculture, Pole Aquimer and Instituto Português do Mar e da Atmosfera.

Together with a number of other parties, NCE Seafood established the Ocean Innovation Norwegian Catapult Centre (OINC) early in 2018. OINC is a national centre with a focus on the development of new solutions for growth and green readjustment within the ocean industries. It will be a test, simulation and visualisation centre where excellent expertise, infrastructure and network will be available for the ocean industries. The catapult centre will receive about Norwegian Krona (NOK) 40 million (ca. 4 million euros) from the Norwegian Catapult programme to support the first phase. The total budget of the centre is about NOK 84 million, around 9 million euros.

Figure 9. From fishing to data fishing – and back: Aqua Cloud Services in the aquaculture ecosystem



Source: NCE Seafood Innovation Cluster³⁵

Oslo Renewable Energy and Environment Cluster (OREEC)



OREEC was established in 2006 and is a hub of innovative cleantech companies, organisations and research institutes located in the Oslo region. The cluster has 80 regional partners and a wide range of collaborators in the whole cleantech sector in Norway. Its ambition is to contribute to the solution of societal challenges linked to climate change. It does this by using Norwegian cleantech and know-how to create green growth opportunities both in Norway and at the international level.

Similarly to NCE Seafood, OREEC collaborates with a number of other clusters: CLEAN in Denmark, ECO World Styria in Austria, ACLIMA and BioVale in Spain, BioBased Delta in the Netherlands, Lombardy Energy Cluster in Italy and with Cleantech Latvia.

CASE FIRM: STORMGEO

StormGeo started in 1997 as Storm Weather Center, a spinoff of Norway's largest commercial broadcaster, TV2. Meteorologist Siri Kalvig saw an opportunity to offer customized weather services to other industries, and she began a venture in collaboration with TV2. Today, the company is one of the largest privately held weather service providers worldwide.

It provides weather intelligence and decision support services worldwide to seven key industries: Shipping, Oil & Gas, Marine Operations, Renewables, Aviation, Cross Industry and Media. StormGeo is headquartered in Bergen, Norway, with 22 offices worldwide and 400 employees.

Since its inception, StormGeo has invested 20% of its revenues in research and development. Its staff includes over 250 operational meteorologists, data scientists and industry experts. The company operates seven 24/7 forecasting centres worldwide.

StormGeo has acquired a number of companies during the past ten years: in 2011 the Dubai-based weather forecasting

³⁵ Available at: <https://bioceed.uib.no/dropfolder/QASH/Aquacloud%20NCE.pdf> [Accessed 25 October 2018]

company, Met Consultancy FZ LLC; in 2012 the Houston-based company, ImpactWeather Inc; in 2014 Applied Weather Technology Inc, headquartered in Silicon Valley, California; in 2016 the Oslo-based Nena, a leading analysis house delivering energy market insights; and in

2018 the also Oslo-based maritime charts supplier Nautisk.

The future of shipping will include a number of ships operated from shore as well as fully autonomous ships. This is why StormGeo is moving towards integrating all

routing services more tightly with voyage planning and route transfer directly to ECDIS (Electronic Chart Display and Information Center). These acquisitions allow the company to integrate their routing and weather services with state-of-the-art charts and publications.

Creative industries



Employment	15 043 000 (2nd/10)	Wage premium (in clusters)	-2% (10th/10)
Average change	2.2% (2nd/10)	Average Gross Value Added	89 300 € (2nd/10)
Average wage	48 300 € (3rd/10)	Value added at Global Frontier firms	169 000 € (4th/10)
Average change	1.2% (2nd/10)	Average change	1.0% (9th/10)

Creative industries comprise activities related to the creation, production and/or distribution of creative goods and services as well as to the integration of creative elements into wider processes and other sectors. The term creative industries encompasses a broad range of activities in which the product or service contains a substantial element of artistic or creative endeavour.³⁶ Creative industries thus consist of activities drawing on advertising, architecture, art, crafts, design, fashion, film, music, performing arts, publishing, R&D, software, toys and games, TV and radio and video games. Creative industries

are a key sector in future European economy and has been growing faster than any emerging industry in the past two decades.

Creative industries employ more than 15 million people in Europe. In terms of subsectors, the employment in Creative industries are dominated by business services and marketing, design, and publishing activities. Music and video production are much smaller industries. Creative industries have the second highest employment growth rate among the emerging industries. This sector has the third highest average wage and gross value

added levels after Biopharmaceuticals and Digital industries.

Creative industries collaborate along the entire value chain. They are also highly customer and service oriented, which helps to access internal innovation processes of suppliers and clients. This contributes to spill-overs to and cross-innovation between other branches within the creative industries and to other industrial sectors. This catalytic innovation role and potential for reinforcing cross-sectoral fertilisation is also stressed by the European Commission Communication.³⁷

³⁶ UNESCO. 2006. Understanding Creative industries: Cultural statistics for public policy making.

³⁷ European Commission. 2012. Promoting cultural and creative sectors for growth and jobs in the EU, COM(2012)537. Available at <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52012DC0537>. [Accessed: 25 October 2018]

Table 18. Key regions in Creative industries

Cluster performance in detail: SME performance driven by high growth firms													Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms				
Cluster stars																	
Region	Size (0-3)	Speciali- sation (0-3)	Produc- tivity (0-3)	SME perform- ance (0-3)	Innova- tion leader (0-3)	Total stars (0-15)	Region	Turnov- er	Emple- yees	Assets	Start- ups	Avg	Region	Turnov- er	Profit	Value Add	Avg
BE21 - Antwerp	3	3	3	3	3	15	UKI3 - Inner London - West	2.0	2.0	2.4	1.0	1.8	UKI3 - Inner London - West	4.1	5.7	5.5	5.1
DE21 - Oberbayern	3	3	3	3	3	15	SE11 - Stockholm	1.6	1.7	1.5	1.6	1.6	SE11 - Stockholm	0.6	0.9	1.9	1.1
DE71 - Darmstadt	3	3	3	3	3	15	BG41 - Yugozapaden	1.5	1.8	1.2	0.5	1.3	NL32 - Noord-Holland	1.3	1.3	0.1	0.9
FR51 - Pays-de-la-Loire	3	3	3	3	3	15	FR10 - Ile-De-France	0.4	0.4	0.4	3.5	1.2	BE10 - Brussels-Capital Region	0.1	0.4	1.7	0.8
FR62 - Midi-Pyrenees	3	3	3	3	3	15	SK01 - Bratislava Region	1.1	1.4	1.0	0.6	1.0	PT30 - Regiao Autonoma da Madeira	1.1	0.7	0.4	0.7
NO01 - Oslo og Akershus	3	3	3	3	3	15	CZ01 - Prague	0.8	1.3	0.8	0.5	0.9	FR10 - Ile-De-France	0.5	0.5	1.3	0.7
UKI3 - Inner London - West	3	3	3	3	3	15	RO32 - Bucharest-Ilfov	0.9	1.1	0.8	0.3	0.8	UKI4 - Inner London - East	0.3	0.7	0.8	0.6
UKI4 - Inner London - East	3	3	3	3	3	15	FI1B - Helsinki-Uusimaa	0.9	0.8	0.8	0.6	0.8	LU00 - Luxembourg	0.7	0.4	0.6	0.6
UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	3	3	3	3	3	15	ES30 - Madrid	0.6	0.8	0.5	1.1	0.7	ES30 - Madrid	0.4	0.4	0.9	0.6
DEA2 - Koeln	3	3	3	2	3	14	ITC4 - Lombardia	0.3	0.4	0.3	2.0	0.7	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0.4	0.6	0.7	0.5

There are 4 other 14 star regions: DK01 – Hovedstaden, FR30 - Nord-Pas-De-Calais, NL32 - Noord-Holland and UKI7 - Outer London - West and North West.

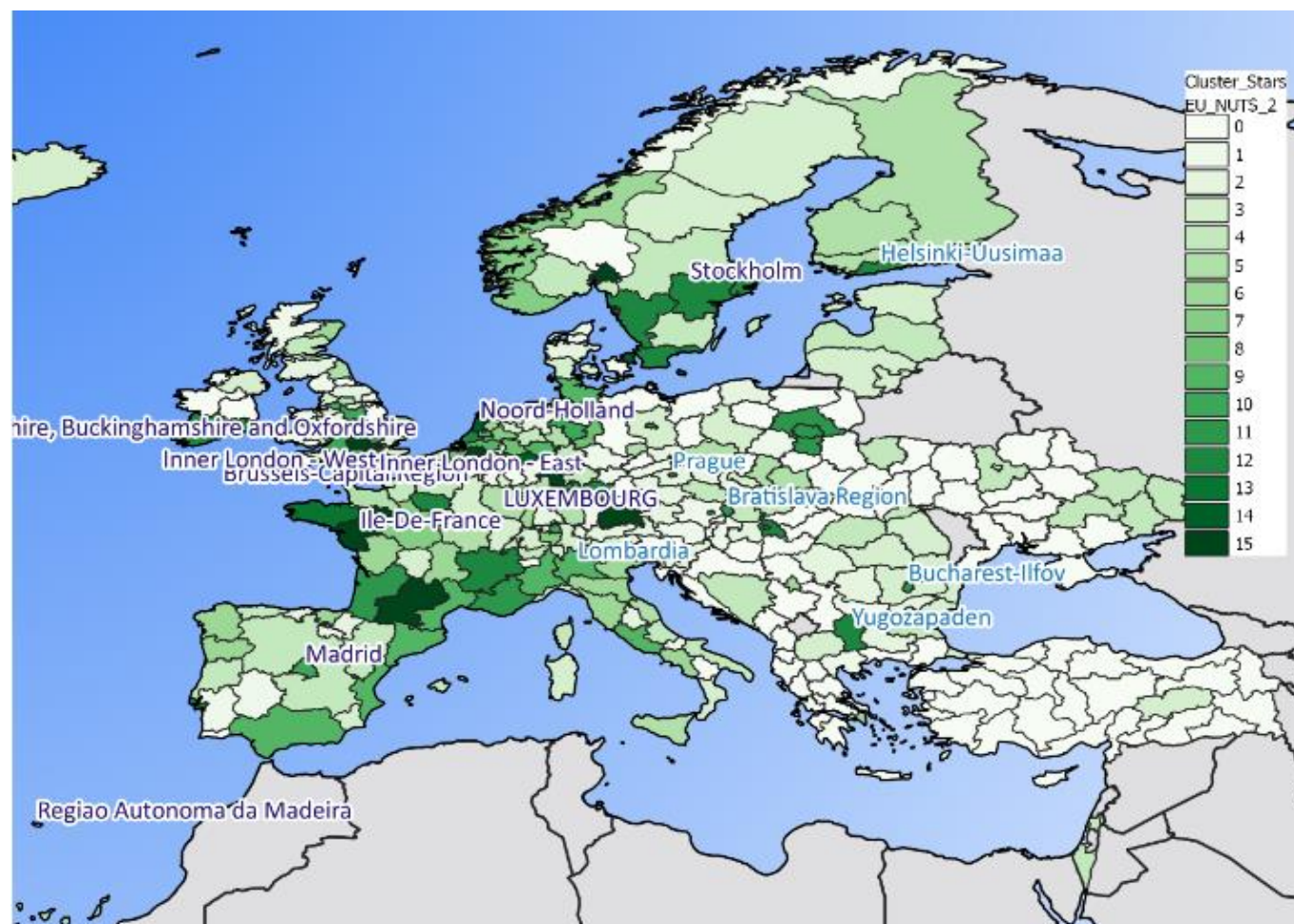
Creative industries are strongest in national capitals and large urban regions. In particular, Paris and London employ more than half a million creative workers each, remarkably both being among the most specialised regions. London is also the home of many of the industry leaders and high-growth firms in this industry. Berlin has over 200 000 employees in creative industries, and the third highest specialisation rate in Germany after Saarland and Hamburg.

As stated above, creative industries concentrate on capital areas and the regions specialised in this emerging industry perform well according to almost all economic indicators. They have the highest labour productivity, labour force participation rate, high-technology employment, digital engagement and the most product and process innovators.

These regions are characterized by strong concentrations of service innovation

intensive industries, marketing and organisational innovators, and high employment growth and low unemployment rates. In business R&D expenditure and number of Patent Cooperation Treaty (PCT) patent applications, these regions are second to the regions that have specialised in Digital industries.

Figure 10. Cluster stars in Creative industries



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded clusters in Creative industries

Creative industries includes the business services; marketing, design, and publishing; music; and video production traded clusters. In terms of employment, the first two dominate the others by having much higher shares. Being a member of the business services traded cluster correlates

with measures for service innovation intensity, high-tech employment, firm investments, internationalisation and IT employment. The specialised regions in business services are usually urban, particularly the country capitals. Other competitiveness indicators are generally

higher than for the regions in general, but similar to those of other emerging industries. London, Stockholm and Brussels are the regions with the highest numbers of industry leaders and global frontier firms per capita.

Table 19. Strong nations in the Business Services traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
Netherlands, 19%	United States, 17% ↗	Netherlands, 11.3‰	Netherlands, 6.7‰ ↓	Netherlands, 221 k€
Germany, 18% ↘	Germany, 15%	Denmark, 4.9‰ ↑	Denmark, 6.1‰ ↑	Canada, 120 k€
United Kingdom, 14%	United Kingdom, 13% ↓	Sweden, 4‰	Ireland, 5.7‰ ↑	Norway, 90 k€

Table 20. Strong nations in the Business Services traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
France, 11%	Italy, 12%	France, 11%	Sweden, 8.9‰	Sweden, 9‰	Sweden, 7.8‰
Italy, 11%	Spain, 10%	United Kingdom, 10%	Finland, 5.3‰	Bulgaria, 6.1‰	Finland, 4.6‰
United Kingdom, 10%	Sweden, 9%	Italy, 10%	Estonia, 5.1‰	Lithuania, 5‰	Estonia, 4.5‰

The story of the business services' specialised regions can be repeated for the strongest specialised regions in marketing, design, and publishing. The regions that belong to this traded cluster typically have

high measures for IT employment, service innovation intensity, high-tech employment, firm investments, high labour cost and labour productivity. The Mazowieckie region (i.e. Warsaw) has the second highest

number of employees, almost 60 000, among the specialised regions in this traded cluster. Paris is the leading specialised region, with over 163 000 employees.

Table 21. Strong nations in the Marketing, Design and Publishing traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Va Gross value added per employee
United Kingdom, 21%	United States, 27% ↑	Ireland, 5.8‰ ↓	United Kingdom, 3.7‰ ↓	Japan, 112 k€ N.A.
Japan, 20%	United Kingdom, 24% ↓	United Kingdom, 3.2‰	Norway, 2.9‰	United Kingdom, 110 k€ ↑
United States, 14% ↗	Japan, 16% ↑	Sweden, 2.1‰	Sweden, 2.6‰ ↘	Belgium, 109 k€ ↗

Table 22. Strong nations in the Marketing, Design and Publishing traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Italy, 12%	Spain, 14%	United Kingdom, 12%	Lithuania, 8.7‰	Latvia, 8.2‰	Lithuania, 7.1‰
Spain, 11%	Italy, 14%	Italy, 10%	Sweden, 7.2‰	Bulgaria, 7.9‰	Sweden, 6.8‰
United Kingdom, 10%	United Kingdom, 9%	Spain, 10%	Latvia, 7‰	Lithuania, 7.4‰	Norway, 6‰

Music and video production are much smaller industries and are harder to register, but again this is an area in which

United Kingdom in general and London in particular shine, together with Southern

and Eastern Ireland, Paris, Flemish Brabant, Berlin, Stockholm, Lazio and Madrid.

Creative industries development examples

There are three 15 cluster star regions in Creative industries in the UK, Inner London East and West, and Berkshire, Buckinghamshire and Oxfordshire. Moreover, the Inner London - West region tops both the SME performance, industry leader and global frontier firm listings.

CREATIVE INDUSTRIES POLICIES IN THE UK

The United Kingdom has a long and indisputably rich history of arts and culture. The first step towards institutionalisation of the creative industries in the UK was the *mapping of the creative sectors* carried out by the UK Department for Culture, Media and Sport (DCMS) in 1998. Since then, together with industry, the government has set up strategies aimed at creating growth, innovation and jobs across the creative sectors.

Statistics from the DCMS show that between 2010 and 2016, the creative industries sub-sectors increased their economic contribution by 45 per cent. Much of the growth is thought to be coming from the field of creattech, in which technology is used to enable creativity and vice versa. Within the creative industries, for example, the category for information technologies, software and computer services grew by 11.4 per cent in 2016, generating hope that emerging fields, such as virtual/immersive technologies, augmented reality and artificial intelligence, might spur further innovation and growth.³⁸

The original definition of creative industries in the UK was “those industries that have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property” and included advertising, architecture, the art and antiques market, crafts, design, designer fashion, film and video, interactive leisure software, music, the performing arts, publishing, software and computer services, television and radio.³⁹

In response to criticism of the definition and means of measuring the contribution of creative industries, there have been continuous efforts to improve conceptual understanding and data collection in order to determine the creative industries’ added value to the UK economy.

“During the last 25 years, the data side of the definition has been further refined, qualifying different categories. The current listing of creative sectors has not changed, but what has changed is the explosion of the growth e.g. in the business sectors like gaming, virtual reality and artificial intelligence. Previously, those sectors had been classified as software businesses, or businesses within computer services sector, for being recognised as creation of creative intellectual property. Now they are recognised within the DCMS’ sector. This relates to the change that has happened in the national level around the ONS (Office of National Statistics) definitions. The UK has

now established a framework for creative economy.”⁴⁰

In 2006, the UK government formally adopted the term “creative economy” to capture this sense of the wider contribution of the creative industries to economic and social life. The creative economy weaves together “economic and cultural values”.⁴¹

The *Creative industries Clusters Programme*, launched in 2018, plans to invest £80 million (ca. 90 million euros) in eight new creative research and development partnerships bringing together the UK’s creative industries with arts and humanities-led research from the UK’s university sector. The objective of the programme is to act as a catalyst to further growth of the creative economy by unlocking emerging fields and adapting new technologies with a new wave of R&D that will open up ways to create, distribute and participate in products and experiences. The programme is part of the government’s *Industrial Strategy Challenge Fund*, aiming at driving economic growth through the development of new products and services, generating a step-change in the creation of new jobs and the supply of high-value skills to fill them.⁴²

CASE FIRM: FESTICKET

The difficulties of arranging a trip to the Coachella festival in California inspired friends Zach Sabban, 33 and Jonathan Younes, 33, to start their business in 2012. The planning and booking process in 2011

³⁸ Creative industries Council. 2017. UK to the World: Facts and Figures. Available at: <http://www.thecreativeindustries.co.uk/uk-creative-overview/facts-and-figures>. [Accessed: 25 October 2018]

³⁹ UK Government. 1998. Creative industries Mapping Documents 1998. Available at: <https://www.gov.uk/government/publications/creative-industries-mapping-documents-1998>. [Accessed: 25 October 2018]

⁴⁰ Interview of Caroline Norbury, founder and Chief Executive of Creative England and member of the Creative industries Council, by Maria Lima-Toivanen, Technical Research Centre of Finland VTT, March 2018.

⁴¹ Newbiggin, J. 2010, The Creative Economy: An introductory guide. Creative and Cultural Economy series/1. British Council. Available at: https://creativeconomy.britishcouncil.org/media/uploads/files/English_GuideToolkit_30_withCover_LR.pdf. [Accessed: 25 October 2018]

⁴² Arts and Humanities Research Council, <https://ahrc.ukri.org/funding/apply-for-funding/archived-opportunities/creative-industries-clusters-programme/> [Accessed: 25 October 2018]

was painful, time consuming and very expensive, with questions like "Should we go camping, or stay at a hotel?", "Is this hostel convenient? Does it provide the best value for money?", "Should we go for the VIP ticket or the General Admission one?" and "Should we book local transportation?". They did not make it to Coachella that year. Instead, they started on a mission to gather the festival and live music community around a central booking platform to make things more open, aware

and connected. After a few weeks of brainstorming, Festicket was born.

Festicket is an innovative website that packages together festival tickets with travel, accommodation and add-ons to create complete festival trips that can be booked in one click. The company works with festivals as official partners so it can provide general admission and VIP tickets to some of the world's greatest festivals.

It has since secured £10.3 million (ca. 11.5 million euros) from investors such as Lepe Partners, PROfounders Capital and Wellington Partners to develop its online platform. Festicket sells tickets and packages to more than 1 000 festivals worldwide and recently reached the mark of 1 million customers. Last year, the company opened offices in Germany, Portugal and Holland and partnered with Eventbrite. Turnover reached £35.8 million (ca. 40 million euros) and its gross profit margin was 10%.

Digital industries



Employment	10 196 000 (5 th /10)	Wage premium (in clusters)	13% (1 st /10)
Average change	0.9% (4 th /10)	Average Gross Value Added	85 000 € (3 rd /10)
Average wage	48 800 € (2 nd /10)	Value added at Global Frontier firms	171 000 € (3 rd /10)
Average change	1.1% (4 th /10)	Average change	1.8% (6 th /10)

Digital industries cover some of the core sectors in the information age, combining services related to information technologies with the hardware they use. It is related to an increasingly cross-cutting technology and has become an element of most parts of economic activity. One of the dominant trends in the digital sector is the shift from hardware to software, and within the software area from product to service.

Digital industries have grown very fast during the past two decades and employs 10.2 million people compared to 7.3 million in 1996. Despite some overlap with Creative industries, Digital industries exhibit a very different enterprise structure, with firms generally being larger when compared to the other emerging industries. The industry mostly employs skilled workers, which is reflected in high

productivity numbers: the average wage is about 50% higher than in the economy at large. In addition, the average gross value added per employee is the second highest among the emerging industries, with only biopharmaceuticals having a higher one.

