European Cluster Observatory

REPORT

European Cluster Panorama 2016

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Internal Market,
Industry,
Entrepreneurship
and SMEs

European Cluster Observatory in Brief

The European Cluster Observatory is a single access point for statistical information, analysis and mapping of clusters and cluster policy in Europe. It is primarily aimed at European, national, regional and local policy-makers and cluster managers and representatives of SME intermediaries. It is an initiative run by the 'Clusters, Social Economy and Entrepreneurship' unit of the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs and aims to promote the development of more world-class clusters in Europe, notably with a view to promoting competitiveness and entrepreneurship in emerging industries and facilitating SMEs' access to clusters and internationalisation activities through clusters.

The ultimate objective is to help Member States and regions to design smart specialisation and cluster strategies that will help companies to develop new, globally competitive advantages in emerging industries through clusters, and in this way to strengthen the role of cluster policies in boosting Europe's industry as part of the Europe 2020 Strategy.

In order to support evidence-based policy-making and partnering, the European Cluster Observatory provides an EU-wide comparative cluster mapping with sectoral and cross-sectoral statistical analysis of the geographical concentration of economic activities and performance. The European Cluster Observatory provides the following services:

- a biannual **'European Cluster Panorama' (cluster mapping)** providing an update of and extension to the statistical mapping of clusters in Europe, including for ten related sectors (i.e. cross-sectoral) and a correlation analysis with key competitiveness indicators;

- a **'European Cluster Trends' report** analysing cross-sectoral clustering trends, cluster internationalisation and global mega trends in industrial transformation; identifying common interaction spaces; and providing a forecast for industrial and cluster opportunities;

- a **'Regional Ecosystem Scoreboard'** setting out strengths and weaknesses of regional and national ecosystems for clusters, and identifying cluster-specific framework conditions for three cross-sectoral collaboration areas;

- a **'European Stress Test for Cluster Policy',** including a self-assessment tool accompanied by policy guidance for developing cluster policies in support of emerging industries;

- a **showcase of modern cluster policy practice, provided in the form of advisory support services to six selected model demonstrator regions**. The services offered include expert analysis, regional survey and benchmarking reports, peer review meetings and policy briefings in support of emerging industries. The policy advice also builds on the policy lessons from related initiatives in the area of emerging industries;

- the **European Cluster Conferences** 2014 and 2016, which bring together **Europe's cluster policy-makers and stakeholders** for a high-level cluster policy dialogue and policy learning, and facilitate exchange of information through, e.g. webpages, newsletters and videos.

More information about the European Cluster Observatory is available at the EU cluster portal at:
http://ec.europa.eu/growth/smes/cluster/observatory/.

Internal Market,
Industry, Entre-
preneurship and

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Key Facts at a Glance

The Role of Clusters in the European Economy

…3 000 strong clusters across Europe account for more than 54 million jobs and 45% of all traded industries' wages (23% of the overall economy)

…wages in strong clusters are close to 3% higher than in industries not located in such regional hotspots, and the wage gap towards both other traded industries and the overall economy is growing

…103 leading clusters are in the top 20% of European peers across all four performance dimensions measured (size, specialisation, productivity, and dynamism)

…all parts of Europe have clusters; 55% of all European regions have between 30% and 60% of traded industries employment in strong clusters

…strong clusters have shown resilience through the crisis; their share in total traded industry employment and wages has from 2008 to 2014 increased slightly to 45% (jobs) and 51% (wages)

…the industrial cluster landscape is constantly evolving as a result of changes in market conditions, technologies, and competition; about one fifth (20%) of all clusters significantly changed in their market position (strong, medium, weak) between 2008 and 2014

Emerging industries: Overall trends and hotspots

…account together for about 46% of all traded industry employment

…continue to outperform the rest of the traded economy with average wages about 9% higher than in all traded industries

…have about 40% of Europe economic activity in cross-sectoral, emerging industries concentrated in 20% of all European locations

…tend to be strongest in regions that have a strong portfolio of traditional sectoral clusters and above average economic performance with average value added per employee 37% above the EU average