Table 23. Key regions in Digital industries

Cluster performance in detail: SME performance driven by high growth firms													Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms					
Cluster stars																		
Region	Size (0-3)	Speciali- sation (0-3)	Produc- tivity (0-3)	SME perform- ance (0-3)	Innova- tion leader (0-3)	Total stars (0-15)	Region	Turnov- er	Emple- yees	Assets	Start- ups	Avg	Region	Turnov- er	Profit	Value Add	Avg	
DE11 - Stuttgart	3	3	3	3	3	15	UKI3 - Inner London - West	1.4	1.4	1.7	0.6	1.3	UKI3 - Inner London - West	1.6	2.5	3.5	2.5	
DE21 - Oberbayern	3	3	3	3	3	15	SE11 - Stockholm	1.3	1.4	1.2	1.1	1.2	SE11 - Stockholm	0.6	0.7	2.2	1.2	
DE71 - Darmstadt	3	3	3	3	3	15	BG41 - Yugozapaden	1.1	1.4	0.9	0.4	1.0	LU00 - Luxembourg	1.2	0.7	1.2	1.0	
DEA1 - Duesseldorf	3	3	3	3	3	15	SK01 - Bratislava Region	0.9	1.2	0.9	0.5	0.9	BE10 - Brussels-Capital Region	0.3	0.6	1.4	0.8	
NO01 - Oslo og Akershus	3	3	3	3	3	15	ITC4 - Lombardia	0.3	0.4	0.3	2.0	0.8	NL32 - Noord-Holland	1.0	0.9	0.0	0.7	
SE11 - Stockholm	3	3	3	3	3	15	FR10 - Ile-De-France	0.3	0.3	0.3	1.9	0.7	BE24 - Flemish Brabant	0.2	0.2	1.6	0.6	
UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	3	3	3	3	3	15	CZ01 - Prague	0.7	1.1	0.7	0.3	0.7	NL23 - Flevoland	0.6	1.0	0.2	0.6	
UKJ3 - Hampshire and Isle of Wight	3	3	3	3	3	15	RO32 - Bucharest-Ilfov	0.8	1.0	0.7	0.3	0.7	FR10 - Ile-De-France	0.5	0.4	0.9	0.6	
DK01 - Hovedstaden	3	3	3	2	3	14	FI1B - Helsinki-Uusimaa	0.8	0.7	0.7	0.5	0.7	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0.4	0.6	0.7	0.6	
FI1B - Helsinki-Uusimaa	3	3	2	3	3	14	ES30 - Madrid	0.4	0.6	0.4	1.0	0.6	IE02 - Southern and Eastern	0.5	0.6	0.5	0.5	

FR10 - Ile-De-France is a 14 star region also.

The specialised clusters in Digital industries are concentrated in Austria, Germany, Israel, Netherlands, Switzerland and capital regions of the Nordic countries: Copenhagen, Helsinki, Oslo and Stockholm. The biggest regions are Lombardy, Stuttgart and Upper Bavaria, with 270 000, 237 000 and 157 000 employees. On the other hand, Israeli districts claim the highest specialisation rates.

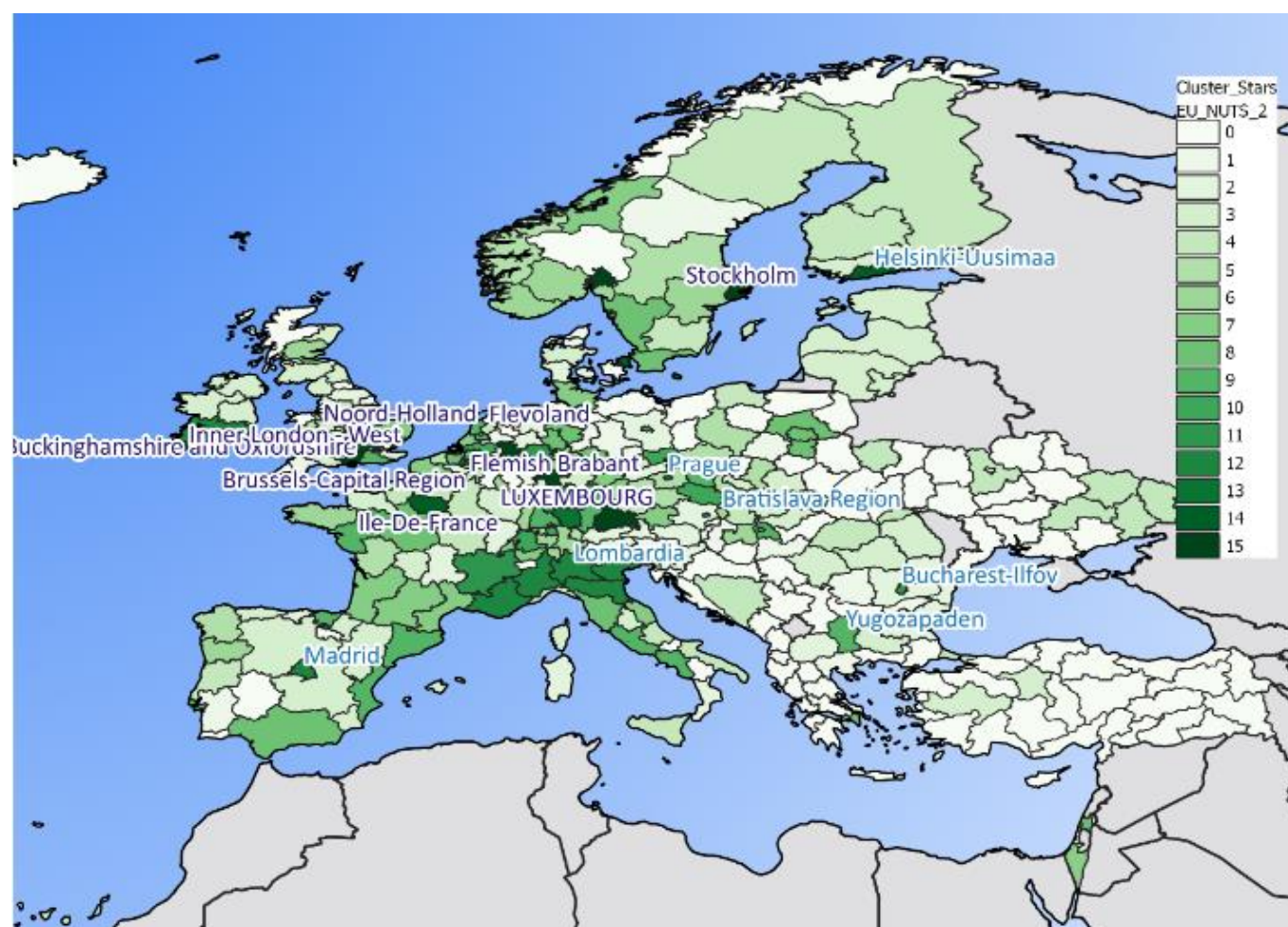
The regions specialised in Digital industries are characterised as having the highest business R&D expenditure, medium and high technology exports rate, 61%

compared to the general average of 48%, and number of Patent Cooperation Treaty (PCT) patent applications. Similarly, capital formation and scale-up rates are on a high level, whereas the start-up rate is the lowest among the specialised regions in other emerging industries. This suggests that these industries are capital intensive and have high entry barriers. These regions have low unemployment rates, and high employment growth and labour force participation rates. In addition, the regions specialised in Digital industries are characterized by strong concentrations of service innovation intensive industries,

marketing and organizational, and product and process innovators. In digital engagement and high-technology employment, these regions closely follow those that have specialised in creative industries.

Digital industries are the largest sector targeted by organised cluster efforts. There are 340 cluster organisations related to digital industries listed in the database of the European Cluster Collaboration Platform.

Figure 11. Cluster stars in Digital industries



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded clusters in Digital industries

Digital industries include the communications equipment and services, and information technology and analytical instruments traded clusters, with the highest complementation from the lighting and electrical equipment, and medical devices clusters.

Being a member of the communications equipment and services traded cluster

tends to be associated with high values for IT employment, high-tech employment, service innovation intensity and with a high ranking in the Composite Indicator of Industrial Change. In this traded cluster, the most specialised regions employ the most persons among these specialised regions. They are Southern and Eastern Ireland, and both the Central and Tel Aviv districts in Israel. These regions have 117 000, 40 000

and 26 000 employees in the cluster, respectively. They all have location quotient values of over 10, i.e. the regional cluster being 10 times as specialised as the average region. On a global level, the United States and Japan take the highest shares of turnover and profits. South Korea shines in the number of high growth firms.

Table 24. Strong nations in the Communications Equipment and Services traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 36% ↑	United States, 52% ↑	Luxembourg, 9.8‰	Luxembourg, 47.9‰ ↑	Australia, 317 k€ ↑
Japan, 12%	Japan, 19% ↑	Finland, 2.8‰ ↓	Switzerland, 1.8‰ ↑	Switzerland, 266 k€
United Kingdom, 10%	France, 6% ↓	Sweden, 2.4‰ ↓	Norway, 1.8‰ ↓	Luxembourg, 239 k€ ↗

Table 25. Strong nations in the Communications Equipment and Services traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 28%	South Korea, 21%	South Korea, 25%	South Korea, 5.4‰	Luxembourg, 4.3‰	Luxembourg, 4.9‰
United Kingdom, 13%	United Kingdom, 13%	United Kingdom, 17%	Estonia, 4.4‰	South Korea, 4‰	South Korea, 4.8‰
Spain, 10%	Spain, 12%	Spain, 9%	Luxembourg, 3.2‰	Bulgaria, 3.9‰	Estonia, 3.9‰

The regions that belong to the information technology and analytical instruments traded cluster typically rank high in measures for firm investments, business R&D expenditure, medium high tech exports, entrepreneurship and patent applications for key enabling technologies. In this traded cluster, the two most

specialised regions are from the Northern and Haifa districts of Israel, with 23 000 and 20 000 persons, respectively. Similarly to the communications equipment and services traded cluster, the specialised region with the highest number of employees is Southern and Eastern Ireland, with almost 80 000 employees. Other

specialised regions with high employment are the German regions Stuttgart and Upper Bavaria, with around 33 000 employees each. On a global level, the American companies are dominating the field, although Korean ones having a large share of the high growth firms.

Table 26. Strong nations in the Information Technology and Analytical Instruments traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 48% ↗	United States, 73%	Ireland, 3.9‰	Ireland, 3.1‰ ↑	Denmark, 149 k€ ↑
Japan, 25% ↘	Japan, 5% ↑	Netherlands, 2.2‰	Netherlands, 2.5‰ ↘	Netherlands, 139 k€ ↑
Germany, 5%	Germany, 5% ↓	Japan, 1.9‰ ↘	United States, 2.2‰	Belgium, 110 k€ ↑

Table 27. Strong nations in the Information Technology and Analytical Instruments traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 48%	South Korea, 41%	South Korea, 45%	South Korea, 9,4‰	South Korea, 8‰	South Korea, 8.9‰
Japan, 12%	Japan, 14%	Japan, 13%	Sweden, 2.4‰	Sweden, 2.9‰	Sweden, 2.5‰
France, 5%	France, 5%	France, 6%	Lithuania, 2‰	Slovenia, 2.3‰	Slovenia, 1.9‰

Digital industries development examples

Stockholm is a 15 cluster star region in Digital industries and the home for some of the industry leaders and high growth firms. It is second to Inner London - West region in both the SME performance, industry leader and global frontier firm listings.

IMPROVING DIGITAL SKILLS IN SWEDEN

The *Swedish Foundation for Strategic Research* is prioritising Information, Communication and Systems Technology and Computational Sciences and Applied Mathematics, in addition to three other life- and material science-related areas. The focus of the Information Communication and Systems Technology research area is placed on high-performing and well-functioning communications networks, not only for pure communications applications, but also as carriers of critical information for various purposes in electric power distribution (smart electricity networks), transport, health and the like. Computational Sciences and Applied Mathematics include sub-areas such as tools for high-performance computing, simulation and modelling, and applied and engineering mathematics.

Sweden launched a *Digital Skills and Jobs Coalition* in May 2018.⁴³ The partnership focuses on skills uptake and life-long

learning. It aims to raise interest in IT among young people and women, and implement the national strategy to digitalise the Swedish school system. The members of the coalition include the Government's Digitalisation Council, Swedsoft, the Swedish National Agency for Education, the Swedish Association of Local Authorities and Regions, the Association of Swedish Engineering industries, the Internet Foundation in Sweden and Swedish IT and Telecom industries.⁴⁴

Similarly, the Swedish Agency for Economic and Regional Growth funds the *Kickstart Digitalisering programme*, which aims to strengthen the digitisation and competitiveness of small and medium-sized industrial companies (SMEs) in Sweden. It seeks to harness the work of SMEs by forming a network and striving for better profitability through digitisation.⁴⁵

Skills360 is an initiative by the Swedish Agency for Government Employers. The programme aims to gather the entire labour market together to address the challenges caused by digitalisation. The stakeholders – the state, business, academy, start-ups and associations - are working on finding ways to deliver relevant skills to the labour market of today.⁴⁶

PHOTONICSWEDEN SUPPORTS DIGITAL INDUSTRY IN STOCKHOLM



The cluster organisation PhotonicSweden was founded in January 2011. It is located in Kista, between the Stockholm-Arlanda airport and central Stockholm. There are large research efforts in the area, which therefore is dubbed Kista Science City. The ICT cluster is particularly robust.

The main purpose of the cluster is to gather all different stakeholders under one roof, to be the voice that the Swedish photonics needs and to make photonics in Sweden grow even faster. The cluster has 51 company members including 33 SME, 14 larger company members and 4 universities and 110 personal members.

Swedish photonics ICT has a strong and long history driven by the big players Ericsson and the Swedish telecom operator, Telia, at an early stage focusing on and pioneering photonics, i.e. fibre optic communication systems and components. Large research programmes, also supported by the Swedish government, have laid the ground for the Swedish Photonics ICT industry of today. Although these larger organisations have moved up

⁴³ <https://ec.europa.eu/digital-single-market/en/news/sweden-launches-digital-skills-and-jobs-coalition-19th-coalition-europe> [Accessed: 25 October 2018]

⁴⁴ <http://www.digitaliseringsradet.se/en> [Accessed: 25 October 2018]

⁴⁵ <https://www.kickstartdigi.se/> [Accessed: 25 October 2018]

⁴⁶ <http://www.skills360.se/> [Accessed: 25 October 2018]

the value chain, new smaller companies have emerged, focusing in certain niche areas but covering altogether a whole value chain in the field from nano-electronics/ photonics via components and high-speed subsystems to fully converged fixed/mobile networks including network management. Today, the Swedish photonics community consists of over 245 high-tech companies with about 8 000 employees and many research groups all around the country.

From the start, PhotonicSweden has had strong support from the European Union. In September 2011, a three-year European project called InnoPho21 was started, which supported Photonics21 and five

other national technology platforms in Europe.

CASE FIRM: ACCEDO

Accedo was founded in 2004 by Michael Lantz and Fredrik Andersson on the basis of the observation that emerging technologies will transform how people watch television and consume video, but video service providers will struggle to keep up with the complexities of the new landscape. This insight led Accedo's founders to create a portfolio of experience-centric video solutions that shorten time-to-market and improve operational agility.

Today, Accedo is a video experience transformation pioneer, providing

applications, tools and services to media companies, consumer electronics and TV operators, to help them deliver the next-generation TV experience. The company is a global market leader in TV application solutions. Accedo's cloud-based platform solutions enable customers to cost-efficiently roll out and manage application offerings and stores for multiple devices and markets. Accedo customers include over 350 of the world's leading video service providers, such as Astro, Deutsche Telekom, Disney, Fox, HBO, NBC Universal, Netflix and Telefonica, among many others. The company has grown 1 000% in 5 years, with 2 000 video experience deployments from 18 offices around the world.

Environmental industries



Employment	8 931 000 (6 th /10)	Wage premium (in clusters)	3% (5 th /10)
Average change	1.1% (3 rd /10)	Average Gross Value Added	59 900 € (9 th /10)
Average wage	40 400 € (6 th /10)	Value added at Global Frontier firms	194 000 € (2 nd /10)
Average change	-0.2% (10 th /10)	Average change	2.4% (4 th /10)

Environmental industries comprise those industries that provide innovative products and services intending to influence positively the natural environment. They correspond to what the Organisation for Economic Cooperation and Development (OECD) and the EU's statistical office Eurostat call the "environmental goods and services industry", consisting of "activities which produce goods and services to

measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems.

This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use".⁴⁷ Among these are activities related to pollution control,

collection and treatment of waste and sewage, renewable energy, recycling/ recycled materials, sustainable water management and eco-construction. Environmental industries cut through all sectors of the economy as the need for more sustainable operations is increasingly realised, and thus have a high growth potential.

Table 28. Key regions in Environmental industries

Cluster stars													Cluster performance in detail: SME performance driven by high growth firms					Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms				
Region	Size (0-3)	Specialisation (0-3)	Productivity (0-3)	SME performance (0-3)	Innovation leader (0-3)	Total stars (0-15)	Region	Turnover	Employees	Assets	Start-ups	Avg	Region	Turnover	Profit	Value Add	Avg					
NO01 - Oslo og Akershus	3	3	3	3	3	15	BG41 - Yugozapaden	0.8	1.0	0.7	0.6	0.8	UKI3 - Inner London - West	1.2	1.5	1.4	1.4					
DE11 - Stuttgart	3	3	3	2	3	14	ITC4 - Lombardia	0.3	0.3	0.2	1.4	0.5	LU00 - Luxembourg	1.0	0.8	0.3	0.7					
DE13 - Freiburg	3	3	3	1	2	12	RO32 - Bucharest-Ilfov	0.5	0.7	0.5	0.4	0.5	NO01 - Oslo og Akershus	0.3	1.0	0.4	0.6					
DE71 - Darmstadt	3	0	3	3	3	12	CZ01 - Prague	0.5	0.7	0.4	0.2	0.5	NL34 - Zeeland	0.8	0.8	0.0	0.5					
DEA1 - Duesseldorf	3	0	3	3	3	12	UKI3 - Inner London - West	0.4	0.4	0.4	0.6	0.4	CH05 - Ostschweiz	0.6	0.6	0.4	0.5					
FR10 - Ile-De-France	3	0	3	3	3	12	LV00 - Latvia	0.5	0.6	0.4	0.3	0.4	NL32 - Noord-Holland	0.6	0.8	0.1	0.5					
ITC4 - Lombardia	3	3	0	3	3	12	SE11 - Stockholm	0.4	0.4	0.3	0.6	0.4	SE32 - Middle Norrland	0.1	0.5	0.9	0.5					
NO04 - Agder og Rogaland	3	3	1	2	3	12	SE23 - West Sweden	0.5	0.5	0.4	0.3	0.4	NO04 - Agder og Rogaland	0.1	0.6	0.6	0.5					
DE21 - Oberbayern	3	0	3	2	3	11	SK01 - Bratislava Region	0.5	0.7	0.4	0.1	0.4	NL33 - Zuid-Holland	0.8	0.5	0.0	0.5					
DEA2 - Koeln	3	0	3	2	3	11	BG33 - Severoiztochen	0.5	0.6	0.4	0.1	0.4	BE10 - Brussels-Capital Region	0.2	0.4	0.7	0.4					

DEA5 – Arnsberg is an 11 star region also.

⁴⁷ The Environmental Goods and Services industry, Manual for Data Collection and Analysis, OECD and EUROSTAT, 1999

Environmental industries are the most cross-cutting of the ten emerging industries, containing parts from 21 of the 51 traded industry sectors. The main sub-sectors are electric power generation and transmission; material and energy efficiency; waste management; reuse, recycling and remanufacturing; environmental services; water; and environmental protection. Environmental industries include services, technologies and processes that can serve or create value for any industrial sector. For example, material and energy efficiency services can be applied in any manufacturing sector.

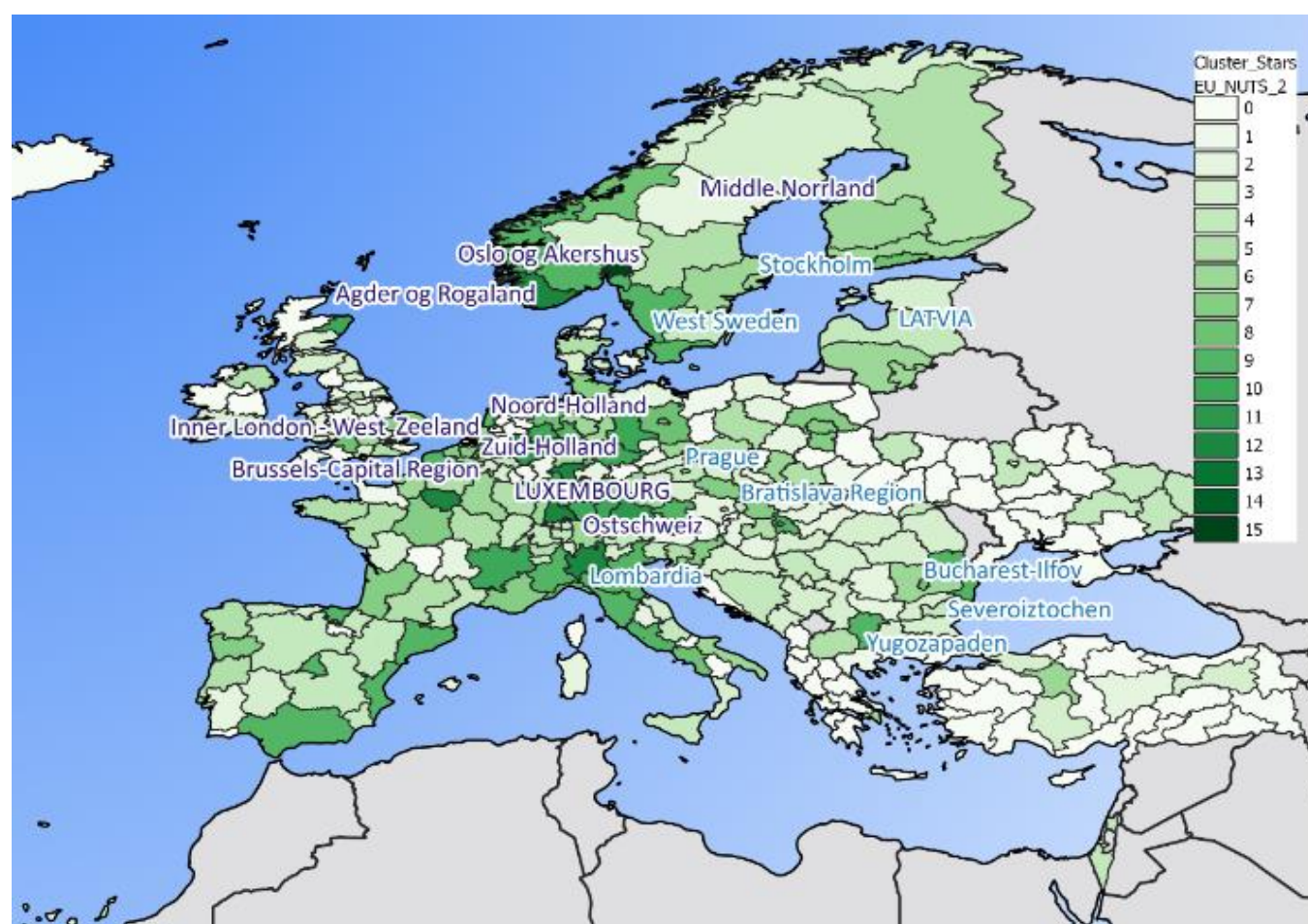
The specialised clusters in environmental industries are concentrated in Norway, with five out of its seven regions having a high location quotient in this area, and in southern Germany with 14 specialised clusters. Other specialised clusters are located nearby: in Austria, Bosnia Herzegovina, Macedonia, Montenegro, Serbia and Slovenia. Although the regions in the Netherlands do not show up as specialised clusters in this industry, a number of industry leaders locate there.

Overall, regions that have specialised in environmental industries are characterised as having the highest capital formation but

a low scale-up level, suggesting that these industries are capital intensive process industries. In addition, Patent Cooperation Treaty (PCT) patent applications are filed relatively frequently. These regions have a high employment growth rate; other employment-related measures are on the average level.

Environmental industries are the second largest sector targeted by organised cluster efforts. There are 234 cluster organisations related to environmental industries listed in the database of the European Cluster Collaboration Platform.

Figure 12. Cluster stars in Environmental industries



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded cluster in Environmental industries

In the environmental services traded cluster, the list of specialised regions with the highest number of employees is dominated by UK regions. Nine out of twelve regions come from the United Kingdom. The three regions with the highest number of employees are Shropshire and Staffordshire together, and the western and north-western regions of Outer London, with 67 000, 33 000 and

30 000 employees, respectively. On the other hand, North Eastern Scotland has the highest specialisation rate of 12.6 and over 20 000 employees in this cluster. The highest number of stars, 12, can be found in Paris (Ile-De-France), Emilia-Romagna and Provence-Alpes-Cote D'Azur regions.

When we look at smaller regions, we can note that seven out of the eight Romanian

regions are specialized ones. On average, each of them have about 9 000 employees in the environmental services cluster. These areas also have large shares of high growth firms. The regions that belong to the environmental services traded cluster typically high labour cost in manufacturing and in general and show plenty of entrepreneurial activity.

Table 29. Strong nations in the Environmental Services traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
France, 36%	United Kingdom, 26% ↓	France, 5.3‰	Estonia, 4.4‰ ↓	United States, 239 k€ N.A.
United Kingdom, 17%	France, 15% ↑	Belgium, 2.6‰ ↗	United Kingdom, 3.9‰ ↓	United Kingdom, 194 k€ ↘
Germany, 8%	United States, 14% ↑	United Kingdom, 2.6‰	Chile, 3‰	Germany, 125 k€ ↑

Table 30. Strong nations in the Environmental Services traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Italy, 13%	Romania, 16%	Romania, 13%	Lithuania, 9.2‰	Latvia, 8.4‰	Latvia, 8.5‰
Romania, 13%	Italy, 15%	South Korea, 11%	Latvia, 8.6‰	Romania, 8.3‰	Lithuania, 8.4‰
South Korea, 11%	South Korea, 9%	Italy, 10%	Estonia, 8.5‰	Lithuania, 6.1‰	Estonia, 7.7‰

Environmental industries development examples

The Netherlands populates a number of Environmental industry leaders. Three Dutch regions, Zeeland, Noord-Holland and Zuid-Holland belong to the top 10 regions of the industry leader and global frontier firm listing.

WATERCAMPUS LEEUWARDEN ENHANCES CRITICAL MASS IN INNOVATION ECOSYSTEMS WITH A FOCUS ON WATER TECHNOLOGY



Wetsus, the European centre of excellence for sustainable water technology, was organized in 2003 to stimulate collaboration between the various public and private organizations that together constitute the water sector. As per January 1, 2018, 104 companies annually invest some €3.3 million euros in the demand-driven 14.5 million euros/year research programme, with a long-term commitment.

The current Wetsus international know-how network includes about 125 partners from all over the world. Companies together determine the research programme, which is executed in the Wetsus laboratory by the 22 involved research institutes. All research projects

are performed under the responsibility of the participating universities. As per January 2018, 50 scientific chairs from all over Europe are involved. Wetsus is very pro-active in cooperation, with a focus on southern, central and eastern Europe. The main countries targeted are Latvia, Netherlands, Portugal and Romania.

WaterCampus Leeuwarden is the meeting point of the Dutch water technology sector and has the ambition to play a sector uniting role for the rest of Europe as well. Together with Wetsus, it strives to stimulate the translation of know-how into business. This has resulted in several demonstration projects of new technological concepts and in the fact that

56 companies have started their business in and around WaterCampus Leeuwarden since 2003. Of these 56 companies, 33 are spin-off companies.

Wetsus and WaterCampus Leeuwarden work closely with organizations such as Bison, EIP-Raw Materials, BeStart, NWP, Water Alliance and Syntens. The objective is to create an innovative and entrepreneurial environment facilitating the access to seed and venture capital in a dedicated way for the water sector. They organise business education and co-offer the BeStart business accelerator program for spin-offs from Wetsus and universities and for other small water technology companies.

Wetsus was the coordinator of the “Energy in Water” project – a European Strategic Cluster Partnership for going international supported by the EU’s COSME programme, which has won the EU Cluster Partnership of the Year Award in 2016. The Wetsus spin-off RedStack was also chosen as national innovation icon in 2016 and SaltTech won an innovation award in Abu Dhabi in 2017.

REDSTACK, NATIONAL ICON FOR 2016

RedStack is a spin-off company from Wetsus, scaling up and commercializing Blue Energy. National innovation icon is the title of the awards for the best technological solutions for societal problems that RedStack had received. The jury underlined the innovative character, contribution to sustainability and economical potential of RedStack and its technology.

First, RedStack uses the energy produced by salt and fresh water in Reverse Electrodialysis (RED). When a small quantity of fresh water is added to salt water in a membrane pile (a stack), osmotic energy is generated. This clean energy can be produced wherever rivers run into the sea, which where many of the world’s cities are located.

The pilot installation of Blue Energy is located on the closure dam Afsluitdijk, the Netherlands, and produces electricity directly from the difference in salt concentration in the surface water on each side of the dam. Blue Energy has the advantage that it can be generated continually, contrary to solar and wind energy, which are both dependent on availability and on the weather.

SALTTECH, WINNER OF INNOVATE@IWS

Salttech won the innovation prize Innovate@IWS in the International Water Summit 2017 in Abu Dhabi. Industrial water users face increased pressure to reduce freshwater consumption and improve the quality of their effluent. Salttech’s Zero liquid discharge technology is an important tool for the purpose. Salttech is rapidly expanding its reference base in various industries and municipalities all over the world. Applications include the food industry, drinking water and up- and downstream process industries.

The company’s Dynamic Vapor Recompression (DyVaR) water processing system uses evaporative and cyclonic technologies to separate out salts and other components, recovering almost all of the clean water, up to 97 per cent, from any high chloride water containing dissolved salts and other contaminants. The remaining 3 per cent is discharged in the form of solid salts and minerals. A standard DyVaR system can handle any salt concentration and can produce any brine concentration, depending on local requirements or user specifications.

Experience industries



Employment	15 989 000 (1st/10)	Wage premium (in clusters)	0% (8th/10)
Average change	2.7% (1st/10)	Average Gross Value Added	84 300 € (4th/10)
Average wage	38 100 € (8th/10)	Value added at Global Frontier firms	142 000 € (6th/10)
Average change	0.9% (5th/10)	Average change	1.3% (8th/10)

Experience industries employ 16 million people in Europe and have the highest employment growth rate among the emerging industries. Experience industries cover creation and consumption of “experiences” and are composed of millions of SMEs at the intersection of arts

and business. Experience industries include activities traditionally associated with the sectors of tourism, culture, or leisure, in particular related to “the creation and operation of visitor attractions such as museums, galleries, science centres, heritage sites, zoos and aquaria and theme

parks”, building on capabilities in “feasibility, architecture, construction, exhibit design, interpretation, equipment supply or management consultancy”.⁴⁸

The creative aspect of the experience economy relates to creative and cultural

Table 31. Key regions in Experience industries

Cluster performance in detail: SME performance driven by high growth firms													Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms					
Cluster stars																		
Region	Size (0-3)	Speciali sation (0-3)	Produc tivity (0-3)	SME perform ance (0-3)	Innova tion leader (0-3)	Total stars (0-15)	Region	Turnov er	Empl oyees	Assets	Start- ups	Avg	Region	Turnov er	Profit	Value Add	Avg	
DE21 - Oberbayern	3	3	3	3	3	15	UKI3 - Inner London - West	1.9	1.9	2.2	1.8	2.0	UKI3 - Inner London - West	4.0	6.1	6.1	5.4	
FR10 - Ile-De-France	3	3	3	3	3	15	BG41 - Yugozapaden	1.6	1.9	1.2	0.4	1.3	LU00 - Luxembourg	1.3	1.3	1.0	1.2	
FR71 - Rhone-Alpes	3	3	3	3	3	15	SK01 - Bratislava Region	1.1	1.3	1.0	0.5	1.0	SE11 - Stockholm	0.5	0.6	1.5	0.9	
FR82 - Provence-Alpes-Cote D'Azur	3	3	3	3	3	15	SE11 - Stockholm	1.0	1.1	1.0	0.8	1.0	IE02 - Southern and Eastern	0.6	0.8	0.7	0.7	
DE71 - Darmstadt	3	3	2	3	3	14	FR10 - Ile-De-France	0.3	0.2	0.3	2.5	0.8	ES53 - Islas Baleares	0.6	0.6	0.8	0.7	
FR51 - Pays-de-la-Loire	3	3	3	2	3	14	PT15 - Algarve	0.9	1.1	0.8	0.1	0.7	UKI4 - Inner London - East	0.6	0.6	0.8	0.7	
AT13 - Wien	3	3	3	1	3	13	ITC4 - Lombardia	0.4	0.4	0.3	1.9	0.7	UKH2 - Bedfordshire and Hertfordshire	0.8	0.9	0.3	0.7	
FR61 - Aquitaine	3	3	3	2	2	13	RO32 - Bucharest-Ilfov	0.9	1.0	0.7	0.2	0.7	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0.5	0.7	0.7	0.6	
FR62 - Midi-Pyrenees	3	3	3	2	2	13	ITI4 - Lazio	0.5	0.5	0.4	1.3	0.7	BE10 - Brussels-Capital Region	0.3	0.4	1.1	0.6	
FR81 - Languedoc - Roussillon	3	3	3	2	2	13	NO01 - Oslo og Akershus	1.0	0.0	1.0	0.7	0.7	NL32 - Noord-Holland	0.8	0.7	0.0	0.5	

There is one other 13 star region: SE11 – Stockholm.

⁴⁸ Experience UK. 2010. A guide to the UK's creative excellence in visitor attractions, UK Trade & Investment. Available at: <https://www.gov.uk/government/publications/experience-uk-a-guide-to-creative-excellence-in-visitor-attractions> [Accessed: 25 October 2018]

industries, and comprises activities resulting in creation of cultural artefacts.

This area is traditionally based on design and artistic creation, although in recent years the role of software and web sites has become increasingly more prominent. Creation also relies on its own set of support industries, including e-commerce, software publishing and management consultancy.

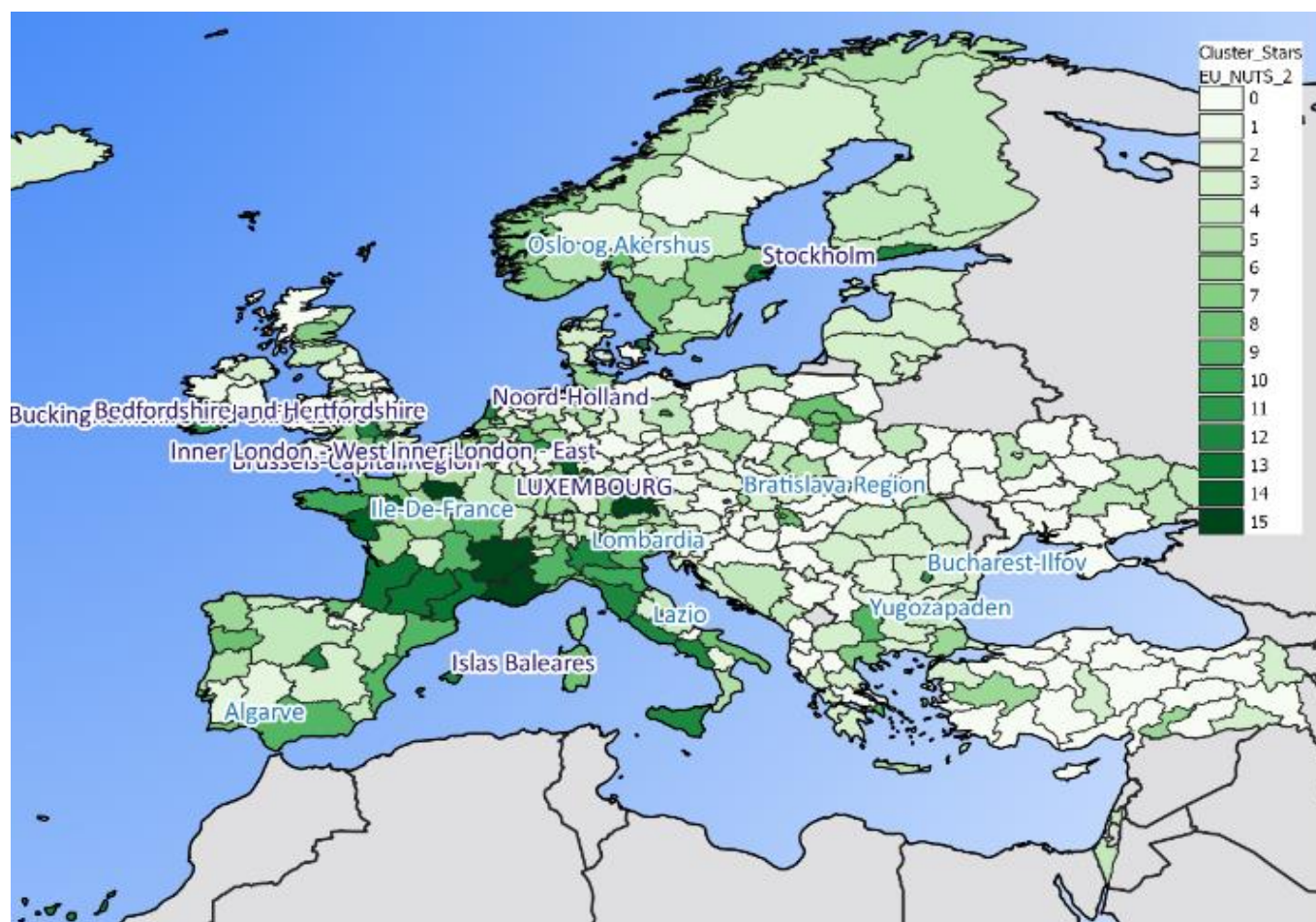
The consumption part of experience industries relates to hospitality, tourism and performing arts, and in particular refers to activities that can be performed on the spot, such as visiting sport events,

theme parks, museums, theatres and galleries. This aspect also relies substantially on support industries, particularly on retail trade and passenger transportation. Water transport could often serve both the main and the support functions, exemplified by the leisure boats. The regions specialised in experience industries include traditional touristic regions in France, Greece, Italy, Malta, Spain and Turkey, but also capital regions such as Paris and Stockholm. This leads to somewhat mixed results in the experience industries' economic indicators.

For example, the regions specialised in experience industries have the highest

scale-up and the second highest start-up rates among the regions specialised in any of the emerging industries. On the other hand, these regions are characterised by having the lowest medium and high technology exports rate, and capital development. Moreover, these regions have the highest unemployment rates and low employment growth and labour force participation rates. In addition, the regions specialised in experience industries are characterised by low digital engagement, small business R&D expenditure and few Patent Cooperation Treaty (PCT) patent applications.

Figure 13. Cluster stars in Experience industries



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded clusters in Experience industries

Experience industries include the hospitality and tourism, and performing arts traded clusters. In the hospitality and tourism traded cluster, five out of the eight specialised regions with highest numbers of

employees are in France. The biggest of these regions are Paris, Rhone-Alpes and Provence-Alpes-Cote D'Azur, with 634 000, 216 000 and 146 000 employees, respectively. Only Lazio comes between,

with almost 300 000 employees in hospitality and tourism. The Spanish region Islas Baleares hosts a particularly large number of this cluster's industry leaders and global frontier firms.

Table 32. Strong nations in the Hospitality and Tourism traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 23% ↗	United States, 32% ↓	Denmark, 9.5‰ ↓	Malta, 13.6‰ ↑	Greece, 168 k€ ↓
Japan, 17% ↑	United Kingdom, 21% ↑	Malta, 3.1‰ ↑	Sweden, 7.9‰	Denmark, 103 k€ ↓
United Kingdom, 15% ↓	Japan, 15% ↑	United Kingdom, 2.3‰ ↓	Switzerland, 4.3‰ ↑	Belgium, 99 k€ ↑

Table 33. Strong nations in the Hospitality and Tourism traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Italy, 18%	Italy, 19%	Italy, 17%	Bulgaria, 12.2‰	Bulgaria, 14.1‰	Norway, 9.9‰
Spain, 15%	Spain, 17%	Spain, 14%	Norway, 7.2‰	Latvia, 5.6‰	Bulgaria, 8.1‰
Bulgaria, 9%	Bulgaria, 10%	United Kingdom, 9%	Lithuania, 5.4‰	Portugal, 5.2‰	Lithuania, 4.8‰

In the performing arts traded cluster, the French presence is even stronger: seven out of the ten specialised regions with highest numbers of employees are in France. The biggest of these regions are Paris, Rhone-Alpes and Pays-de-la-Loire,

with 442 000, 82 000 and 60 000 employees, respectively. France dominates the cluster star ranking with top five regions being located in France also. On the other hand, the UK region Inner London - West has the highest share of industry

leaders, global frontier firms and high-growth firms among all regions. Being a member of this traded cluster correlates with high values for interaction with public authorities, internationalisation and amount of internet purchases.

Table 34. Strong nations in the Performing Arts traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United Kingdom, 35%	United Kingdom, 164% ↓	United Kingdom, 5.2‰	United Kingdom, 24.8‰ ↓	United Kingdom, 103 k€
Japan, 17% ↑	Japan, 42% ↑	Sweden, 3.9‰ ↓	Norway, 21.2‰ ↑	Germany, 42 k€ ↑
France, 8% ↓	Norway, 11% ↑	Austria, 3.4‰ ↓	Austria, 4.7‰ ↑	Italy, 30 k€

Table 35. Strong nations in the Performing Arts traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Italy, 25%	Italy, 27%	Italy, 23%	Lithuania, 14.9‰	Lithuania, 8‰	Lithuania, 11.6‰
Spain, 13%	Spain, 17%	France, 12%	Latvia, 8.5‰	Sweden, 5.2‰	Norway, 10.9‰
France, 12%	France, 13%	Spain, 11%	Norway, 7.7‰	Latvia, 4.6‰	Sweden, 4.9‰

Experience industries development examples

There are three 15 cluster star regions in Experience industries in France, Ile-De-France (Paris) region being one of those (together with FR71 - Rhone-Alpes and FR82 - Provence-Alpes-Cote D'Azur). Moreover, the Ile-De-France region has the highest number of rapidly growing start-ups in the industry.

CAP DIGITAL AND SYSTEMATIC PARIS-REGION SUPPORT EXPERIENCE INDUSTRIES IN ILE-DE-FRANCE

Cap Digital



Created in 2006 as a non-profit organisation, Cap Digital is the French Hub for digital and ecological transformation, and the biggest cluster organisation in Europe with more than 1 000 members; mostly innovative SMEs but also large companies, major universities, research labs and investors. Since 2014, it has been certified as a Cluster of Excellence (Gold Label). It focuses on six markets: EdTech & Talents, eHealth & Well-being, Cultural & Creative industries, Sustainable City, Industry & services, Technologies, Data & AI.

Cap Digital supports research and innovation by providing personalised support to its members (information, expertise, certification). Cap Digital also provides its members with networking and matchmaking opportunities, business coaching, training courses, open innovation programs, and intelligence through market and technology watch and forecast.