…have each their own geographical footprint, indicating location-specific opportunities for specialisation and diversification

…the list of European hotspots of cross-sectoral, emerging industries differs significantly from the list of hotspots of traditional clusters

1. Introduction

The European economy has in the recent past made progress in putting one of the deepest economic crisis in its existence behind it. Exports are up, growth and investment have improved, and labour markets are slowly moving towards their pre-crisis state. Still, the economic challenges that EU member countries are facing remain formidable. The heterogeneity across Europe is high, and especially Southern European countries continue to struggle with high unemployment, particularly among the young. The macroeconomic climate still hinges on the support given by historically unprecedented monetary policies. And it is not only these current economic issues that are a concern: The result of the UK referendum on leaving the EU has been a shock, and has raised broader economic and political questions.

Successful upgrading of European competitiveness is critical for the EU to meet these challenges, and create new dynamism in the European economy. The European Commission has in the context of Commission President Juncker's Agenda for Jobs, Growth, Fairness and Democratic Change[1] launched a wide range of initiatives with this goal in mind. Focusing on microeconomic dimensions of this overall agenda key recent efforts include the Single Market Strategy, the Digital Single Market, the Digitisation of Industry strategy, the Energy Union, the Circular Economy Package, the Start-up and Scale-up Initiative and the New Skills Agenda with the Investment Plan for Europe and set of up of Thematic Platforms to facilitate the implementation of smart specialisation strategies that guide innovation-related investments under the European Structural and Investments Funds being other important contributors.

Clusters are a key dimension of this policy agenda. They have powerful roles in diagnostics, design, and delivery of effective policies in order to contribute to the number one objective of achieving more jobs, growth and investments. Clusters offer a fertile ground for fostering industry transformation and the development of emerging industries. Accordingly, the European Commission has had a long standing focus on clusters, providing data, policy tools, and support for cross-European linkages among cluster organisations.

The European Cluster Panorama, provided by the European Cluster Observatory, focuses on providing policy makers and business leaders across the EU with fresh insights into trends of cross-industry linkages and the regional footprint of these groups of related activities. The Panorama applies evidence-based categories for understanding the likely directions of industrial change and industry emergence, mapping the performance and economic geography of ten specific emerging industries across Europe.

Its first version, the European Cluster Panorama 2014, documented the strong economic performance of these broader cross-sectoral, emerging industries in terms of productivity and dynamism, outperforming both the average of existing clusters and the broader EU economy. The economic geography of emerging industries shows opportunities across Europe. But it also revealed a significant role of legacy effects and underlying competitiveness driving future opportunities: many of the European regions registering the strongest position in these ten emerging industries are also in the leading group in terms of current cluster portfolio strengths and prosperity.

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[1] *Jean-Claude Juncker, A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change, Strasbourg, 15 July 2014. https://ec.europa.eu/priorities/sites/beta-political/files/juncker-political-guidelines-speech_en_0.pdf.*

This European Cluster Panorama 2016 provides an updated perspective on clusters across Europe, focusing again in more detail on the evolution of the ten emerging industries identified in 2014. The analysis is based not only on two additional years of data, but can draw on a significantly enhanced and broadened data set (see the methodological appendix for a more detailed discussion of how the data set was constructed):

■ One key novelty is the introduction of **firm-level data** to supplement the statistical data from national and EU statistical offices. This firm-based data significantly increases the robustness of the data, especially in countries like Germany that collect regional data through samples rather than reporting by all firms. It also enables performance of individual firms to be tracked over time, gaining more granular insights into patterns of entrepreneurship.

■ Another key novelty is the inclusion of **new indicators**, in particular data on skills. Skills are a critical dimension of the quality of the business environment, including for its ability to adapt to industrial transformation processes. It can thus sharpen our understanding of how clusters interact with other factors to influence economic performance. Skills are also a signal for the type of activities that a cluster within a specific category is engaged in.

Based on this enhanced data set, a deeper analysis is presented compared to the last Panorama in 2014. Updated information is provided on the ten emerging industries, tracking their further evolution in the post-crisis recovery with data now available up to 2014. The information on the role of existing clusters in Europe is also updated, looking at their overall size, dynamics, and patterns of regional distribution. The combination of these two views provides comprehensive insights in the current status and future opportunities inherent in the economic structure of European regions.