The cluster has been involved in over 20 European projects since 2006, and is currently running nine of them. It is also a member of powerful European networks such as the NEM initiative (European Technology platform dedicated to digital content), EBN (European Business Network) and two KICs: EIT Digital and EIT

Health. Cap Digital participates in INNOSUP-1 cluster project INNOLABS, which aims for leveraging cross capacity building between ICT, Health, BIO and Medicine sectors for new emerging industries in personalized health.

Every year in June, Cap Digital organises Futur.e.s, the European largest free digital Festival showcasing the latest French and international digital innovations to both the professionals and the general public with the aim of imagining tomorrow's world. The 2018 edition attracted more than 12 000 attendees around an exhibition area, with conferences led by visionaries and labs. In 2016, Cap Digital created EdFab, a 350m² facility in the north of Paris dedicated to promoting innovation in the fields of education, training and jobs transformation.

Systematic Paris-Region



With its Open Innovation focus, the Systematic Paris-Region international competitiveness cluster was established in 2005 to bring together and promote an ecosystem of excellence that includes over 800 members, including 480 SME and 150 larger company members. Systematic connects stakeholders from software, digital and industry and boosts digital projects through collaborative innovation, SME development, networking and business sourcing, across a range of future growth sectors: energy, telecoms, healthcare, transport, information systems, factory of the future, digital city and security. Technology fields focus on embedded and real time systems, and advanced systems architecture.

The cluster promotes its members, its region and its innovation projects, with the aim of raising their profile and enhancing the attractiveness of the geographical territory and ecosystem. The main

countries targeted are China, India, Morocco, Singapore and the United States. Systematic collaborates with DSP Valley in Leuven, Belgium; Digital Cluster in Barcelona, Spain; and Bicc Net in Munich, Germany in European Strategic Cluster Partnerships for Going International (ESCP-4i) projects SmartCityTech, Internationalisation of cross-domain Smart City Solutions powered by ICT (sensor systems, data processing platforms) and European SmartCityTech Go Global.

CASE FIRM: PARIS SAINT-GERMAIN (PSG)

French football has recently seen the arrival of foreign investors: the sovereign Al Thani family of Qatar to Paris Saint-Germain (PSG) and the Russian oligarch Dmitry Rybolovlev to the Association Sportive de Monaco. In 2013, PSG made a sponsorship deal with the Qatar Tourism Authority (QTA), which would net the club up to 200 million euros a year.

During the 2015/2016 season, PSG generated 521 million euros in revenues. The club was 6th among the 20 most powerful football clubs in the world. However, a worsening of on-pitch performance in 2016/17, as PSG finished second in Ligue 1 and only reached the Round of 16 in the Champions League, was reflected in a decrease in revenue by 35 million to 486 million euros. The high profile signings of both Neymar Jr. and Kylian Mbappé reflected a very clear desire

of PSG to regain their superiority in France and to aim to win the Champions League.⁴⁹

Since its acquisition by Qatar Sports Investments (QSI) in June 2011, PSG has set in motion a strategy to compete with the biggest sports brands in the world. The strategic objective is to make PSG a powerful and global professional sports brand like the New York Yankees or Real Madrid. PSG wants to become a brand of entertainment expected to go beyond the strict framework of sport.⁵⁰

In the goal of enriching its brand, PSG has come to represent multiple types of sports. It prides itself as being the first among the European giants to have moved from a

single-brand focus to include other types of sports. To this aim, in October 2016, PSG created a professional Dota 2 team based in China. The decision to invest in eSports is part of the international development strategy and the project to digitise the club. eSports has become ever more popular among young fans and in particular millennials. The global eSports audience was expected to reach 380 million in 2018, with 165 million enthusiasts.⁵¹ With the creation of the eSports team, PSG intends to strengthen its ties with millions of passionate fans, attract new consumers and enhance the brand globally. Using this growing phenomenon, the club also wants to reinforce the internationalization of the brand, especially in Asia. Besides France,

the club has youth development programmes in Canada, the United States, Brazil, England, Portugal, Morocco, Lebanon, Egypt, India, Indonesia and Saudi Arabia.

After QSI acquired the club, PSG and SportFive, an international sports marketing agency owned by the French media group Lagardère Unlimited, ended their exclusive partnership. Since then, the size of the sales team has more than doubled within the club to the current 70 people. The sales team includes seven activities: ticketing, hospitality, partnerships, licensed merchandise, international development, marketing and operational implementation/ production.

⁴⁹ Deloitte. 2018. Football Money League, Sports Business Group. Available at: <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/sports-business-group/deloitte-uk-sbg-dfml2018.pdf> [Accessed: 25 October 2018]

⁵⁰ Chanavat, N. 2017. French football, foreign investors: global sports as country branding, *Journal of Business Strategy*, Vol 38(6), pp. 3-10.

⁵¹ Newzoo. 2017. Global Esports Market Report. Available at: <https://newzoo.com/insights/trend-reports/global-esports-market-report-2018-light/> [Accessed: 25 October 2018]

Logistical Services



Employment	7 879 000 (7th/10)	Wage premium (in clusters)	3% (5th/10)
Average change	0.8% (6th/10)	Average Gross Value Added	46 100 € (10th/10)
Average wage	28 400 € (10th/10)	Value added at Global Frontier firms	109 000 € (10th/10)
Average change	2.3% (1st/10)	Average change	0.3% (10th/10)

Logistical Services is an industry based on the transportation and logistics cluster, with contributions from several supporting industries. Logistics is the management of the flow of goods or people and the actual process of transport between a starting point and a specific destination, which may be land-, air- or space-based. On the one hand, this includes the logistics operation

provision, on the other hand, the development and provision of IT-systems for the logistics planning, organisation and management.

Logistical Services employ 7.9 million people in Europe. At 28 400 euros, the average wage is the lowest among the emerging industries, and it is the only

industry to have an average wage below that of the economy at large. In addition, Logistical Services have the lowest productivity among the emerging industries, both in general and for the global frontier firms. On the other hand, the average annual growth rate over the last five years, 2.3%, has been the highest among the emerging industries.

Table 36. Key regions in Logistical Services

Cluster performance in detail: SME performance driven by high growth firms													Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms					
Cluster stars																		
Region	Size (0-3)	Speciali- sation (0-3)	Produc- tivity (0-3)	SME perform- ance (0-3)	Innova- tion leader (0-3)	Total stars (0-15)	Region	Turnov- er	Emple- yees	Assets	Start- ups	Avg	Region	Turnov- er	Profit	Value Add	Avg	
UKI7 - Outer London - West and North West	3	2	3	2	3	13	LV00 - Latvia	1.3	1.5	0.8	0.6	1.1	ITC2 - Valle D'Aosta	0.0	0.9	3.7	1.5	
ES11 - Galicia	3	3	0	3	3	12	LT00 - Lithuania	1.8	1.7	0.7	0.0	1.0	UKI3 - Inner London - West	1.5	1.4	0.8	1.2	
ES52 - Comunidad Valenciana	3	3	0	3	3	12	BG41 - Yugozapaden	1.2	1.4	1.0	0.2	0.9	BE21 - Antwerp	0.3	0.7	2.2	1.1	
ES61 - Andalucia	3	3	0	3	3	12	SK01 - Bratislava Region	1.0	1.5	0.9	0.0	0.8	BE10 - Brussels-Capital Region	1.3	0.7	0.3	0.8	
FR71 - Rhone-Alpes	3	0	3	3	3	12	ITI4 - Lazio	0.5	0.5	0.5	1.4	0.7	ITH1 - Provincia Autonoma di Bolzano/Bozen	0.0	0.0	2.4	0.8	
ITC4 - Lombardia	3	3	0	3	3	12	BG42 - Yuzhen Tsentralen	0.9	1.0	0.7	0.1	0.7	DE50 - Bremen	1.1	0.7	0.6	0.8	
ITI4 - Lazio	3	3	0	3	3	12	EE00 - Estonia	1.0	0.8	0.9	0.0	0.7	UKM5 - North Eastern Scotland	1.0	1.0	0.4	0.8	
ES21 - Pais Vasco	3	3	0	2	3	11	BG32 - Severen Tsentralen	0.8	1.1	0.6	0.0	0.6	UKC2 - Northumberland and Tyne and Wear	0.9	0.9	0.1	0.7	
ES41 - Castilla y Leon	3	3	0	2	3	11	ITC4 - Lombardia	0.4	0.3	0.3	1.3	0.6	PT30 - Regiao Autonoma da Madeira	0.0	0.6	1.3	0.7	
ES70 - Canary Islands	3	3	0	2	3	11	LV00 - Latvia	1.3	1.5	0.8	0.6	1.1	ITC2 - Valle D'Aosta	0.0	0.9	3.7	1.5	

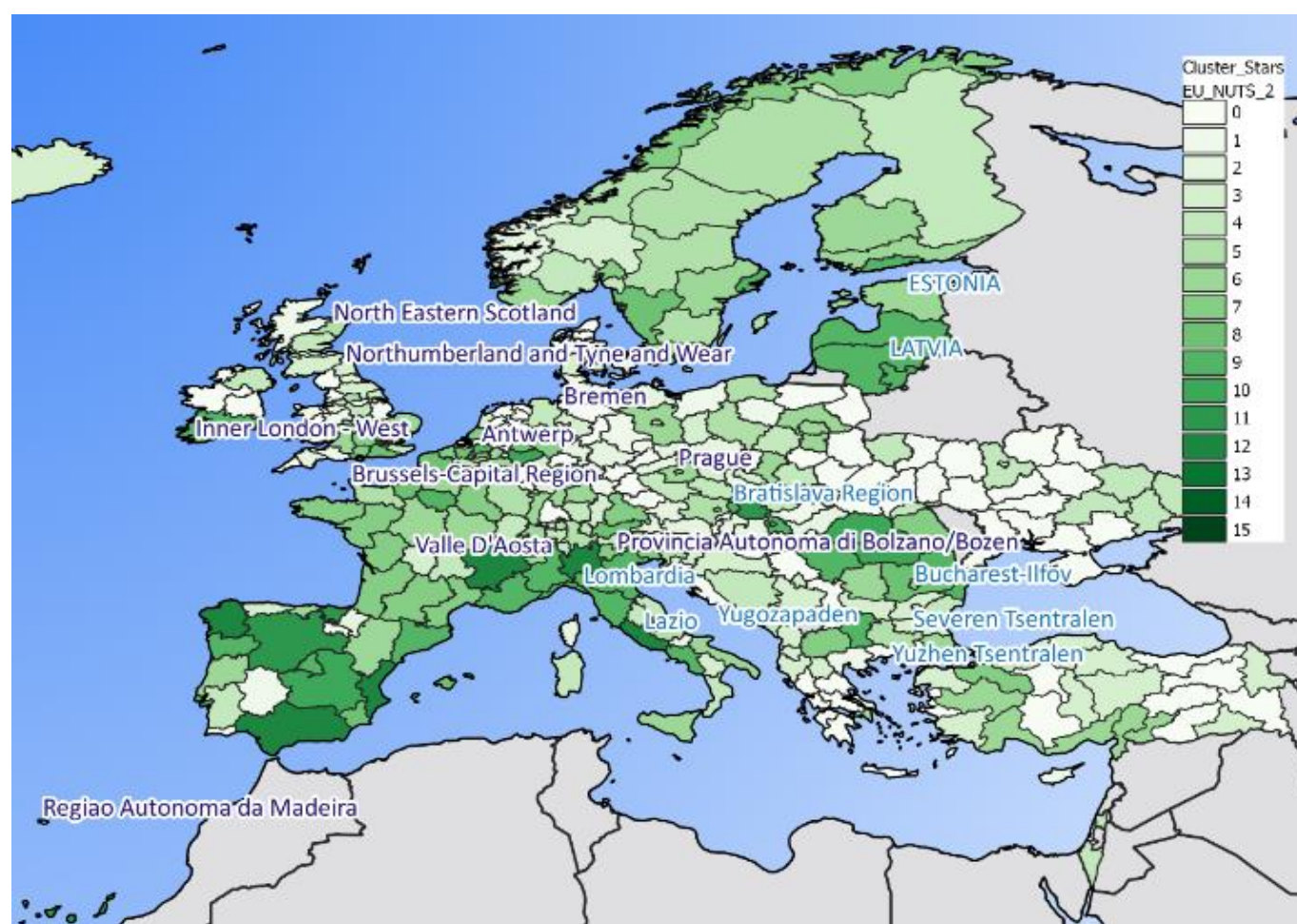
There are 2 other 11 star regions: SK02 - Western Slovakia and UKH2 - Bedfordshire and Hertfordshire.

The regions specialised in Logistical Services are located in the Baltic States, Iceland, Kosovo, Macedonia, Montenegro, Spain, Turkey and Ukraine. These clusters include some weaker regions in Europe. These

regions have the lowest labour force participation rate, low productivity, the lowest high-technology employment and digital engagement, the fewest product and process, and marketing and organisational

innovators, as well as Patent Cooperation Treaty (PCT) patent applications, and the smallest business R&D expenditure when compared to regions that have specialised in some other emerging industry.

Figure 14. Cluster stars in Logistical Services



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded cluster in Logistical Services

Logistical Services is an industry based on the transportation and logistics cluster. Similarly to the Logistical Services emerging industry, the specialised regions in the transportation and logistics traded cluster are located in Iceland, Kosovo, Latvia,

Macedonia, Montenegro, Spain, Turkey and Ukraine. Four Belgian regions – Antwerp, Flemish Brabant, West-Flanders and East-Flanders – have such a high share of Global Frontier firms in the transportation and logistics cluster that they are among the

ten best regions in this regard. However, only Flemish Brabant has a location quotient over 1.5, i.e. is considered a specialized cluster.

Table 37. Strong nations in the Transportation and Logistics traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 27% ↗	United States, 37% ↑	Iceland, 3.7‰ ↑	Ireland, 5.5‰ ↓	Ireland, 209 k€ ↑
Japan, 15% ↗	Japan, 11% ↓	Luxembourg, 2.7‰ ↑	Iceland, 4.9‰ ↓	United States, 144 k€ ↑
France, 9% ↘	Spain, 11% ↓	Denmark, 2.4‰ ↑	Spain, 2.2‰ ↓	Netherlands, 135 k€ ↑

Table 38. Strong nations in the Transportation and Logistics traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
Italy, 20%	Italy, 19%	Italy, 19%	Lithuania, 19.6‰	Lithuania, 18.6‰	Lithuania, 16.4‰
Romania, 9%	Spain, 10%	France, 8%	Latvia, 12.9‰	Latvia, 16.1‰	Estonia, 8.9‰
Spain, 8%	Romania, 10%	Spain, 7%	Estonia, 10.7‰	Bulgaria, 10.7‰	Latvia, 8.4‰

Logistical Services development examples

Latvia has the highest average number of high growth firms and rapidly growing start-ups in Logistical Services among the regions in Europe. It has three cluster star ratings for size, specialisation and SME performance dimensions of the cluster performance measurement also.

LATVIAN SUPPLY CHAIN CLUSTER SUPPORTS LATVIAN LOGISTICAL SERVICES



Latvian Supply Chain Cluster (LSCC) is a branch of the Latvian Logistics Association, established with financial support of the Ministry of Economics of Latvia. LSCC is a consortium of leading manufacturers, logistics and R&D institutions in Latvia. It has 30 larger company members. The cluster was established with the primary goal of value creation for all supply chain partners, including manufacturers, suppliers, distributors, customers and customers' customers. It represents the sector in national transport policy planning processes.

LSCC's core competence is Supply Chain Strategy development and implementation for particular markets or segments in order to operationalise and support companies' business strategy. The cluster aims to unite the transport sector representatives from micro, small and medium-sized enterprises, thus contributing to their growth, competitiveness and efficiency. LSCC can act as strategic local partner in Latvia for logistics innovation. Rail Baltic's new intermodal services and freight terminals help towards achieving this aim.

LSCC's current focus is on facilitation of the productivity of business and network processes by using a supply-chain operations reference-model (SCOR) as the cross-industry standard diagnostic tool for supply-chain management. Its long-term corporate level strategy is to position LSCC as a green TEN-T core network infrastructure-based Supply Chain Cluster.

The main countries targeted by the cluster organisation are Belarus, Estonia, Lithuania, Russian Federation and Sweden. Latvian Logistics Association participates in the "Five for Cross-industry Value Chain Excellence" EU project. The project involves

five partners from Sweden, Estonia and Latvia, representing five clusters working in three industrial sectors: information technologies, logistics, and food production and processing. The objective of the project is to improve management and performance practices of the involved clusters, enable clusters to provide more professional business services to SMEs, develop the capacities necessary for cross-sectoral and international collaboration, and raise awareness of other local cluster organisations and business networks of the benefits of the cluster management's excellence approach. LSCC strives towards cluster excellence and has received the European Cluster Management Excellence Bronze Label for its efforts towards improving its cluster management.

CASE FIRM: SMARTLYNX AIRLINES

SmartLynx Airlines, with headquarters in Riga, was founded as Latcharter Airlines in 1992 by four professional pilots and one experienced engineer. The company commenced operations with two leased TU-134B aircraft serving both leisure and ad hoc charter markets. It was the first airline to carry out package holidays from

Riga and was well equipped to provide for sports, event, concert, governmental, military and executive charter flights. In line with the growth of the leisure market, by 1996 the airline had become the second largest local carrier and fleet owner.

In 2000, Latcharter added two YAK-42D aircraft to the fleet. By then it served 9 holiday destinations on a regular basis. In addition to the established business areas, the airline began wet lease, having the Organization for Security and Cooperation in Europe (OSCE) as its first lessee.

Maintaining a stable growth and keeping up with fleet modernization, Latcharter introduced A320-200 planes in 2003 and gradually ousted the Soviet-built aircraft.

The airline was acquired by Loftleidir Icelandic of the Icelandair Group in the

summer of 2006. In 2007, the fleet was supplemented by five more A320-200 and two B767-300 aircraft.

On the occasion of the 15th anniversary of the airline, Latcharter was rebranded to SmartLynx. The brand emphasises the ability to provide smart and reliable solutions within a business to business niche market. The lynx, both a wildcat indigenous to Latvia and a star constellation, was chosen as a symbol to represent these values.

The company restructured but maintained its market position during the economic downturn of 2008 and 2009, keeping a record of stability throughout the years and returning to profitability by 2012.

The ownership changed in 2012 when the management of SmartLynx acquired the

company in a management buyout. Although a connection with Loftleidir remains, SmartLynx has since then been an independent entity.

In the same year, SmartLynx further expanded its charter operations to Tallinn, Estonia, and established a subsidiary, SmartLynx Airlines Estonia. The Estonian company started operations with a wet-leased A320 from its parent company and added its own by early 2013.

In 2016, a Netherlands-based investment fund became the owner of the company. SmartLynx aims to enlarge its fleet by 1-2 airplanes each year and to continue to expand the geography of its operations worldwide.

Medical Devices

Employment	4 852 000 (9th/10)	Wage premium (in clusters)	0% (8th/10)
Average change	-0.1% (10th/10)	Average Gross Value Added	76 100 € (5th/10)
Average wage	47 000 € (4th/10)	Value added at Global Frontier firms	161 000 € (5th/10)
Average change	0.4% (8th/10)	Average change	2.7% (3rd/10)

Medical Devices is a core part of the life sciences industry and connects to a large and growing area of local health care services. It combines the fields of science, engineering and technologies to facilitate new innovations in the biomedical sphere and an increasing convergence of physical and biological technology platforms. The industry employs 4.9 million people in

Europe, with no growth during the last five years.

A medical device is an instrument, apparatus, software, material, etc. that is intended for supporting or sustaining life. It may diagnose, prevent, monitor, treat or alleviate disease, compensate for an injury, or provide information for medical or diagnostic purposes. Products in the

Medical Device industry are generally based on interdisciplinary engineering, and the complexity of medical device products continues to increase with the inclusion of multiple technologies. Technologies such as advanced, tailored materials, microelectronics, biotechnology, and software and informatics are important technologies featured in medical devices.

Table 39. Key regions in Medical Devices

Cluster stars													Cluster performance in detail: SME performance driven by high growth firms				Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms			
Region	Size (0-3)	Speciali- sation (0-3)	Produc- tivity (0-3)	SME perform- ance (0-3)	Innova- tion leader (0-3)	Total stars (0-15)	Region	Turnov- er	Empl- oyees	Assets	Start- ups	Avg	Region	Turnov- er	Profit	Value Add	Avg			
DE11 - Stuttgart	3	3	3	3	3	15	ITC4 - Lombardia	0.4	0.5	0.3	2.3	0.9	BE24 - Flemish Brabant	0.3	0.0	3.1	1.2			
DE21 - Oberbayern	3	3	3	3	3	15	BG41 - Yugozapaden	0.8	0.9	0.6	0.3	0.7	SE11 - Stockholm	0.6	0.8	1.7	1.0			
DE71 - Darmstadt	3	3	3	3	3	15	Korea	0.6	0.5	0.6	0.9	0.6	NL23 - Flevoland	0.3	1.6	0.4	0.7			
DEA1 - Duesseldorf	3	3	3	3	3	15	ITH5 - Emilia-Romagna	0.4	0.5	0.4	0.7	0.5	BE10 - Brussels-Capital Region	0.5	0.2	1.4	0.7			
DE12 - Karlsruhe	3	3	3	2	3	14	CZ05 - Northeast	0.6	0.8	0.5	0.1	0.5	DK01 - Hovedstaden	0.4	0.7	1.1	0.7			
DE14 - Tuebingen	3	3	3	2	3	14	CZ07 - Central Moravia	0.5	0.7	0.5	0.0	0.4	UKI3 - Inner London - West	0.8	0.8	0.4	0.6			
DE13 - Freiburg	3	3	2	2	3	13	CZ01 - Prague	0.5	0.6	0.4	0.1	0.4	NL21 - Overijssel	1.2	0.7	0.0	0.6			
DE25 - Mittelfranken	3	3	3	1	2	12	RO32 - Bucharest-Ilfov	0.4	0.5	0.4	0.4	0.4	AT13 - Wien	0.2	0.4	1.2	0.6			
FR10 - Ile-De-France	3	0	3	3	3	12	ITH3 - Veneto	0.4	0.5	0.3	0.4	0.4	DE21 - Oberbayern	0.6	0.5	0.7	0.6			
ITC1 - Piemonte	3	3	0	3	3	12	SE11 - Stockholm	0.3	0.3	0.4	0.5	0.4	BE21 - Antwerp	0.4	0.3	0.8	0.5			

There are 5 other 12 star regions: ITC4 – Lombardia, ITH3 – Veneto, ITH4 - Friuli-Venezia Giulia, ITH5 - Emilia-Romagna and UKJ1 - Berkshire, Buckinghamshire and Oxfordshire.