Moreover, the enhanced data set also enable a number of new analyses that provide a more granular perspective on clusters, emerging industries, and their dynamics. A focus is placed on two particular aspects: the heterogeneity of cluster profiles, and the dynamics of cluster evolution:

■ The **profile of individual clusters** is measured within a given cluster category or emerging industry through differences in the mix of occupations most prevalent in different locations. How clusters with different profiles perform, and what type of regions they are located in can provide important additional insights for policy.

■ The **dynamics of cluster evolution** are measured through a closer look at firm entry and exit data as well as through exploiting the longer time-series of data. This helps to identify where entrepreneurship in terms of new business formation is most prevalent, both in terms of the regions and the specific clusters and emerging industries. It also allows to track the dynamics of cluster evolution, i.e. how much change is observed over time in the economic geography of clusters and emerging industries and the economic composition of regions.

All underlying data used in this report are available at the cluster mapping tool of the European Cluster Observatory under the web pages of the EU Cluster Portal set up by the European Commission's Directorate General for Internal Market, Industry, Entrepreneurship and SMEs.[2] The definitions of specific analytical categories, in particular the definitions of all clusters and emerging industries, as well as the analytical approaches used to develop them, are also all available on the EU Cluster Portal.

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[2] *https://ec.europa.eu/growth/smes/cluster/observatory/cluster-mapping-services/mapping-tool_en.*

2. Concepts and data sources explained

What are clusters?

Clusters are regional concentrations of activities in groups of related industries. Clusters emerge naturally in market processes, because local spill-overs among such activities enhance performance at the firm and regional level. Examples of such positive effects – that usually grow with the critical mass in a given location – are a labour market with specialised skills, local supplier networks with specialised capabilities, and a local knowledge pool driven by the research and innovation activities of local firms and knowledge institutions.

The evolution of clusters is driven by the benefits of agglomeration. Some of these are the automatic result of market forces, such as firms growing faster or choosing to locate in clusters, while others depend on purposeful action, e.g. collaboration among firms that enhances spill-overs or government action that improves the cluster-specific business environment. But the evolution of clusters is also affected by economic forces encouraging dispersion: as clusters become larger, there are increasing 'congestion costs' that emerge as disadvantages of the agglomeration effect. For instance, firms bidding up prices for scarce inputs in clusters, such as wages for specialised workers. There is also the potential risk of a 'lock-in' effect in the face of technological change, i.e. all firms in a cluster opting for one technology that might get disrupted by innovation in other locations. The interplay between these forces of agglomeration and dispersion shapes the evolution of clusters over time,

Clusters differ from cluster organisations, which are the organisations that manage the networks of firms and other entities within a given cluster. Cluster organisations can help firms to better engage with other local actors within their cluster and to organise collective action to strengthen the local context. And they can reduce the transaction costs for firms, especially SMEs, in building linkages to firms and collaboration partners in other locations. The stronger the local cluster, the higher the potential for building successful international linkages.

Clusters are also different from both narrow specialisation in individual industries and broad agglomeration of economic activity in cities: clusters reflect the positive spill-overs among a set of related industries, neither driven only by economies of scale in one industry nor by the economy-wide benefits of economic density across all industries.

Clusters have a distinct geographic dimension, reflecting the dynamics of local spill-overs. They are also deeply embedded in a broader geographic context: they serve markets elsewhere and are connected to other clusters with complementary strengths in regional, interregional or global value chains. This mirrors the role of location for firms: while local conditions provide the unique context for building distinct capabilities and strategic positions, national and international linkages are critical to access other markets, suppliers, and collaboration partner.

More explanations can be found in the Smart Guide to Cluster Policy[3] that was published in June 2016 to give guidance on how to make better use of clusters for promoting regional industrial modernisation, supporting the growth of SMEs and encouraging smart specialisation.