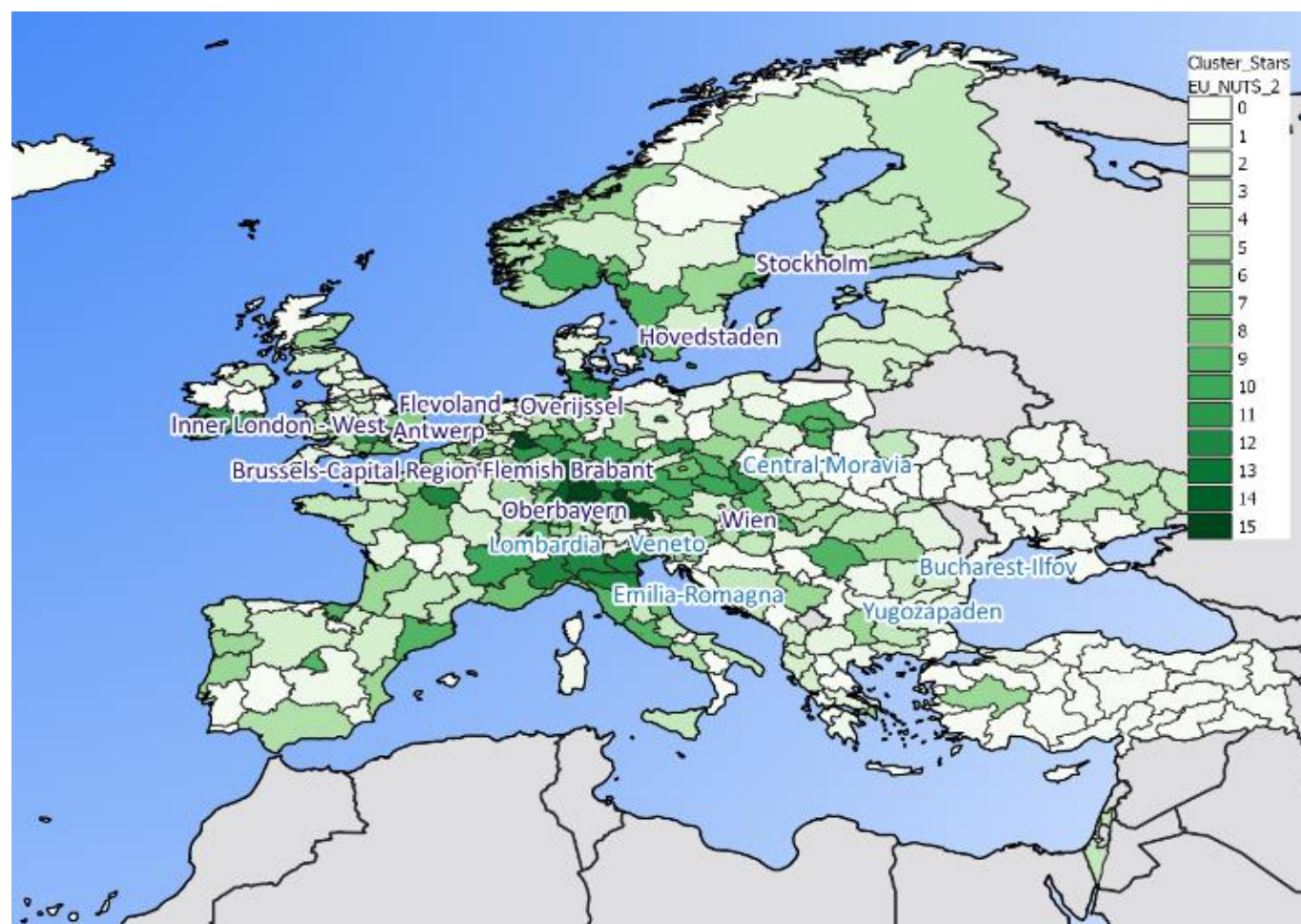
The specialised clusters in the medical devices industry are generally to be found in Czechia, Denmark, Germany, Hungary, Israel, Italy, Norway and Poland. The industry is concentrated in Germany, particularly in its southern part, with 23 specialised clusters. Stuttgart, Upper Bavaria, Karlsruhe and Düsseldorf have

more than 70 000 employees each. However, the region that employs the most people in the industry is Lombardy in Italy, with over 178 000 employees.

The regions specialised in Medical Devices are characterised as having low unemployment rate, and high business

R&D expenditure, capital formation, medium and high technology exports rate, 60% compared to the general average of 48%, and a high number of Patent Cooperation Treaty (PCT) patent applications. In this regard, these regions are similar to the regions that have specialised in digital industries.

Figure 15. Cluster stars in the Medical Devices industry



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded clusters in Medical Devices industry

The Medical Devices emerging industry extends the cluster category of the same name to include appliances, lighting and

electrical equipment, and information technology and analytical instruments.

Being a member of the medical devices traded cluster correlates with measures for medium high tech exports, firm

investments, business R&D expenditure and digitalisation. German regions are strong in the medical devices traded cluster populating five out of the eight highest ranking regions. However, the two 15 star regions are Rhone-Alpes and Southern and

Eastern Ireland. Southern and Eastern Ireland, Lombardy and the Polish Slaskie region each has around 19 000 employees in the medical devices cluster, the biggest number among the specialised regions. Similarly to the specialised clusters in the

emerging industry with the same name, medical devices clusters are common in Czechia, Denmark, Germany, Hungary, Israel, Italy, Norway and Poland.

Table 40. Strong nations in the Medical Devices traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 33%	United States, 44%	Ireland, 24.5% ↘	Ireland, 34.5% ↓	United Kingdom, 109 k€ ↗
Germany, 23% ↗	Ireland, 17% ↓	Iceland, 5.9%	Denmark, 8.2% ↑	Switzerland, 107 k€
Ireland, 12% ↘	Germany, 16% ↗	Denmark, 4.2% ↑	Iceland, 7.1% ↑	Denmark, 104 k€ ↑

Table 41. Strong nations in the Medical Devices traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 20%	Italy, 18%	South Korea, 19%	Lithuania, 4.7%	Bulgaria, 4.7%	Lithuania, 3.8%
Italy, 14%	South Korea, 15%	Italy, 12%	South Korea, 3.9%	Czechia, 4.6%	Sweden, 3.7%
United States, 12%	United States, 11%	United States, 11%	Bulgaria, 3.5%	Ireland, 3.9%	South Korea, 3.6%

Appliances is a small industry and is hard to register. The regions that belong to the appliances traded cluster typically have high measures for medium high tech exports, entrepreneurial activity, design applications, IT employment and

innovation. This is a cluster in which Northern Italy is particularly strong: three out of the top five specialised regions with the highest numbers of employees come from Northern Italy. These regions are Lombardy, Friuli-Venezia Giulia and Veneto,

each having almost 10 000 employees. Other than that, specialized regions are dispersed around Central Europe. On a global level, Korean companies are well represented among the high growth firms.

Table 42. Strong nations in the Appliances traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
Japan, 34%	Netherlands, 32% ↑	Netherlands, 14%	Netherlands, 18.6% ↑	Netherlands, 110 k€ ↑
Netherlands, 24%	Japan, 23% ↑	Sweden, 5.8% ↗	Sweden, 5.4% ↑	United Kingdom, 89 k€ ↗
United States, 11% ↑	United States, 13% ↑	Slovenia, 3.7% ↘	Slovenia, 1.7% ↓	Germany, 86 k€ ↑

Table 43. Strong nations in the Appliances traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 30%	South Korea, 18%	South Korea, 33%	Bulgaria, 8%	Slovenia, 9.4%	Luxembourg, 7.5%
Italy, 12%	Italy, 15%	Italy, 10%	South Korea, 5.8%	Czechia, 9.2%	South Korea, 6.5%
Poland, 7%	Czechia, 10%	United Kingdom, 5%	Lithuania, 5%	Bulgaria, 9.2%	Bulgaria, 5.6%

Medical Devices industry development examples

The Lombardy region has the highest number of rapidly growing start-ups in the Medical Devices industry and leads our SME performance listing. It is one of the five Italian 12 cluster star regions in the industry, the others being Piemonte, Veneto, Friuli-Venezia Giulia and Emilia-Romagna. As said, Lombardy employs the most people in the industry in Europe also.

CLUSTERS SUPPORTING MEDICAL DEVICES IN THE LOMBARDY REGION

Cluster Lombardo Scienze della Vita



The Lombardy Life Sciences Cluster Association was established in July 2015 by a group of businesses, research facilities, universities and business associations. The total number of members is 100, including 46 SME and 8 larger company members, and 22 research organisations, universities and technology centres. The cluster is the driver for regional innovation in the life science sector.

The cluster operates by nurturing the integration and the development of competence and technology inside working groups. These include:

- Pharmaceuticals group focuses on research and development of innovative therapeutic approaches and new drugs
- Medical Device group is engaged in products and technologies used in healthcare facilities for diagnosis and therapies
- ICT for health group works on themes such as medical care applications,

mobile apps and social media enablers, welfare home automation and Big Data

- Advanced Therapy group works on gene therapy, cell-based products and combined therapies
- Diagnostics group is focused on diagnostics in vivo, in vitro and device diagnostics.
- Neuro-inflammation group works on the development of innovative therapeutic approaches, new drugs and the development of biomarkers.

Lombardy Cluster Technologies for Living Environments



The Lombardy Cluster of Technologies for Living Environments (also known as Cluster TECHforLIFE) was created in 2012 and is based in Lecco, 50 kilometres north of Milan. It fosters the development of knowledge as well as the implementation of highly innovative technological applications, plants, buildings and products for the social inclusion, safety, well-being, health and sustainable lifestyle of the population through an ambient intelligence and assisted living approach. The cluster has 32 members including 7 SME and 5 larger company members.

The Cluster TECHforLIFE is able to include all phases of the development of products and services: innovation, integration, testing, marketing. It is one of the six founding members of the National Technological Cluster for Living Environments. In 2016, the Cluster TECHforLIFE became a reference site with the partnership of Regione Lombardia. Reference sites are ecosystems which

comprise different players, including regional and/or local authorities, cities, integrated hospitals/care organisations, industry organisations, SMEs and/or start-ups, research and innovation organisations that jointly implement a comprehensive, innovation-based approach to active and healthy ageing and can give evidence and concrete illustrations of the impact of such approaches on the ground.

CASE FIRM: BRACCO IMAGING

Headquartered in Milan, Bracco Imaging develops, manufactures and markets diagnostic imaging agents and solutions that meet medical needs and facilitate clinical solutions. It is one of the world's leading companies in the diagnostic imaging business. Bracco Group has around 3 450 employees and annual total consolidated revenue of around 1.3 billion euros. It presently invests 10% of its turnover in research and counts around 300 scientists and researchers, 12% of employees. Especially, young researchers are encouraged to promote their role in the company and business.

Bracco's commitment to diagnostic imaging began in the 1950s and produced the first results at the start of the 1960s, with the development of the first contrast agent, iodamide, to improve image quality in radiographic procedures. The following years saw a redoubling of efforts in R&D and resulted in the development of a highly innovative contrast agent, iopamidol, which allowed for an improved tolerability and safety during radiographic, vascular and CT procedures. Launched in the beginning of the 1980s, it is still today the go-to product for the international scientific community.

Mobility Technologies

Employment	10 921 000 (4th/10)	Wage premium (in clusters)	5% (4th/10)
Average change	0.2% (9th/10)	Average Gross Value Added	68 800 € (7th/10)
Average wage	40 500 € (5th/10)	Value added at Global Frontier firms	127 000 € (8th/10)
Average change	0.3% (9th/10)	Average change	2.2% (5th/10)

Mobility Technologies are a core part of the European manufacturing industry and are a clear focus for Europe's strategy to re-industrialize. They stem from the automotive cluster as a core and expand it with related technologies from the production technology and aerospace cluster as well as a few related upstream activities such as metalworking and plastics. Topics dealt with by technological innovation in the field of mobility include road vehicle engineering, internal

combustion engines, batteries and motors, electric and hybrid powertrains, urban and high speed rail transportation, aircraft types and aerodynamics, radar, navigation, GPS, GIS, etc. Mobility Technologies employs 10.9 million people in Europe and it is the fourth largest emerging industry in this context.

Examples of emerging mobility technologies are predominantly bundled under the so-called smart mobility trends,

which involve the development of cleaner energy fuelling and more energy-efficient solutions. The design of hybrid, electrified or zero-emission vehicles illustrates the need for cross-sectoral linkages by the involvement, for example, of energy and automotive industries as a means to meet objectives of governments and manufacturers.

Table 44. Key regions in Mobility Technologies

Cluster performance in detail: SME performance driven by high growth firms													Business performance by innovation leaders: top1% industry leaders and top 5% global frontier firms					
Cluster stars																		
	Size	Speciali	Produc	SME	Innova	Total		Turnov	Emplo	Assets	Start-	Avg		Turnov	Profit	Value	Avg	
Region	(0-3)	(0-3)	(0-3)	(0-3)	(0-3)	(0-15)	Region	er	yees		ups		Region	er		Add		
DE11 - Stuttgart	3	3	3	3	3	15	ITC4 - Lombardia	0.4	0.5	0.4	2.4	0.9	ES22 - Navarra	0.3	0.4	0.8	0.5	
DE14 – Tuebinge n	3	3	3	2	3	14	ITH5 - Emilia-Romagna	0.5	0.6	0.4	1.0	0.6	UKI3 - Inner London - West	0.7	0.6	0.3	0.5	
DEA5 - Arnsberg	3	3	3	2	3	14	Korea	0.5	0.4	0.6	0.9	0.6	SE11 - Stockholm	0.4	0.5	0.6	0.5	
DE13 - Freiburg	3	3	3	2	2	13	CZ07 - Central Moravia	0.7	1.0	0.6	0.0	0.6	SE23 - West Sweden	0.5	0.5	0.4	0.5	
DE27 - Schwaben	3	3	3	1	3	13	CZ05 - Northeast	0.6	0.9	0.6	0.0	0.5	ITC4 - Lombardia	0.1	0.1	1.2	0.5	
DE12 - Karlsruhe	3	3	3	1	2	12	ITH3 - Veneto	0.4	0.5	0.4	0.8	0.5	FI1B - Helsinki-Uusimaa	0.5	0.5	0.4	0.5	
DE23 - Oberpfalz	3	3	3	1	2	12	SI03 - Eastern Slovenia	0.6	0.7	0.5	0.0	0.5	AT31 - Oberosterreich	0.3	0.7	0.5	0.5	
DE26 - Unterfranken	3	3	3	1	2	12	SE21 - Smaland and the islands	0.7	0.6	0.5	0.1	0.5	AT34 - Vorarlberg	0.2	0.7	0.5	0.5	
DEA1 - Duesseldorf	3	3	0	3	3	12	CZ03 - Southwest	0.5	0.7	0.5	0.1	0.4	LU00 - Luxembourg	0.5	0.4	0.4	0.4	
ES21 - Pais Vasco	3	3	0	3	3	12	CZ06 - Southeast	0.5	0.7	0.5	0.0	0.4	NL23 - Flevoland	0.3	0.8	0.2	0.4	

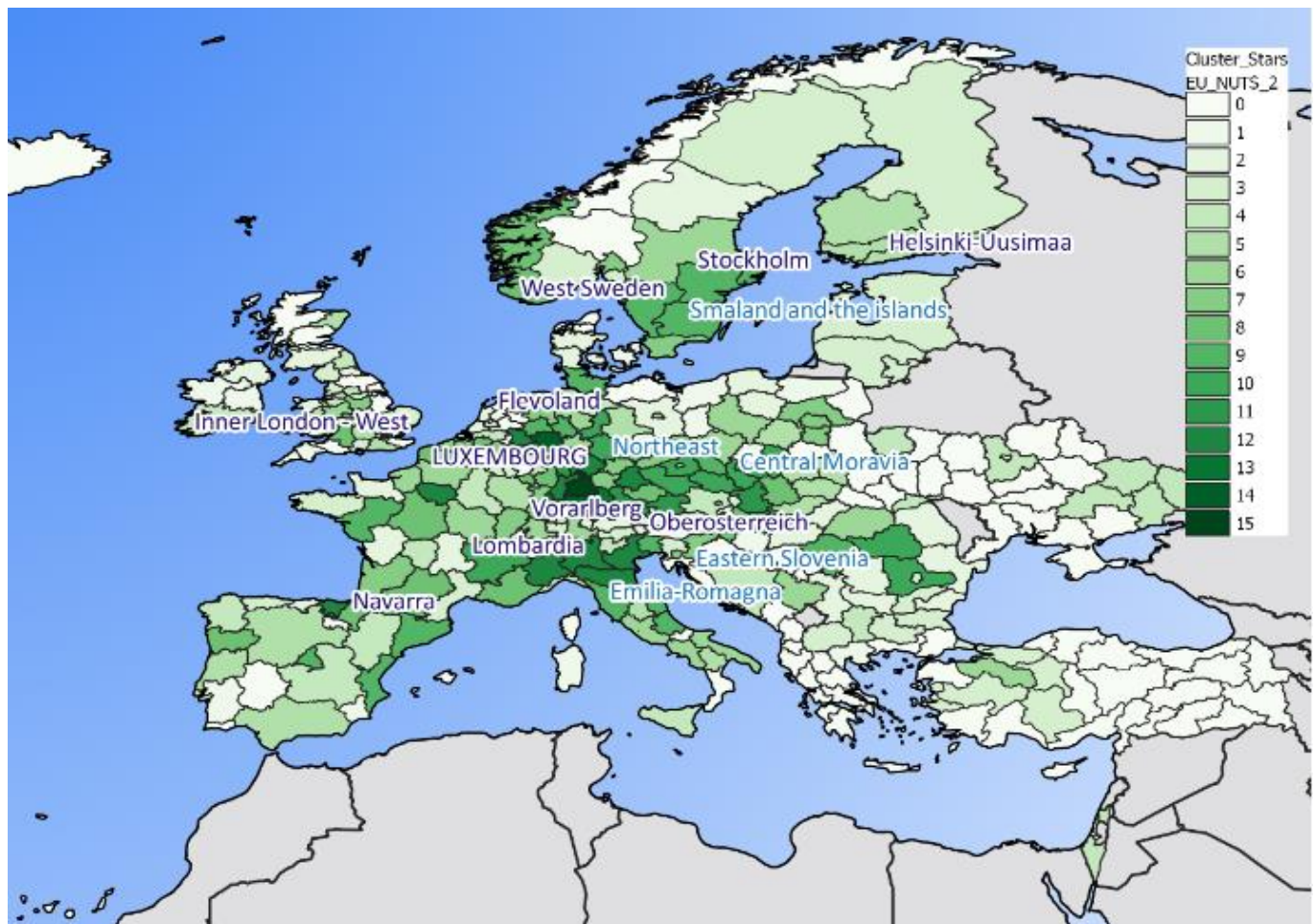
There are 5 other 12 star regions: FR10 - Ile-De-France, ITC1 - Piemonte, ITC4 - Lombardia, ITH3 - Veneto and ITH5 - Emilia-Romagna.

Not surprisingly, the specialised mobility technology clusters are located in areas of traditional automotive strength. Stuttgart is the largest cluster, together with a number of other German clusters. The specialised clusters outside Germany are located in Turkey, Romania, Sweden and Austria. The

highest concentrations of high growth firms appear in Italy, Korea, Czechia and Sweden. The vast majority of all clusters have automotive as the core category, usually followed by production technology or metalworking.

The regions specialised in mobility technologies do not stand up among the ten emerging industries, neither for good nor for bad. These regions have the third highest medium and high technology exports rate, 58%, just behind Digital industries and Medical Devices.

Figure 16. Cluster stars in Mobility Technologies industry



Note: Dark blue colour shows the regions with the highest industry leader and the light blue with the highest high growth firm concentrations. Source: EuroGeographics for the NUTS 2 administrative boundaries

Key traded clusters in Mobility Technologies

Mobility Technologies stem from the automotive cluster as a core and expand it with related technologies from the production technology and aerospace cluster as well as a few related upstream activities such as metalworking, plastics, and lighting and electrical equipment.

Not surprisingly, the automotive traded cluster follows the Mobility Technology emerging industry in its employment

patterns. Three German regions, Stuttgart, Braunschweig and Upper Bavaria, stand out as specialised regions, with about 77 000, 48 000 and 40 000 employees. Similarly, Slaskie in Poland, West Romania and Western Transdanubia in Hungary comprise the “New Detroit” automotive cluster in the Widening countries. These specialized regions have 77 000, 64 000 and 42 000 employees. Stuttgart is the leading cluster star region with 15 stars. On a global level,

Japan, Germany and the United States have a tight competition in their shares of the global automotive industry turnover and profits. Korean companies populate the high growth firm listings. Being a member of the automotive traded cluster correlates with measures for medium high tech exports, entrepreneurial activity, creativity, business R&D expenditure and firm investments.