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[3] *The Smart Guide explains what cluster and cluster policies are and what not, what makes them successful and why they matter. It presents eight Do's and Don'ts and many cluster programme examples and practical instruments. See http://ec.europa.eu/DocsRoom/documents/16903/attachments/1/translations/en/renditions/native.*

What are emerging industries?

Emerging industries have been 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 with higher added value".[4] They are in many cases new combinations of existing industrial sectors that are changing in response to new technologies, new business models and market demands.

The 2014 Cluster Panorama developed a method to empirically identify broad sets of 'emerging industries' in which such new combinations of related activities were seen as likely to emerge.[5] Data on weak linkages across industries were used as indicators of the potential for stronger future linkages to emerge. Emerging industries based on these weak linkages can be contrasted with the clusters based on existing strong linkages visibly today, often reflecting the cumulative effect of past connections. The figure below indicates how the ten emerging industries identified relate to the traditional cluster categories.

Figure 1: Emerging Industries and Clusters

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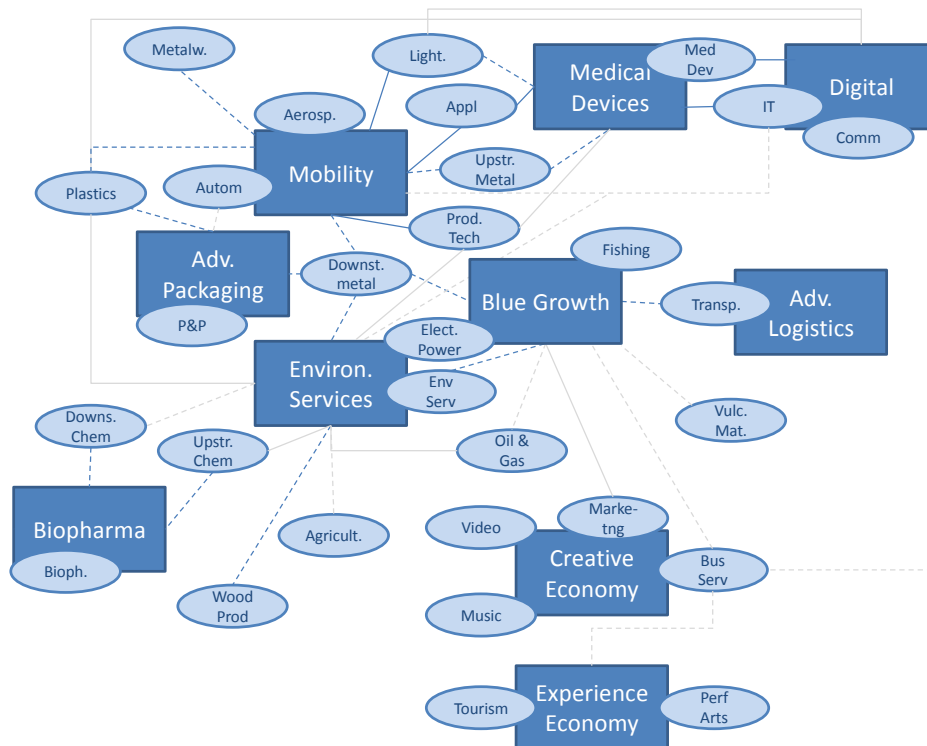
[4] *This definition developed by Heffernan & Phaal (2009) was used in the policy roadmap of the European Forum for Clusters in Emerging Industries that is available at http://www.emergingindustries.eu/Up-load/CMS/Docs/Policy_roadmap.pdf.*

[5] *The detailed process and reasons for choosing such an approach are explained in the "Methodology and Findings Report for a Cluster Mapping of Related Sectors", available at http://ec.europa.eu/growth/smes/cluster/observatory/cluster-mapping-services/cluster-panorama_en.*

 What regional level is used?

Regions are the geographical areas in which the local spill-overs that drive cluster evolution have a meaningful influence on economic performance. Depending on the specific sector, activity, and externality the scope of the appropriate area varies: It is, for example, the area in which it makes sense to speak about an integrated labour market where people can find jobs without moving. It also refers to the area in which there is a significant likelihood for knowledge to be spread through unplanned meetings or chance observations of what others do.