Table 45. Strong nations in the Automotive traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
Japan, 24%	Japan, 29% ↑	Netherlands, 4.7‰ ↑	Sweden, 4.4‰ ↓	Netherlands, 175 k€ ↑
Germany, 20%	Germany, 21% ↓	Sweden, 3.1‰ ↓	Germany, 2.5‰ ↓	Belgium, 134 k€ ↑
United States, 15% ↓	United States, 20% ↓	Germany, 2.4‰	Japan, 2.2‰ ↑	Germany, 114 k€

Table 46. Strong nations in the Automotive traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 46%	South Korea, 34%	South Korea, 48%	South Korea, 9‰	Czechia, 6.7‰	South Korea, 9.3‰
Italy, 7%	Italy, 10%	Italy, 6%	Slovakia, 4.9‰	South Korea, 6.5‰	Czechia, 4.3‰
Spain, 6%	Spain, 8%	United Kingdom, 5%	Czechia, 4.2‰	Slovakia, 5.4‰	Slovakia, 3.9‰

Being a member of the aerospace vehicles and defence traded cluster correlates with measures for medium high tech exports, business R&D expenditure, firm investments, entrepreneurial activity and with a high ranking in the Composite Indicator of Industrial Change.⁵² In this

traded cluster, the specialised region with the highest numbers of employees are Israel's Central district; the Gloucestershire, Wiltshire and Bristol/Bath area in the United Kingdom; Midi-Pyrenees in France and Upper Bavaria in Germany, each having from 10 to 15 000 employees. On a global

level, the American firms in the industry account for half of the global turnover but a huge three quarters of the profits.

⁵² The Composite Indicator of Industrial Change (CIIC) builds on the work done by the 2011 EC Expert group on Measuring Innovation, in particular the sub-group on Measuring Structural Change, and the follow-up by the Joint Research Centre fine-tuning the indicators proposed by the Expert group. Following these references, industrial modernization is understood to rely on different dimensions including economic development, evolution towards a more innovative regional economy, new and emerging technologies, digitalisation, firm investments, entrepreneurship, internationalisation and creativity. For each dimension specific indicators have been selected and average performance for the selected indicators is captured in a composite indicator. For more information, see European Observatory for Clusters and Industrial Change. 2019. Methodology report for the European cluster database.

Table 47. Strong nations in the Aerospace Vehicles and Defence traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
United States, 50%	United States, 75%	Netherlands, 12.1‰	Netherlands, 3.6‰ ↓	Netherlands, 131 k€ ↗
Netherlands, 21%	France, 23% ↑	United States, 1.5‰	France, 3.4‰ ↑	Germany, 130 k€ ↑
France, 10% ↑	Netherlands, 6% ↓	France, 1.4‰ ↑	United States, 2.3‰	France, 112 k€ ↑

Table 48. Strong nations in the Aerospace Vehicles and Defence traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 19%	Spain, 18%	South Korea, 18%	Czechia, 6.6‰	Czechia, 7.5‰	Czechia, 4.9‰
France, 13%	South Korea, 14%	France, 14%	Lithuania, 4.9‰	Estonia, 4‰	Lithuania, 3.6‰
Italy, 12%	France, 13%	Spain, 11%	South Korea, 3.7‰	Spain, 3.9‰	South Korea, 3.4‰

In the production technology and heavy machinery traded cluster, the specialised regions with the highest numbers of employees are located in Italy and Germany. Lombardy has the highest number of employees, 131 000, followed by Stuttgart with 107 000 and Düsseldorf

with 92 000 employees. Emilia-Romagna has 85 000, Veneto 76 000 and Piemonte 70 000 employees. German regions also house smaller clusters, but in general, this cluster's specialised regions are rather evenly dispersed throughout Europe. The regions that belong to the production

technology and heavy machinery traded cluster typically have a number of patent applications for key enabling technologies and high measures for digitalisation, medium high tech exports, firm investments and business R&D expenditure.

Table 49. Strong nations in the Production Technology and Heavy Machinery traded cluster, industry leaders

Turnover	Profit	Turnover per inhabitant	Profit per inhabitant	Gross value added per employee
Japan, 23 % ↑	Japan, 32 % ↑	Ireland, 6‰ ↑	Finland, 7.8‰ ↑	Belgium, 88 k€
Germany, 21 %	Germany, 23 % ↑	Finland, 4.4 ‰ ↘	Cyprus, 5.7‰ ↑	Germany, 86 k€ ↗
United States, 15 % ↘	United States, 18 % ↓	Luxembourg, 4.4‰ ↑	Sweden, 5.5‰ ↑	Austria, 86 k€

Table 50. Strong nations in the Production Technology and Heavy Machinery traded cluster, high growth firms

High Growth Firms (turnover)	High Growth Firms (employees)	High Growth Firms (assets)	High Growth Firms per inhabitant (turnover)	High Growth Firms per inhabitant (employees)	High Growth Firms per inhabitant (assets)
South Korea, 30%	South Korea, 25%	South Korea, 31%	South Korea, 5.8‰	Czechia, 5.4‰	South Korea, 6‰
Italy, 17%	Italy, 19%	Italy, 14%	Estonia, 4.1‰	South Korea, 4.9‰	Estonia, 4.5‰
Spain, 6%	Spain, 8%	Germany, 9%	Bulgaria, 4‰	Bulgaria, 4.7‰	Czechia, 3.7‰

Mobility Technologies development examples

Stuttgart is the only region with 15 cluster stars in Mobility Technologies industry. It is the largest cluster also, and is linked to a number of related clusters in Germany and in Central Europe in general.

CLUSTERS SUPPORTING MOBILITY TECHNOLOGIES IN STUTTART

automotive-bw



The cluster automotive-bw was established in 2010 to bundle the competences of the vehicle industry throughout the whole of Baden-Württemberg in Germany. In particular, it intends to support small and medium-sized component suppliers in managing the structural transformation and in developing business models which are fit for the future. The cluster has 72 members including 31 SME and 24 larger company members.

In the cluster, there are four working groups for innovative automotive solutions – so-called TecNets. They work on future topics, which are of concern for the automotive industry. The TecNets electric mobility, lightweight construction and efficiency technology have existed for several years already; with ConnectedCar the fourth TecNet group was created in 2015. The state agencies are also on board as cooperation partners: e-mobil BW supports the TecNet group electric mobility; Leichtbau BW shows its commitment in the TecNet group lightweight construction. The main countries targeted by the cluster organisation are China, Japan and Mexico.

Baden Württemberg: Connected e.V.



The cluster bwcon is the leading business initiative for the promotion of the high-tech sectors in the region with offices in Stuttgart and Freiburg. Established in 1997, the main goal of the cluster organisation is to foster key technologies in order to strengthen the region's economic development. Therefore, the focus of bwcon is in information and communication technologies (ICT), which are seen as the innovation drivers for other industrial fields, such as mobility, production, health care and energy. The cluster has 618 members, including 449 SME and 23 larger company members.

bwcon believes it is especially competitive in business development and business plan coaching for the high-tech sector. With the *Heidelberg Innovation Forum*, it has run one of the leading investment matchmakings in Germany for several years now. In addition to the *Green Innovation and Investment Forum*, it has a tailored format for Green Tech. The *bwcon Coaching Group for start-ups* is one of the most well-known expert pools for business plan development in Baden-Württemberg.

The cluster collaborates with ITS Baden-Württemberg and MicroTec Südwest in Germany, Media Evolution in Sweden, Mov'eo in France, and PoloICT and Smart Communities Tech in Italy in European Strategic Cluster Partnerships for Going International (ESCP-4i) projects Mobility Goes International and Mobility Goes International - In Action. bwcon participates in *Cloud Socket*, the Horizon2020 research project. Cloud Socket aims to apply semantic, rule-based inference, meta modelling and knowledge management techniques to bridge the gap

between business needs and the use and exploitation of Cloud resources and components.

CASE FIRM: VOLOCOPTER

Volocopter GmbH of Bruchsal (previously Karlsruhe) was founded by Alexander Zosel and Stephen Wolf in 2012. The company is the global leader in the development of electrical vertical take-off and landing multicopters (eVTOL) as autonomous air taxis for the safe transport of people. They are based on drone technology and scaled up to carry two people, initially for distances of 27 km. Its flexible technical platform permits piloted, remote controlled and fully autonomous flight.

The company focuses on developing their aircrafts specifically for inner city missions. Volocopter features stable flight, allowing it to manoeuvre micro turbulences around skyscrapers and thus offering a smooth ride for passengers. It has an agreeable sound signature and is so quiet that from 100 m away it will not be heard over the background noise of a typical city. As it is electrically powered, it is emission-free in flight. Both noise and pollution are paramount considerations for achieving public acceptance of any new transport system.

In 2011, Volocopter earned its entry into the history of aviation through the manned flight of the world's first purely electrical multicopter. Since then the young enterprise has set new milestones: In 2016, Volocopter was granted a provisional licensing for a two-seater Volocopter by the German aviation authority and in 2017 the aviation start-up showcased the first ever autonomous flight of an air taxi in cooperation with RTA Dubai. Volocopter pioneers in close cooperation with aviation authorities and the definition of standards for infrastructure and reliable operation.

The company has presented a concept that defines the infrastructure necessary to

operate and scale an air taxi service into a full network system spanning over mega cities. Volo-Hubs resemble cable cart stations, with Volocopters landing and taking off every 30 seconds, for example. Battery packs will be swapped automatically in a protected area by robots

before moving on to the section where passengers embark for take-off.

An on-line fund-raising effort in 2013 on the Seedmatch website raised 500 000 euros in 2 hours and 35 minutes, setting a new European Union record. In 2017,

Volocopter received investments from a number of organizations, including from Daimler AG, totalling 25 million euros. The aircraft entered serial production in April 2018 and will be built under contract by the German sailplane manufacturer DG Flugzeugbau.

4. International clusters landscape

Cluster programs in leading international countries tend to concentrate on those industry sectors where the nation and its companies are competitive on the global level. Some provide substantial resources for innovation, high-tech or industrial clusters to boost R&D investments.

DIVERGENT TRENDS IN R&D INVESTMENTS

The financial crisis of 2007-2009 has characterised the economic development of this decade. Investments in research and development fluctuated during and after the crisis, and it has been something of a

dividing issue. During the crisis and immediately after it, investments in R&D generally decreased. After this, the development in different countries has been so divergent as to have led to the creation of three distinct classes.⁵³ To the first category belong those countries in

which R&D investments did not decrease during the financial crisis and in which they have grown strongly thereafter. These countries include China, South Korea and Denmark. In the second category are those countries in which R&D investments decreased during the crisis but have since increased. Such countries are for instance the Netherlands, Germany, Norway and the United Kingdom. The final category contains countries where R&D investment dropped during the crisis and has remained below pre-crisis levels. Canada, Finland, Greece, Portugal, Romania, Spain and Sweden are such countries.

China

China is the world's third largest economy after the EU and the United States. Since our database covers OECD member states and the countries participating in the COSME programme, we do not have Chinese company data for our analysis. Many Chinese companies would have made their way to our lists of Industry Leaders, companies at the Global Frontier, High Growth Firms or rapidly growing start-ups.

For example, around one fifth of Fortune 500 enterprises are from China. Most of these are state-owned enterprises (SOEs) and are controlled by the State-owned Assets Supervision and Administration Commission (SASAC). There are around 167 000 SOEs as of 2015, but when referring to SOEs, observers often talk about the 100 or so central government-owned mammoth SOE groups in monopolistic and oligopolistic industries. The most notable

ones, making their way to the Fortune 100 list, are presented in Table 53.⁵⁴

POLICY APPROACH TO SUPPORT CLUSTERS

Chinese clusters differ from the EU ones. They are agglomerations of companies, including big firms, limited to geographic areas and that often do not have an organisation of reference that acts as a representative.

Made in China 2025⁵⁵

The first national-level manufacturing innovation platform, established in June 2016, aims to exploit synergies and complementarities across activities and to strengthen the link between development and commercialisation.⁵⁶ Made in China 2025 is the first action plan specifically targeting manufacturing. It is inspired by Germany's "Industrie 4.0" plan. The plan lists nine tasks and includes 10 priority

sectors. For some of the priority sectors, 2020 objectives are specified. For example, the Development Plan for the Robotics Industry 2016-20 aims at larger industry scale, i.e. an annual domestic production of 100 000 industrial robots; better quality, i.e. 80 000 hours mean time between failures for domestically produced industrial robots; 50% or greater market share for domestic core components; and more widespread application of industrial robots.⁵⁷

Internet Plus

Similarly, Internet Plus seeks to integrate mobile internet, cloud computing, big data and the Internet of Things with modern manufacturing, to encourage the development of a wide array of services and to encourage internet-based companies to increase their presence in the international market.⁵⁸

⁵³ Global Innovation Index 2018. Cornell University, INSEAD, and World Intellectual Property Organization

⁵⁴ Molnar, M. 2017. Boosting firm dynamism and performance in China. OECD Economic department working paper No. 1408.

⁵⁵ This section draws from Molnar, M. 2017. Boosting firm dynamism and performance in China. OECD Economic department working paper No. 1408.

⁵⁶ Molnar, M. 2017. Boosting firm dynamism and performance in China. OECD Economic department working paper No. 1408

⁵⁷ Guofa 2015/28 Guanyu Yinfa Zhongguo Zhizao 2015 de Tongzhi (Notice on Made in China 2025)

⁵⁸ Guofa 2015/40 Guanyu Jiji Tuijin Hulanwang Jia Xingdongde Zhidao Yijian (Guiding Opinion on Promoting Internet Plus Activities)

Table 51. Chinese state-owned enterprises among the Fortune 100 ranking

State-owned enterprise	2018 ranking	2015 ranking	Main business	Controlling authority	Revenue (billion USD)	Total assets (bn. USD)	Employees (thousand)	Return on assets (%)
State Grid	2	7	Electricity	SASAC	349	585	914	1.6
Sinopec Group	3	2	Energy	SASAC	327	347	668	0.4
China National Petroleum	4	4	Energy	SASAC	326	529	1470	-0.1
China State Construction Engineering	23	37	Construction	SASAC	156	240	270	1.1
Industrial & Commercial Bank of China	26	18	Finance	Ministry of Finance	153	4006	453	1.0
China Construction Bank	31	29	Finance	Ministry of Finance	139	3397	370	1.1
SAIC Motor	36	60	Vehicle manufacturing	SASAC (Shanghai)	129	111	149	4.6
Agricultural Bank of China	40	36	Finance	Ministry of Finance	122	3233	492	0.9
China Life Insurance	42	94	Finance	Ministry of Finance	120	553	170	0.0
Bank of China	46	45	Finance	Ministry of Finance	115	2989	311	0.9
China Mobile Communications	53	55	Communication	SASAC	110	264	468	4.2
China Railway Engineering Group	56	71	Transport	SASAC	103	130	290	0.9
China Railway Construction	58	79	Construction	SASAC	101	127	365	1.0
Dongfeng Motor	65	109	Vehicle manufacturing	SASAC	93	71	180	2.0
China Resources	86	115	Consumer goods, finance, etc.	SASAC	82	187	423	1.7
China National Offshore Oil	87	72	Energy	SASAC	81	173	98	1.7
China Communications Construction	91	165	Construction	SASAC	79	183	161	0.8

Sources: Fortune 500, available at <http://fortune.com/global500>, accessed on October 23, 2018, and Molnar, M. 2017, Boosting firm dynamism and performance in China. OECD Economic department working paper No. 1408

HIGH-TECH ZONES

In China, the term "high-tech zone" usually refers to a "National-Level High-Tech Industry Development Zone". Neither the NDRC nor the Ministry of Industry and Information Technology provide direct financial support for the development of Chinese industrial clusters. However, companies located in these zones benefit from better infrastructure and access to talent, and can receive special incentives such as lower tax rates.

The national high-tech zones have become the main engine for driving growth in China's economy. The zones have nurtured around 40 per cent of China's high-tech companies. In 2017, the zones housed more than 350 State key laboratories, 2 900 research institutes and 11 000 company technology centers. The gross domestic product of national high-tech zones reached 9.5 trillion yuan (1.2 trillion euros), representing 11.5 per cent of the country's total GDP last year. The national high-tech zones added more than 136 000 new companies from January to May 2018,

a 25 per cent increase over the previous year. They also exported goods and services valued at 1.4 trillion yuan (180 billion euros) in the first five months of 2018, accounting for 22 per cent of China's total exports during the period.⁵⁹

The first China high-tech zone was established in Beijing in 1988 at Zhongguancun Science Park. Since then the number of national level high-tech zones has increased rapidly and there are currently 168 zones located in 31 provinces. Altogether, there are six

⁵⁹ Zhang, Z. 2017. High-tech zones are 'driving growth'. China Daily, 7 July 2018

different park types. However, not all Chinese high-tech zones have national approval. Local governments see these

zones as a useful tool for developing industries. There are many high-tech zones

which have been set up locally and do not have national level approval.

Israel

For several decades after its founding in 1947, Israel's economy was heavily dominated by the public sector and trade was greatly restricted. Since the late 1980s, the government has actively created policies to unleash the potential of the private sector. It has played a critical role in pioneering innovative industries by encouraging companies to take risks and experiment with new ideas.

TECHNOLOGICAL CLUSTERS⁶⁰

The Technology Clusters in which Israeli firms have the highest share of global turnover and profits are presented in Table 55. Not surprisingly, Israeli cluster programs concentrate on these industry sectors.

Biofuels and Energy Agriculture Cluster

The Biofuels and Energy Agriculture cluster emerged from decades of academic and applied research in the fields of biotech, agriculture and chemistry; from world leading agrotech and agro-industry and from advanced biotech industries.

Table 52. Traded industry sectors with the highest Israeli share of global turnover and profits

Traded industry	Average share of global turnover and profits	Rank (absolute)	Rank (per inhabitant)
Agricultural Inputs and Services	7%	4	2
Biopharmaceuticals	4%	5	3
Textile Manufacturing	3%	5	4
Furniture	2%	5	6
Apparel	1%	8	7
Printing Services	1%	15	11
Downstream Metal Products	1%	12	11
Information Technology and Analytical Instruments	1%	11	11
Transportation and Logistics	0%	21	28
Hospitality and Tourism	0%	16	24

Note: The turnovers and profits of the companies headquartered in the country is calculated and compared to the global total (OECD and COSME countries). Absolute ranking is based on the total value, relative ranking to the total value divided by the country's population.

New types of fuel and biomass crops as well as algae technologies are in development, and innovative processes and catalysts for conversion of feedstock

and waste into fuels are about to change the economics of biofuels.

Electric Vehicle and Energy Storage Cluster

The Electric Vehicle (EV) and Energy Storage Cluster emerged from academic and applied research in the fields of electrochemistry and electric engineering,

⁶⁰ This section draws from Prime Minister's Office: Technological Clusters, <http://www.pmo.gov.il/English/PrimeMinistersOffice/DivisionsAndAuthorities/OilFree/Pages/OilTech.aspx> [Accessed 25 October 2018].

excellent information and communication technology industries, and a local business culture of entrepreneurship and innovation. The cluster also benefits from development and production of special energy applications for use in the defence and biomedical sectors. Companies in the cluster develop and produce improved batteries; new types of fuel cells, super-capacitors and metal-air batteries; grid and battery management systems; EV infrastructure solutions and managed EV charging systems.

The Israeli government has taken steps to incentivise a local market for implementation of EV technologies and infrastructures, offering large tax benefits and regulatory support.

Natural Gas and Synthetic Fuels Emerging Market

Recent findings of huge natural gas fields off the Israeli coast are turning Israel into a leading regional energy supplier. The Israeli government is building a long-term strategy and policies for increasing the use of gas in Israel. One of the main targets of the

government is increasing the use of natural gas and natural gas based synthetic fuels in the Israeli transportation sector.

Engines, Composite Materials and Other Technologies

Many Israeli companies and start-ups are providing various solutions for reducing fuel consumptions of vehicles. This is backed by advanced academic and applied research and defence developments. Creative companies are developing new engines, efficient power train technologies and new composite light materials.

Japan

INDUSTRIAL CLUSTER PROJECT⁶¹

In 2001, the Japanese Ministry of Economy, Trade and Industry introduced a plan to enhance Japan's industrial competitiveness. This ongoing project involves regional SMEs and start-ups who use research results obtained from

universities and research institutes to establish industrial clusters.

Although some Japanese cluster organisations are matching their EU equivalents with regard to definition and activities, most of the cluster structures correspond to a R&D centre that

coordinates private companies, universities and public entities in the realisation of very specific research projects, usually funded by public funds. Other clusters are acting as a communication network aimed to share information, and do not have any real physical entity.

Table 53. Traded industry sectors with the highest Japanese share of global turnover and profits

Traded industry	Average share of global turnover and profits	Rank (absolute)	Rank (per inhabitant)
Recreational and Small Electric Goods	37%	1	5
Textile Manufacturing	30%	1	6
Downstream Chemical Products	28%	2	4
Appliances	25%	1	5
Production Technology and Heavy Machinery	25%	1	10
Vulcanized and Fired Materials	24%	1	7
Automotive	24%	1	5
Upstream Metal Manufacturing	24%	1	7
Apparel	21%	1	8
Lighting and Electrical Equipment	21%	2	8

Note: The turnovers and profits of the companies headquartered in the country is calculated and compared to the global total (OECD and COSME countries). Absolute ranking is based on the total value, relative ranking to the total value divided by the country's population.

⁶¹ This section draws from the EU-Japan Centre for Industrial Cooperation, <https://www.eu-japan.eu/> [Accessed 25 October 2018].

Some regional areas with a concentration of companies operating within a specific sector are considered as industrial clusters although they do not have any de facto “cluster organisation” to coordinate them but are supported by local development agencies. Japan Innovation Network (JIN) is an example of a cluster that is based on close ties between corporations, government and industry. It was established in 2013 by METI and it helps large companies to innovate. Sony, Hitachi, NTT, Panasonic and NEC are part of the network.

In some cases local Regional Industrial Promotion Agencies are supporting such companies in their internationalisation process. This support is provided by a “cluster department” within the Agency, but without any visual display of their existence or cooperation with regional

METI’s offices or with the Japan External Trade Organisation (JETRO).

JETRO has developed a mapping tool⁶² that provides information about the industrial clusters in various regions of Japan and various sectors. For example, Okinawa is defined as Asia’s major “Smart Hub”, which signifies a strong role in IoT (Internet-of-Things) development. The industrial clusters are not necessarily supported by a cluster organisation but are localised on a map.

There are at least 52 cluster organisations in Japan, in the following fields:

- Pharmaceuticals, biotechnology, healthcare, medical and welfare: 28 clusters
- Environment and energy: 3 clusters
- IT: 2 clusters

- Automobile and transport equipment: 2 clusters
- Electronic components, devices and semiconductors: 6 clusters
- Precision manufacturing: 2 clusters
- Aerospace: 2 clusters
- Food: 2 clusters
- Material, energy, nanotech, robotic, marine: 1 cluster each

Of these 52 cluster organisations, 14 show recent ongoing activities with EU organisations.

Some financial supporting programmes have recently been launched that could also apply to existing clusters. These annually budgeted programmes aim to provide funding to improve regional industries.

South Korea

South Korea is a noted case of a successful economic catch-up, which was accomplished through a government-led, manufacturing and export-oriented strategy.

In 1998, the country launched radical reforms in the fields of labour, business, government and funding when President Kim took office. South Korea also searched for new growth sources appropriate to the knowledge economy and the government extensively supported ICT and creative venture enterprises.⁶³

South Korea appears frequently in our statistics for rapidly growing start-ups and fast growing firms. This might be because of active government support via tax incentives, and direct investments have contributed to a broad and expanding

venture capital market in recent years. In addition, angel investments, which fell by more than 90% between 2000 and 2011, have been growing recently due to policy initiatives. These include, for instance, greater tax deductibility of angel investments, creation of an Angel Investment Support Center to facilitate matchmaking between angel investors and young companies, and the founding of a co-investment scheme (Angel Investment Matching Fund). Other policy instruments targeted at supporting alternative funding channels for new and growth-oriented SMEs include the introduction of a regulatory framework for crowdfunding, increased tax deductions for equity investments, the launch of the Korea New Exchange (KONEX), which is a dedicated platform for public listings for SMEs, and the introduction of facilitating measures

(e.g. tax incentives and lighter regulation) for mergers and acquisitions involving start-ups or venture businesses. Moreover, the government has provided funds for investment and debt restructuring and expanded the scope of protected assets during bankruptcy in order to facilitate a second opportunity for entrepreneurs.

CENTRES FOR CREATIVE ECONOMY AND INNOVATION

Centres for Creative Economy and Innovation (CCEIs) were established to underpin start-ups and SMEs across the regions in South Korea. Large companies with massive production and marketing capabilities as well as capital and technology were also in an important position in facilitating the establishment of regional creative economy ecosystems in

⁶² <https://www.jetro.go.jp/en/invest/region/icinfo/> [Accessed 25 October 2018]

⁶³ OECD. 2014. Industry and Technology Policies in Korea. OECD Reviews of Innovation Policy. Available at <https://www.oecd-ilibrary.org/docserver/9789264213227-en> [Accessed 25 October 2018]

Table 54. Traded industry sectors with the highest Korean share of global turnover and profits

Traded industry	Average share of global turnover and profits	Rank (absolute)	Rank (per inhabitant)
Insurance Services	13%	2	4
Apparel	11%	2	4
Education and Knowledge Creation	10%	2	6
Upstream Chemical Products	9%	3	6
Leather and Related Products	9%	2	4
Water Transportation	8%	3	11
Plastics	5%	3	13
Footwear	5%	4	6
Textile Manufacturing	5%	4	12
Metalworking Technology	4%	2	18

Note: The turnovers and profits of the companies headquartered in the country is calculated and compared to the global total (OECD and COSME countries). Absolute ranking is based on the total value, relative ranking to the total value divided by the country's population.

order to supplement the weaknesses of each region.⁶⁴

Each CCEI has different focus areas and company partners in order to maximise the resources, networks and markets already established in the surrounding region. For example, KT Corporation, the biggest telephone company in South Korea, sponsors the Kyunggi Province CCEI. Its focus areas are the IoT (Internet-of-Things), games and financial technology. CCEI on Jeju Island concentrates on culture, software, IT and tourism and collaborates with Kakao, the internet company that designed Kakaotalk, the most widely used instant messaging platform in South Korea. Kakao has its headquarters on the island.

Other companies that have partnered with CCEIs to support rising start-ups and SMEs include large conglomerates such as CJ, Posco, LG, Naver and Samsung.⁶⁵

It is surprising to see that CCEIs' focus areas and the strong Korean multinationals do not show up particularly well in our analysis of the traded clusters where the Korean firms have the highest share of global turnover and profits. This is because these firms are giant conglomerates that operate in a large number of industries. Consequently, their turnovers and profits are distributed in a number of industries.

Despite the close interaction between the government and conglomerates in the

South Korean administrative environment, the administration and CCEIs are now at a transitional stage (following the corruption scandal of the previous president) and the relationship between the conglomerates and the government is currently unclear.⁶⁶

The CCEIs also face challenges with respect to regenerating their core businesses. Many CCEIs are required to implement reforms and adapt to changes in operation and funding environment. For example, the focus of the Samsung-supported Daegu CCEI has shifted from a strong textile and electronics industry towards the IT industry, such as developing drones and robotic technology.

⁶⁴ UN report. 2017. Strengthening the Creative industries for Development in the Republic of Korea. Empowering small and medium-sized enterprises, jobs and sustainable development. Available at http://unctad.org/en/PublicationsLibrary/ditcted2017d4_en.pdf. [Accessed 25 October 2018]

⁶⁵ Kyung Eun Park, R. 2016. Preparing students for South Korea's creative economy: The success and challenges of educational reform. Available at https://www.asiapacific.ca/sites/default/files/field/south_korea_education_report_updated.pdf. [Accessed 25 October 2018]

⁶⁶ Interview of Jungwoo Lee, Science and Technology Policy Institute (STEPI) by Maria Mäntylä, Technical Research Centre of Finland VTT, March 2018.

Figure 17. Centres for Creative Economy and Innovation



Source: CCEI website, <https://ccei.creativekorea.or.kr>

United States

INNOVATIVE ECONOMY CLUSTERS⁶⁷

In September of 2010, US Small Business Administration (SBA) funded 10 Innovative Economy Clusters selected from among 173 applicants. These clusters represented a wide range of diverse geographic areas and industries and focused on leading research and commercializing new products.

SBA is supporting two types of innovative economies: Regional Innovation Clusters and Advanced Defense Technologies. The seven Regional Innovation Clusters focus on providing business training, commercialisation and technology transfer services, counselling, mentoring and other services that support the growth and development of small businesses in the cluster region. The Regional Innovation Clusters are:

- The focus of the Project 17 Agricultural Technology Cluster (California) is on agricultural innovation, including production, related physical and human capital infrastructure and cutting-edge agriculture research.
- Carolina's Nuclear Cluster provides strategy, structure and on-the-ground execution to boost North and South Carolina businesses serving the nuclear energy industry locally, regionally and multi-nationally.
- Northeast Electrochemical Energy Storage Cluster works to enhance economic growth by developing, manufacturing and deploying fuel cell and hydrogen technologies and associated fueling systems.
- Enterprise for Innovative Geospatial Solutions organises complimentary geospatial businesses, government agencies and educational institutions in Mississippi and the Louisiana Gulf Coast to help create a trained workforce, to transfer geospatial technology from public institutions into the market and to foster new business growth.
- Illinois Smart Grid Regional Innovation Cluster is a collaboration of more than 100 entities in the Chicago region, focused on the acceleration of Smart Grid innovation, deployments and new market development.
- The Northeast Ohio Technology Coalition focuses on advanced energy and flexible electronics. The Internet-of-Things (IoT) is emerging as a major economic driver in Northeast Ohio that has the potential to increase manufacturing productivity for the region.

Table 55. Traded industry sectors with the highest American share of global turnover and profits

Traded industry	Average share of global turnover and profits	Rank (absolute)	Rank (per inhabitant)
Aerospace Vehicles and Defence	81%	1	2
Tobacco	55%	1	2
Medical Devices	49%	1	5
Information Technology and Analytical Instruments	47%	1	6
Biopharmaceuticals	45%	1	8
Oil and Gas Production and Transportation	43%	1	5
Upstream Chemical Products	34%	1	9
Furniture	34%	1	12
Paper and Packaging	31%	1	13
Recreational and Small Electric Goods	29%	2	9

Note: The turnovers and profits of the companies headquartered in the country is calculated and compared to the global total (OECD and COSME countries). Absolute ranking is based on the total value, relative ranking to the total value divided by the country's population.

⁶⁷ This section draws from Innovative Economy Clusters, <https://www.sba.gov/content/innovative-economy-clusters> [Accessed 25 October 2018].

- Upper Michigan Green Aviation Coalition is a public-private partnership with 41 members participating in the creation of an industry cluster surrounding the concept of green aviation.

The SBA also worked with the US Department of Defense (DoD) to identify areas around the country where regional innovation clusters can help meet critical defence technology needs.

Many of the aforementioned clusters are among the traded clusters where the United States has the highest share of global turnover and profits (see Table 55). The same applies for the following regional and local cluster examples: Pittsburgh, Research Triangle in North Carolina and Seaport Innovation District in Boston, which have strong emphases on bio- and medical device technologies as well as on information technologies.

LOCAL AND REGIONAL CLUSTER INITIATIVES

In a recent study of American clusters, Baily and Montalbano concluded that there are many successful clusters in the United States and that policy makers, universities and local leaders have all contributed to that success. For example, Pittsburgh has been able to transform into a vibrant economic city following the collapse of the steel industry. North Carolina has created a thriving research park and Boston has been able to bring innovative start-up companies

to the Seaport district. All levels of government have played a role in supporting and developing these clusters and non-profit and philanthropic support has also been valuable.⁶⁸

Pittsburgh, Pennsylvania (Urban Cluster)⁶⁹

Pittsburgh was known as the “steel city” because of its iron and steel industry, but employment in the steel industry collapsed in the 1980s. It has since developed technology clusters around biotech, pharmaceuticals and information technology. Today, Pittsburgh is a symbol of renaissance following industrial decline.

The cluster’s core competencies lie in the research capabilities of the University of Pittsburgh (UPitt) and Carnegie Mellon University (CMU). Pittsburgh was able to participate in healthcare, one of the largest segments of the US economy. The University of Pittsburgh Medical Center is a top-tier hospital and research institution and is the largest single employer in the county.⁷⁰ On the other hand, Carnegie Mellon University is a highly regarded institution that developed expertise in computer science and artificial intelligence. These institutions allowed Pittsburgh to develop two technology clusters: one around biotech and pharmaceuticals and the other around information technology.⁷¹

Research Triangle Park (Regional Cluster)

The Research Triangle in North Carolina includes the cities/town of Raleigh, Durham and Chapel Hill and is outlined by three

educational institutions: Duke University, University of North Carolina- Chapel Hill (UNC) and North Carolina State (NC State). The Park was created to increase research in the region’s universities and to attract companies involved in research and development. The two most prominent clusters in the park are biotech and pharmaceuticals, and information technology.

The Research Triangle Park’s success was due in large part to many of the same factors that led to success in Pittsburgh: excellent research universities, high levels of federal and state funding, positions in fast-growing sectors, forward-thinking and strong leadership, low costs of living and a high quality of life.⁷²

Seaport Innovation District – Boston, Massachusetts⁷³

The Seaport Innovation District was a planned initiative—an officially designated and branded area. Seaport is a “re-imagined urban area” that has transit access, historic building stock and is close to downtown Boston. There is no anchor university or research firm in the district. Instead, the city is the main actor.

The Innovation District was a result of the vision and initiative of former Mayor Thomas Menino. Serving as Mayor of Boston from 1993 to 2014, Menino capitalized on the waterfront to create a dense cluster of work buildings, dining and entertainment options and physical spaces

⁶⁸ Baily, M. and Montalbano, N. 2018. Clusters and Innovation Districts: Lessons from the United States Experience. Brookings Economic Studies, May 2018, Washington

⁶⁹ This section draws from Porter, M. 2001. Pittsburgh. Clusters of Innovation Initiative. Council on Competitiveness. Available at: http://www.clustermapping.us/sites/default/files/files/resource/Clusters_of_Innovation_Initiative-_Pittsburgh.pdf [Accessed 25 October 2018]

⁷⁰ https://www.workstats.dli.pa.gov/Documents/Top%2050/Allegheny_County_Top_50.pdf [Accessed 25 October 2018]

⁷¹ Doyle, P. 2015. An Innovation Case Study: Pittsburgh. Technology Review. Available at: <https://www.technologyreview.com/s/543376/an-innovation-case-study-pittsburgh/> [Accessed 25 October 2018].

⁷² Baily, M. and Montalbano, N. 2018. Clusters and Innovation Districts: Lessons from the United States Experience. Brookings Economic Studies, May 2018, Washington

⁷³ This section draws from The Intersector Project. 2015. The Development of Boston's Innovation District: A Case Study of Cross-Sector Collaboration and Public Entrepreneurship. Available at: <http://intersector.com/wp-content/uploads/2015/10/The-Development-of-Bostons-Innovation-District.pdf> [Accessed 25 October 2018].

where entrepreneurs could converge. He and his team proposed the plan, attracted major tenants, engaged the community, promoted the project, created flexible housing options and mobilized resources.

The development of the Boston Innovation District provides an example of a government-led economic development approach involving collaboration across sectors.

Glossary

Cluster star – This cluster strength measure is based on five dimension: cluster size (i.e. number of employees in the given industry), the degree to which the cluster is specialised (measured by the location quotient), employee productivity (measured by average wage), SME performance (number of high growth firms) and innovation leaders (number of global frontier firms). For the first three dimensions, a star is assigned to regions that are in the top 20 per cent in Europe in the years 2014, 2015 and 2016 (with a star being allocated for each year for each dimension). For the latter two dimensions, three stars are assigned to regions that are in the top 20 per cent in Europe in the years 2008 – 2016, two in the top 20-40 per cent and one in the top 40-60 per cent. The highest possible cluster star number that a dynamic regional cluster can obtain is therefore 15.

Composite Indicator of Industrial Change – The Composite Indicator of Industrial Change (CIIC) builds on the work done by the 2011 EC Expert group on Measuring Innovation, in particular the sub-group on Measuring Structural Change, and the follow-up by the Joint Research Centre fine-tuning the indicators proposed by the Expert group. Following these references, industrial modernization is understood to rely on different dimensions including economic development, evolution towards a more innovative regional economy, new and emerging technologies, digitalisation, firm investments, entrepreneurship, internationalisation and creativity. For each dimension specific indicators have been selected and average performance for the selected indicators is captured in a composite indicator. For more information, see European Observatory for Clusters and Industrial Change. 2019. Methodology report for the European cluster database.

Emerging industry – The establishment of an entirely new industrial value chain, or the radical reconfiguration of an existing one, driven by a disruptive idea, leading to turning these ideas into new products or

services with higher added value. Ten cross-sectoral related emerging industries have been identified and are analysed in this report, which description are also added further below.

Global Frontier – The labour productivity (value added based, per employee), calculated by adding up factor incomes going to employees (wages) and to capital owners (profits), which the top 5% of firms reach within any given sectoral or emerging industry and year.

GVA (Gross Value Added) – GVA measures the contribution of each economic unit by estimating the value of an output (goods or services) less the value of inputs used in that output's production process.

High Growth Firm – A firm that initially possesses at least ten employees and that experiences average annualized turnover/employment/total assets growth of at least 20 per cent per annum, over a three-year period. The firm must have total assets of 500 000 euros at least.

Industry Leader – A company that belongs to the top 1% of companies having the highest turnover or the highest profits in any particular year in any given sectoral or emerging industry.

Location quotient – A location quotient measures the specialisation of an area in an activity (e.g. sector) compared to a wider geographical area (e.g. EU). The location quotient is calculated as the industry's share of total employment in a given region compared to the industry's share of total employment in all countries considered in the analysis. Values above unity imply high regional specialisation, with a location quotient of two corresponding to twice as many employees in an industry than would be expected if all employment was distributed evenly.

Rapidly growing start-up – A firm that possesses from 3 to 20 employees and that experiences such a high average turnover, employment or asset growth over a one-,

two- or three-year period that it belongs to the top 10% of firms within any given sectoral or emerging industry. The firm must have total assets of 500 000 euros at least.

Specialised cluster – A traded cluster that has a specialisation rate of over 1.5 – measured by the location quotient – and has more than 500 employees in the traded cluster.

Traded cluster – Traded clusters are geographic concentrations that result from the cluster mapping of traded industries, and hence are groups of closely located related traded industries. Traded industries are those where firms sell their products and services across many regions, compete with rivals from other locations and as a result also tend to cluster together in in regions with favourable business environments.

Emerging industries

Advanced Packaging comprises conventional packaging industry complemented by stakeholders creating and providing additional added-value products and services to fulfil or expand the scope of the core functions of the packaging. This emerging industry includes the paper and packaging industry sector, with the highest complementation from plastics and downstream metal products sectors.

Biopharmaceuticals as an emerging industry is an expansion of the biopharmaceutical sector, with upstream and downstream chemical products and other core activities, such as research and development. Biopharmaceuticals form the scientific basis of the life science industries.

Blue Growth industries includes all sectors and industries related to a maritime environment, as well as sectors producing, making use of and treating fresh-water sources. This emerging industry includes the fishing and fishing products, and electric power generation and transmission

industry sectors, with the highest complementation from water transportation and environmental services sectors.

Creative industries includes the business services; marketing, design, and publishing; music; and video production industry sectors. Creative industries comprise activities related to the creation, production and/or distribution of creative goods and services as well as to the integration of creative elements into wider processes and other sectors.

Digital industries covers core sectors in the information age, combining services related to information technologies with the hardware they use. This emerging industry includes the communications equipment and services, and information technology and analytical instruments industry sectors, with the highest complementation from lighting and electrical equipment, and medical devices sectors.

Environmental industries comprises those industries that intend to influence positively the natural environment. These emerging industries provide cleaner technologies and innovative products and services that reduce environmental risk and minimise pollution and resource use.

Experience industries covers creation and consumption of “experiences”. This emerging industry lies at the intersection of art and business and combines creation and consumption of cultural products and services. Experience industries include the hospitality and tourism, and performing arts sectors.

Logistical Services is an expansion of the transportation and logistics sector. This emerging industry includes the logistics operation provision and the development and provision of IT-systems for the logistics planning, organisation and management.

Medical Devices is a core part of the life sciences industry and connects to a large and growing area of local health care

services. This emerging industry combines the fields of science, engineering and technologies to facilitate new innovations in the biomedical sphere and an increasing convergence of physical and biological technology platforms. It extends the industry sector category of the same name to include appliances, lighting and electrical equipment, and information technology and analytical instruments.

Mobility Technologies as an emerging industry stems from the automotive sector as a core and expands it with related technologies from the production technology and aerospace sectors, as well as a few related upstream activities such as metalworking, plastics, and lighting and electrical equipment.

Methodological appendix

This appendix summarises the methodology followed to collect and analyse the data for this report.

Orbis database by Bureau Van Dijk

We use in our analysis firm-level data from the Orbis database by Bureau Van Dijk. Administrative datasets such as the Orbis database typically have a census-like nature and have a broad coverage. Because of their large size, administrative databases often allow applied economic analysis of subgroups, for example, investigating firm behaviour by industry and/or enterprise size or by geographical area.

In addition, administrative micro-data permit the construction of longitudinal panels. The creation of panel datasets of company micro-data clearly requires continuity over time in firm-level information in order to guarantee a sufficient panel size. Official business surveys are somewhat hampered in this regard, as firms are selected on the basis of a rotating sample to minimise response burdens. This means that the probability that a firm is surveyed continuously over time is very low, especially for small enterprises and micro-firms.⁷⁴

REPRESENTATIVENESS ISSUES

Orbis brings together firm-level data from many countries. In addition to the European countries, Orbis covers other, non-European countries, notably the United States, Japan and Korea. Orbis does not cover all variables equally well in all countries. Hence there is a trade-off between coverage and the type of analysis one can carry out. More specifically, the key obstacle to including a wider coverage of countries in the analysis is the lack of availability of certain variables, for

example, value add or employment costs together with profit/loss accounts.

Generally, most large European countries but also smaller ones have data which are almost equally well suited for obtaining measures of either labour or productivity. However, for some English-speaking countries, e.g. Canada and the United States, and small EU countries, e.g. Estonia and Greece, these variables are not readily available, or only partially.

Although the coverage of Orbis is less satisfactory for the United States than for many European countries, its coverage of US affiliates abroad is still good. In addition, firms located in the United States are well represented in the global frontier grouping. On the other hand, multinational firms may systematically shift profits across the countries in which they have affiliates, depending on the tax system of the countries of its affiliates. It is not clear in which direction these factors will bias the analyses.

ISSUES IN FINANCIAL STATEMENTS

The largest problem with the Orbis database is the probable difference between countries in the types of enterprises that are included in the company population. The requirements for inclusion, such as registration at a Chamber of Commerce or activity above a certain threshold, differ from one country to another. This means that the coverage of certain sectors and especially of smaller companies may not be consistent between countries. This tends to result in smaller and younger firms being under-represented in some economies. This is one reason for the decision to analyse firms with more than 20 employees separately from those with less than that number.

For a company, the Orbis database reports one or more financial statements, whose

type is specified by the consolidation code. Most of the large companies report either consolidated accounts (the statement of a parent company integrating the statements of its controlled subsidiaries) or unconsolidated accounts (the statement not integrating the statements of the controlled entities).