This notion of regions is applied in the Panorama by using data for specific administrative regions, generally at the so-called NUTS 2 level. The European economy is made up of 327 such regions,[6] each with its own profile and economic performance. These regions are used as a pragmatic choice because they are likely to encompass the 'economically relevant' regions, there is data available, and in most cases there is some level of government that can take action for this specific region.

Why are regions important?

The European economy is ultimately a combination of linked regional economies. While macroeconomic conditions are well tracked at the level of nations, microeconomic circumstances differ significantly across regions, even when they are part of the same national economy. An effective strategy to understand and strengthen European competitiveness, especially its microeconomic dimensions, has to acknowledge this heterogeneity across regions.

One of the key dimensions in which regions differ is their specialisation pattern. Previous studies have shown that the strength of a region's cluster portfolio is related to the overall level of prosperity that the region is able to support[7]. The European Cluster Panorama adds an additional step and explores the presence of emerging industries, build up from core clusters and further related industries, across Europe. It ultimately wants to enable European regions to pursue more evidence-based strategies as they explore their unique opportunities in emerging industries, a key ambition of the entrepreneurial discover process part of smart specialisation strategies.[8]

What data are used?

The 2016 Panorama is based on a new dataset that is compiled specifically for analysing detailed patterns of cluster evolution. The core of the dataset is the firm- and plant-level data sources from the Orbis Historical dataset supplied by Bureau van Dijk (June 2016 release). This dataset provides detailed data on the economic performance of firms. It allows to use data of firms' turnover, wage bill, capital, materials and employment[9] totalling more than 1 billion data points. The coverage is very good in most countries in Europe, and especially for larger limited liability companies, however significant gaps were still present.

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[6] *The analysis covers all EU-28 countries (comprising 276 NUTS-2 regions) as well as Albania, Bosnia and Herzegovina, Iceland, Israel, FYROM, Kosovo (regarding the political status of which no claims are implied), Montenegro, Norway, Serbia, Switzerland, and Turkey by applying the NUTS (Nomenclature of Territorial Units for Statistics) standard for the subdivisions of countries for statistical purposes.*

[7] *For example in Ketels, C. & S. Protsiv (2013). Clusters and the New Growth Path for Europe. WWWforEurope working paper series, issue 14.*

[8] *See for more detail the material on the European Commission's Smart Specialisation Platform: http://s3platform.jrc.ec.europa.eu.*

[9] *Employment is usually the only variable available on plant level, the rest are for the firm as a whole.*

Therefore, three Eurostat datasets were used for calibration: Business demography to obtain counts of businesses in missing legal forms,[10] Structural Business Statistics to provide aggregate values to match to, and Regional Economic Accounts to calibrate the final numbers to be comparable across countries.[11] Using this firm-level data allows to get a more consistent picture across European businesses and computing entrepreneurship indicators that would otherwise be unavailable.

While the dataset is completely new, it resembles the one used in the 2014 Panorama and most of the values remained fairly stable in the countries where data quality was good in both 2014 and 2016. The main difference is that the employment indicator is now using a uniform definition across countries, defining a full-time employee as equivalent to 1 800 hours worked per year. This has the advantage that it makes the labour input more comparable across countries and does not depend on local legislation specifying a standard work week (although of course the measurement of working hours is imprecise).

The main outcome of this is that the countries where the average work time is significantly lower than 1 800 hours (e.g. Germany and the Netherlands) see their employment numbers lowered while their productivity is increased, while the opposite occurs in the Eastern countries with longer working hours.

Another major addition to the dataset are the skills indicators obtained from Labour Force Surveys (LFS), which were used to obtain the relative sophistication of workers in each cluster according to the following four skill levels[12] using broad sections of the ISCO 08 occupational classification:

■ Officials, Managers, Professionals, Technicians ("Managers"): jobs usually employing abstract cognitive tasks (ISCO sections 0, 1, 2, 3)

■ Clerical Support Workers ("Clerks"): jobs using routine cognitive tasks, usually in offices (ISCO group 4)

■ Craft, Trade, Operators, Assemblers ("Crafts"): routine manual jobs, usually on the factory floor (ISCO sections 6, 7, 8)

■ Service, Sales, Elementary ("Services"): basic non-routine manual jobs like sales or cleaning (ISCO sections 5 and 9).