A general practice in total factor productivity research is to use unconsolidated accounts only. Consolidated accounts would involve double counting when both the consolidated account of the parent with all its subsidiaries and the unconsolidated accounts of the subsidiaries were reported. However, when drafting the lists of industry leader, global frontier, high-growth firm, or rapidly growing start-up firms, both consolidated and unconsolidated accounts were used. This was done for the purpose of picking up the key players in each emerging industry and traded industry sector, and analysing their regional and national vicinity. The aim of the company analysis is not to aggregate economic activity, but to analyse how key industry players, both established and growing ones, are distributed among various geographical regions.

For example, the Finnish multinational Kone Corporation appears three times in the Orbis database for Finland: as the consolidated “Kone Oyj” with over 55 000 employees, and as unconsolidated accounts “Kone Industrial Oy” and “Kone Hissit Oy”, both having around 700 employees. From Kone Corporation’s annual report, we know that Kone employs about 2 400 persons in Finland, that is, there are around 1 000 persons in Kone headquarters that do not directly show up in the Orbis database. Clearly, a large multinational corporation is an important player for the national innovation ecosystem, its influence does not

⁷⁴ Ribeiro, S., Menghinello, S. and De Backer, K. 2010. The OECD ORBIS Database: Responding to the Need for Firm-Level Micro-Data in the OECD. OECD Statistics Working Papers 2010/1, OECD Publishing.

necessarily show up in unconsolidated accounts and it needs to be included one way or another in the analysis.

Another example concerning the problems with unconsolidated/consolidated accounts is the Finnish start-up Uros. It reached a turnover of 481 million euros in 2017 with an average annual growth rate of 865% over the previous three years. However, in the Orbis database the company appears with consolidated accounts only, although it has only 27 employees.

In the Orbis database, large corporations are not necessarily tied to a particular region. If this was the case, the company's possible presence in our industry leader, global frontier or high growth firm lists were divided to all regions in the particular country according to those regions' population shares. That is, a highly populated region got a bigger share of that company's "success" than a less populated region. Moreover, when calculating how well a region can attract or nurture Industry Leaders, Global Frontier or High Growth Firms, or rapidly growing start-ups, we use relative measures. That is, we divide the number of such companies by the region's population (million people). An exception is the section about European cluster strength and competitiveness, where we also present absolute shares.

Companies are usually classified according to their primary activity. In our analysis, a company's turnover, employment and assets contribute to its primary activity and industrial sector only. This may create some biases since, in reality, a company's output

might contribute to a number of different industrial sectors.

FILTERING FOR OUTLIERS

One could notice that on a few occasions, there are remarkable changes in the number of employees in a company even though there is no major change in the company turnover. Hence it is assumed that these observations are false and they were corrected. More specifically, the turnover/employee ratio for each company for each year was calculated. It is assumed that the first and last year figures are correct and calculated a turnover/employee trend between these years. If for a particular year, this ratio differed more than one standard deviation from the company trend, the expected turnover/employee ratio was used to calculate an estimated number of employees for that year, and then this estimate was used for the further analysis.

Identifying and categorising clusters

Research on clusters emphasises the productive benefits firms can draw from connections with other proximate firms and actors. Due to the difficulty of capturing such definition and economic phenomena statistically, the question remains how best to identify and categorise clusters and how to translate the findings on the revealed effects of clusters and identified patterns into recommendations for cluster-specific policies.

Since the early 2000s, several quantitative cluster mapping exercises have emerged to

tackle the issue. at European level the European Cluster Observatory provided the first cluster mapping with a consistent methodology to compare cluster strength across Europe.⁷⁵ Many of the existing mappings are available as open and interactive regional datasets, based on a common benchmark set of cluster definitions (e.g. cluster mappings for the EU⁷⁶, United States⁷⁷, Canada⁷⁸ and Mexico⁷⁹).

Cluster mappings evaluate the size and performance of clusters in different areas using a common set of relatedness indicators. The key benefit from these mappings is that, instead of relying mainly on case studies and expert choice, a transparent and data-based algorithm can be used to perform much of the clustering.

GROUPING INDUSTRIES INTO CLUSTERS

The most widely used approach to grouping industries into clusters is the algorithm developed by Delgado et al.⁸⁰ It builds on previous work by Porter⁸¹ and provides a transparent and systematic way to create several alternative cluster configurations and to rank them in order to select the ones that best describe the desired inter-industry linkages

Another trend during the past decades, however, has been the ever-deeper integration of global value chains, which has made long linkages between countries and even continents an everyday feature of today's economic activity. Because of the deeper international integration, traded commodities can travel long distances and cross national borders multiple times as an intermediate product before eventually

⁷⁵ www.clustercollaboration.eu/cluster-mapping

⁷⁶ ibd

⁷⁷ www.clustermapping.us

⁷⁸ www.competeprosper.ca/clusters/data

⁷⁹ www.icluster.inadem.gob.mx/

⁸⁰ Delgado, M., Porter, M., Stern, S. 2014. Defining clusters of related industries. NBER Working Paper 20375; Delgado, M., Porter, M., Stern, S. 2016. Defining clusters of related industries. *Journal of Economic Geography*, Vol 16, 1-38.

⁸¹ Porter, M. 2003. The Economic Performance of Regions, *Regional Studies*, Vol 37, 549-578.

ending up with the final user. This development has had a tremendous impact not only on trade statistics, but also on the fragmentation of global economic geography.

TRADE IN VALUE ADDED (TiVA)

The OECD - WTO "Trade in Value Added" (TiVA) Initiative, launched in 2012, is one way to capture this development in global trade patterns. It provides a database consisting of 63 economies aggregated to 34 industrial sectors and allows for the analysis of different countries based on their trade profiles and their role in global value chains. Some key pieces of information from the data are, for example, the composition of foreign intermediate

goods and domestic value added in each country's exports as well as detailed country- and industry-specific origins of final consumption. The foreign value added share in domestic exports can be as high as 59 per cent for small integrated countries such as Luxembourg, but only less than 4 per cent for exporters of natural resources, such as Saudi Arabia.⁸²

The trade in value added data provides an analytical view to regional economic interdependencies. Experts such as Escaith and Gaudin used the TiVA data to group countries into clusters based on their trade profiles.⁸³ To categorise countries, they used a variety of indicators describing trade policy dimensions, trade in value added

profiles and other structural variables describing economic activity.

STABLE CLUSTER CONFIGURATIONS

Escaith and Gaudin emphasised that applying different clustering procedures yields very different results in terms of country groups. However, they were able to identify some cluster configurations that remain stable regardless of the clustering method used. The most stable groups are presented in Table 57 below. The groups can be differentiated based on their export category to commodities exporters, manufacturing products exporters and service exporters. For clarity, these categories are further split based on region and the level of economic development.

Table 56. Selected stable groupings between different clustering methods and TiVA indicators for Trade in Value Added

Trade profile (stable cluster configuration)	Countries
Commodities exporters (developing)	Argentina, Brazil, Chile, Mexico, South Africa
Commodities exporters (developed)	Australia, Canada, Norway, Russia
Manufacturing EU12	Bulgaria, Czechia, Estonia, Hungary, Slovakia, Slovenia
Manufacturing Europe and Near East	Austria, Finland, Israel, Sweden
Manufacturing Asian (developing)	China, Thailand
Manufacturing Asian (developed)	South Korea, Taiwan
Large service-oriented European	Cyprus, Denmark, France, Germany, Greece, Italy, Spain, Switzerland
Other large or service-oriented	Japan, USA

Source: Escaith and Gaudin, 2014

The strongest determinants of TiVA clusters are the country's natural resources and the level of orientation towards services. The structure of exports (commodity or manufacture) also plays a role. The level of economic development, on the other hand, appears to be an important factor but less decisive for the service-oriented economies. The findings also support the general observations that smaller economies tend to be more connected to global value chains compared with larger

economies that typically enjoy a stronger domestic demand.

The findings underline the strong and established patterns in global value chains. Particularly for the manufacturing sector, the large share of manufacturing in GDP is not associated with a high domestic value added in manufacturing exports, suggesting that these sectors often rely on a high content of imported materials. In addition, some policy variables appear to have an

effect on the TiVA profiles. These include, for example, foreign direct investments, development of international trade infrastructure as well as investments in ICT and R&D, providing further evidence against protective trade policies that aim to reduce the level of imports. Instead, countries that freely import intermediate goods are also able to export more and thus create a trade surplus.

⁸² OECD-WTO. 2016. Trade in Value Added Statistics. Available at: oe.cd/tiva

⁸³ Escaith, H. and Gaudin, H. 2014. Clustering Value-Added Trade: Structural and Policy Dimensions. WTO Economic Research and Statistics Division. Staff Working Paper ERSD-2014-08.

Annex A - Key statistics for specialised clusters 51 traded industries

This Annex presents key statistics – employment, average wage, average gross value added and their average annual changes over a five-year period – in specialised clusters for the following 51 traded industries. A **specialised cluster** is a regional concentration of related traded industries that has a specialisation rate of over 1.5, measured by the location quotient, and has more than 500 employees in the traded industrial sector.

Performance of specialised clusters by Traded industries	Employment 2016	Average change	Average wage 2016 (PPP)	Average change	Average Gross Value Added 2014 (PPP)	Value added by Global Frontier firms 2016	Average change
Aerospace Vehicles and Defence	309 000	-7.5%	39 800 €	8.5%	79 200 €	180 000 €	5.3%
Agricultural Inputs and Services	482 000	2.8%	21 500 €	3.4%	65 400 €	144 000 €	-7.9%
Apparel	1 366 000	0.5%	13 800 €	4.1%	30 800 €	81 000 €	1.3%
Appliances	238 000	4.9%	28 200 €	-2.2%	52 300 €	122 000 €	1.5%
Automotive	2 583 000	1.8%	38 400 €	1.3%	78 100 €	120 000 €	3.1%
Biopharmaceuticals	532 000	0.9%	55 500 €	3.2%	147 200 €	319 000 €	7.3%
Business Services	12 898 000	2.6%	49 000 €	1.1%	87 700 €	220 000 €	2.3%
Coal Mining	259 000	8.9%	22 800 €	3.3%	39 500 €	540 000 €	13.2%
Communications Equipment and Services	851 000	0.4%	49 100 €	1.1%	124 700 €	278 000 €	0.7%
Construction Products and Services	3 466 000	-0.4%	30 200 €	0.5%	51 700 €	167 000 €	3.3%
Distribution and Electronic Commerce	16 498 000	1.4%	36 100 €	0.8%	75 200 €	187 000 €	1.3%
Downstream Chemical Products	2 604 000	0.5%	31 700 €	1.1%	52 600 €	189 000 €	4.9%
Downstream Metal Products	1 028 000	0.3%	35 000 €	-0.4%	50 300 €	109 000 €	2.6%
Education and Knowledge Creation	5 019 000	2.7%	38 000 €	1.5%	56 000 €	135 000 €	1.9%
Electric Power Generation and Transmission	1 107 000	1.3%	41 400 €	1.3%	138 000 €	1 305 000 €	-1.9%
Environmental Services	1 404 000	1.1%	28 400 €	0.1%	48 300 €	190 000 €	1.8%
Financial Services	8 065 000	1.2%	45 400 €	5.2%	84 300 €	909 000 €	1.7%
Fishing and Fishing Products	481 000	0.9%	18 900 €	0.4%	46 100 €	173 000 €	8.3%
Food Processing and Manufacturing	2 503 000	1.4%	31 300 €	-0.7%	71 800 €	163 000 €	3.2%
Footwear	476 000	0.2%	18 800 €	1.8%	58 300 €	85 000 €	2.8%
Forestry	524 000	3.8%	18 600 €	5.7%	58 000 €	89 000 €	0.5%
Furniture	3 735 000	0.4%	30 200 €	0.9%	39 300 €	81 000 €	2.1%

Performance of specialised clusters by Traded industries	Employment 2016	Average change	Average wage 2016 (PPP)	Average change	Average Gross Value Added 2014 (PPP)	Value added by Global Frontier firms 2016	Average change
Hospitality and Tourism	11 845 000	2.9%	35 500 €	-0.7%	70 000 €	129 000 €	1.5%
Information Technology and Analytical Instruments	1 698 000	0.3%	50 200 €	0.7%	101 100 €	157 000 €	3.2%
Insurance Services	2 844 000	0.8%	43 100 €	3.1%	107 100 €	234 000 €	3.4%
Jewellery and Precious Metals	175 000	-3.7%	25 300 €	1.4%	37 000 €	118 000 €	0.2%
Leather and Related Products	123 000	0.9%	24 500 €	2.1%	145 400 €	111 000 €	2.5%
Lighting and Electrical Equipment	2 082 000	-0.8%	37 800 €	0.8%	51 300 €	123 000 €	1.9%
Livestock Processing	914 000	0.1%	25 900 €	0.1%	233 900 €	103 000 €	3.2%
Marketing, Design, and Publishing	2 133 000	0.7%	40 400 €	1.2%	88 800 €	167 000 €	0.1%
Medical Devices	742 000	0.9%	42 500 €	0.0%	59 900 €	161 000 €	5.2%
Metal Mining	64 000	9.8%	28 400 €	-6.8%	71 000 €	484 000 €	11.6%
Metalworking Technology	3 063 000	0.4%	35 300 €	-0.3%	47 800 €	101 000 €	1.2%
Music and Sound Recording	130 000	-2.5%	40 600 €	2.6%	64 900 €	339 000 €	-31.3%
Non-metal Mining	318 000	0.4%	29 000 €	-0.2%	59 000 €	157 000 €	3.2%
Oil and Gas Production and Transporta- tion	462 000	1.1%	64 700 €	-5.0%	28 100 €	1412 000 €	-5.0%
Paper and Packaging	1 068 000	-1.2%	34 600 €	1.1%	64 700 €	143 000 €	4.5%
Performing Arts	3 454 000	1.7%	46 000 €	-0.5%	69 600 €	147 000 €	-2.2%
Plastics	1 971 000	0.0%	33 700 €	0.9%	53 600 €	129 000 €	4.6%
Printing Services	1 305 000	-2.2%	34 000 €	2.1%	43 300 €	102 000 €	1.6%
Production Technology and Heavy Machinery	3 373 000	0.7%	42 900 €	-0.7%	66 200 €	128 000 €	1.8%
Recreational and Small Electric Goods	804 000	0.4%	29 800 €	0.4%	45 200 €	131 000 €	3.9%
Textile Manufacturing	1 203 000	1.0%	23 200 €	0.9%	31 200 €	101 000 €	4.0%
Tobacco	39 000	0.7%	45 700 €	4.7%	206 800 €	703 000 €	-4.7%
Transportation and Logistics	7 522 000	1.1%	28 600 €	2.0%	47 000 €	105 000 €	0.4%
Upstream Chemical Products	426 000	-2.1%	41 300 €	0.6%	83 300 €	349 000 €	5.7%
Upstream Metal Manufacturing	1 670 000	0.5%	39 800 €	0.0%	87 800 €	135 000 €	1.9%
Video Production and Distribution	392 000	0.8%	51 100 €	0.8%	98 100 €	512 000 €	2.3%
Vulcanized and Fired Materials	2 110 000	-1.8%	30 000 €	1.7%	52 300 €	114 000 €	2.5%
Water Transportation	917 000	0.9%	44 200 €	-0.6%	79 000 €	237 000 €	1.5%
Wood Products	2 539 000	-0.2%	25 600 €	0.5%	38 800 €	98.0 000 €	4.1%

Note: average change is the average annual change over a five-year period, typically 2011 – 2016.

Annex B - Specialised clusters vs other locations in 51 traded industries

This annex presents the average number of employees and the average wages in specialised clusters and other locations for the 51 traded sectoral industries. A **specialised cluster** is a regional concentration of related traded industries that has a specialisation rate of over 1.5, measured by the location quotient, and has more than 500 employees in the traded industrial sector.

The “**plain**” **wage premium** compares the average wage levels in specialised clusters and other locations directly. The “**modified**” **wage premium**, on the other hand, takes into account the average wage level in the country. For example, it can be that most of the specialised clusters locate in lower wage countries. In this case, the difference in wage levels follows from the differences between nations, not from the differences between specialised clusters versus other locations. For the “modified” wage premium, a traded industry’s wage level in a region is first compared to the region’s average wage level and the possible premium is calculated. These premiums for specialised clusters and other locations in a country are then summed up. Finally, the “modified” wage premium is the average of these national premiums.

The wage premium calculation does not, however, take into account the varying employee profiles different regions may have. For example, if a region hosts a specialised cluster in Aerospace Vehicles and Defence traded industry, the organisations in that region employ 6 700 employees, on average, with an average annual wage of 35 800 euros. This amount of employees surely includes a large number of blue-collar workers. On the other hand, the ca. 300 non-specialised regions employ around 200 persons only. Most of these persons probably hold a managerial position with a respective wage level.

Traded industry	Strong clusters		Other locations		Wage premium		
	Avg employment	Avg wage	Avg employment	Avg wage	Plain	Modified	Difference
Aerospace Vehicles and Defence	6 700	35 800 €	200	54 700 €	-35 %	-12 %	
Agricultural Inputs and Services	3 700	17 800 €	700	26 700 €	-33 %	5 %	
Apparel	13 500	8 800 €	1 400	25 600 €	-66 %	-5 %	
Appliances	3 800	24 100 €	200	40 500 €	-40 %	18 %	
Automotive	19 000	34 700 €	4 600	42 000 €	-17 %	21 %	
Biopharmaceuticals	6 400	55 500 €	700	55 500 €	0 %	14 %	
Business Services	116 200	56 000 €	25 400	44 400 €	26 %	18 %	
Coal Mining	7 700	20 100 €	100	45 900 €	-56 %	45 %	
Communications Equipment and Services	10 900	46 600 €	1 100	52 600 €	-11 %	52 %	
Construction Products and Services	20 300	24 200 €	7 300	34 300 €	-29 %	-6 %	
Distribution and Electronic Commerce	88 700	22 600 €	43 300	38 600 €	-41 %	14 %	
Downstream Chemical Products	27 500	27 400 €	4 400	35 800 €	-23 %	29 %	
Downstream Metal Products	5 900	34 500 €	2 000	35 400 €	-3 %	10 %	
Education and Knowledge Creation	29 100	36 800 €	10 200	39 000 €	-6 %	-6 %	
Electric Power Generation and Transmission	7 100	36 300 €	1 800	48 100 €	-25 %	16 %	
Environmental Services	7 900	20 400 €	2 900	34 600 €	-41 %	-14 %	
Financial Services	69 200	46 500 €	14 900	44 400 €	5 %	11 %	
Fishing and Fishing Products	12 700	16 500 €	300	28 100 €	-41 %	-9 %	
Food Processing and Manufacturing	9 500	24 100 €	6 200	35 700 €	-32 %	-1 %	
Footwear	7 700	17 100 €	300	24 700 €	-31 %	9 %	
Forestry	4 300	16 700 €	500	24 300 €	-31 %	20 %	
Furniture	24 500	23 800 €	6 900	36 300 €	-34 %	20 %	

Traded industry	Strong clusters		Other locations		Wage premium		
	Avg employment	Avg wage	Avg employment	Avg wage	Plain	Modified	Difference
Hospitality and Tourism	70 800	37 500 €	29 100	34 900 €	7 %	-12 %	
Information Technology and Analytical Instruments	12 800	53 900 €	3 400	47 700 €	13 %	4 %	
Insurance Services	29 900	43 600 €	5 000	42 600 €	2 %	43 %	
Jewellery and Precious Metals	2 100	23 200 €	300	28 100 €	-17 %	5 %	
Leather and Related Products	2 400	24 100 €	100	25 400 €	-5 %	9 %	
Lighting and Electrical Equipment	11 300	31 200 €	4 400	42 400 €	-26 %	-4 %	
Livestock Processing	5 800	22 400 €	1 600	30 100 €	-26 %	4 %	
Marketing, Design, and Publishing	24 000	44 400 €	4 000	37 600 €	18 %	57 %	
Medical Devices	5 700	43 600 €	1 300	41 400 €	5 %	24 %	
Metal Mining	2 300	25 900 €	<100	48 000 €	-46 %	-12 %	
Metalworking Technology	17 000	33 100 €	5 900	37 400 €	-11 %	2 %	
Music and Sound Recording	3 600	43 400 €	100	35 900 €	21 %	26 %	
Non-metal Mining	2 700	21 300 €	500	37 600 €	-43 %	-3 %	
Oil and Gas Production and Transportation	5 800	68 000 €	600	60 200 €	13 %	14 %	
Paper and Packaging	6 900	30 800 €	2 200	37 300 €	-17 %	7 %	
Performing Arts	36 900	63 400 €	6 900	36 100 €	76 %	-16 %	
Plastics	11 500	28 600 €	4 000	37 600 €	-24 %	7 %	
Printing Services	10 100	35 900 €	2 900	33 100 €	8 %	-11 %	
Production Technology and Heavy Machinery	20 100	43 800 €	6 100	41 900 €	5 %	-7 %	
Recreational and Small Electric Goods	7 300	28 300 €	1 200	31 900 €	-11 %	35 %	
Textile Manufacturing	11 300	18 500 €	1 600	31 200 €	-41 %	3 %	
Tobacco	1 500	47 600 €	<100	33 100 €	44 %	72 %	
Transportation and Logistics	52 800	17 000 €	17 600	32 800 €	-48 %	-18 %	
Upstream Chemical Products	3 700	37 700 €	700	44 700 €	-16 %	7 %	
Upstream Metal Manufacturing	10 800	36 800 €	3 000	42 800 €	-14 %	6 %	
Video Production and Distribution	6 200	59 200 €	500	39 600 €	49 %	34 %	
Vulcanized and Fired Materials	14 900	21 600 €	4 300	35 600 €	-39 %	8 %	
Water Transportation	8 700	44 000 €	1 100	44 600 €	-1 %	2 %	
Wood Products	16 700	19 600 €	4 600	31 600 €	-38 %	0 %	