Finally, the dataset is complemented with new data on fast-growing new firms (so-called "gazelles") that was derived using the same data source. Data on company births, their ownership structure (to remove subsidiaries of the existing firms), as well as the financial indicators computed in the previous step were used to select the firms that are less than 5 years old and grew by at least 10% a year over 3 years.[13]

Other differences between the 2014 and 2016 editions of the Panorama include the per-industry discounting of monetary indicators over time (i.e. the inflation adjustment for output is based on the prices for this industry's output within a country, and similarly for the inputs a company uses based on input-output tables). This, together with purchasing parity adjustments, makes the monetary values across regions more comparable and in general increases the relative stance of poorer regions since they also generally have lower prices.

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[10] *Usually sole traders, but in some countries also partnerships. More details on this procedure can be found in methodological appendix.*

[11] *This calibration was necessary due to different definitions of employment and wages used in different countries and to ensure that the dataset is consistent with regional and national accounts.*

[12] *Acemoglu, D., D. Autor (2011) Skills, Tasks and Technologies: Implications for Employment and Earnings. Handbook of Labor Economics, Volume 4b.*

[13] *More details follow in the section dedicated to entrepreneurship.*

All data (other than skills) is now from a uniform source: company accounts (as opposed to, for example, employee surveys), which further enhances the comparability across regions and industries, though some inconsistencies remain.

How is cluster performance measured?

The strength of a cluster is a complex multi-faceted concept, capturing aspects of overall size, specialisation, productivity, and dynamism (see figure 2).

Figure 2: Measuring cluster performance
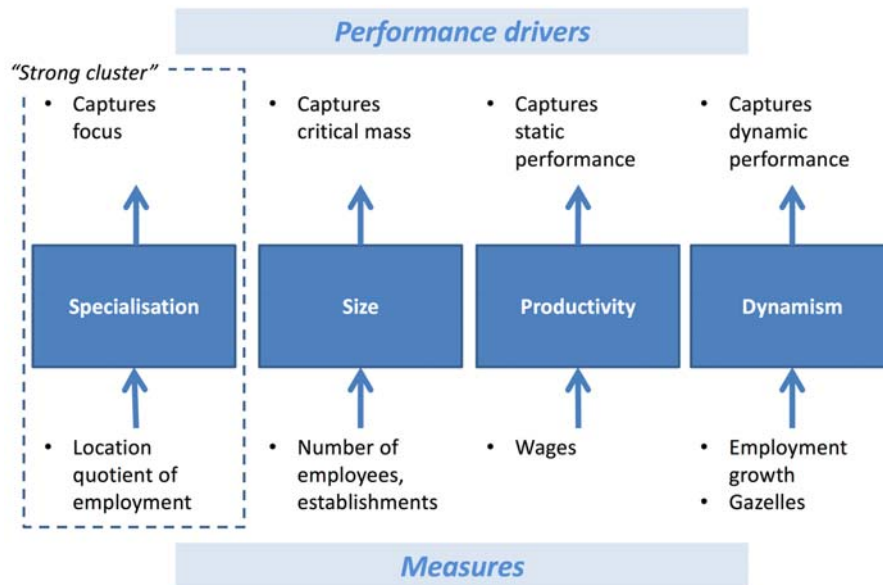
In the analysis of the European Cluster Panorama, a two-stage approach is used. In the first stage, '**strong clusters'** are identified, i.e. situations in which a region is specialised in a set of related industries relative to peers. This notion is operationalised by identifying the top 20% of European locations by location quotient, subject to a cut-off of at least 500 employees. [14]

■ **Specialisation,** measured by the relative size of regional employment in a given (sectoral or cross-sectoral) cluster category reflected in its location quotient (LQ). This relative measure indicates how much stronger a region is in a cluster category than would be expected given its overall size, compared to the average employment size in the specific cluster category across all regions

In the second stage, up to three additional '**performance stars'** are awarded to capture how well a location is leveraging the presence of a cluster. These further stars are awarded if a location falls into the top 20% of European regions in any of the following three dimensions:

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[14] *The Location Quotient is a measure of a region's specialisation in an industry and is computed as the ratio of this industry's shares of a) this region's employment and b) of the whole European employment across all regions. Thus, the values above one imply high regional specialisation, with LQ of 2 corresponding to twice as many employees in an industry than expected if all employment was distributed evenly.*

- **Absolute size**, measured by the number of employees and establishments. This measure is based on the observation that the number of linkages within a cluster is growing exponentially with the number of participants. Only when economic activity in a given cluster category moves beyond a threshold of critical mass do cluster effects become significant.

- **Productivity,** measured by the wages paid in a regional cluster (adjusted for local cost levels). This measure reflects not only what is being done in a region, but how well it is being done, influenced by the strength of cluster effects. Wages are also influenced by the structure of labour markets and other factors but are strongly correlated with productivity.

- **Dynamism**, measured by a simple average of measures on employment growth and the presence of fast-growing new firms (gazelles). This measure aims to capture whether a cluster continues to benefit from strong cluster effects in its development, or not. The cluster may be hindered in its growth because it has already reached a level where costs are greater than the benefits or other factors such as industry-specific growth trends.

The two first employment-based indicators formed the basis of the initial 'three-star' methodology used by the European Cluster Observatory of the first European cluster mapping in 2007.[15] Our current star-rating is comparable to the one used in the 2014 European Cluster Panorama. The one conceptual change is the inclusion of data on gazelles, i.e. consistently fast growing new companies, to measure dynamism. Regions that grow through creating new firms rather than through employment growth in established firms score higher compared to the method used in 2014. The overall effect of this change on the report rankings is, however, relatively minor.

The **strength of a region's cluster portfolio** is measured by summing up the performance across its individual clusters. For the analysis of overall regional performance, the total number of stars across all sectoral clusters or cross-sectoral, emerging industries is used as the core measure. There are other measures that are reported in some tables, in particular the share of employment in strong clusters for regions. This measure essentially weights clusters by their employment size, which provides another useful perspective on the strength of the cluster portfolio. Because it is also more affected by whether specific large cluster categories are strong, in particular business services, the star methodology is used as the main indicator of regional cluster or emerging industry strength.

While these indicators enhance the understanding of economic geography across Europe, some caveats should be kept in mind: First, some indicators, particularly the new ones, are measured with error and depend on changes in how industries are captured in the different statistical systems[16]. Second, all indicators have some biases: Absolute employment size can be a sign of low productivity. Large regions benefit in the size measure, but are less likely to have high location quotient. More established clusters tend to have higher wages, while they generally grow slower due to their already large size. High wages measure not only superior productivity but are also reflective of the general cost and wage levels in a region.[17] With these different possible 'biases' often working in different directions, the four-star clusters really stand out with strong performance across all dimensions.

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[15] See "The concept of clusters and cluster policies and their role for competitiveness and innovation", Communication from the European Commission of 17 October 2008 available at http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=NBNA23591.

[16] For example, while the attempt is to only use the data supplied using NACE 2.0 industry codes, sometimes the older NACE 1.1 classification needs to be used complicating the growth computations. In other cases, the detailed regional wage data was missing and had to be imputed using a combination of the detailed national data and less detailed regional data.

[17] This is to some degree controlled for using purchasing power adjusted data.

3. The Role of Clusters in Europe

3.1   Measuring clusters in the European economy

Industries that show significant levels of geographic concentration account for 47% of all European employment covered in our data. While the data is not fully comparable given differences in sectoral coverage, this ratio is significantly higher than in the United States where traded industries account for 36% of employment.[18] Firms operating in these industries serve markets beyond their home location, compete with rivals from other locations, and have a choice where to locate. Because of these characteristics, similar to firms engaged in international trade, these industries are often called "traded".[19]

Figure 3: Employment and wage dynamics in Europe in the post-crisis period
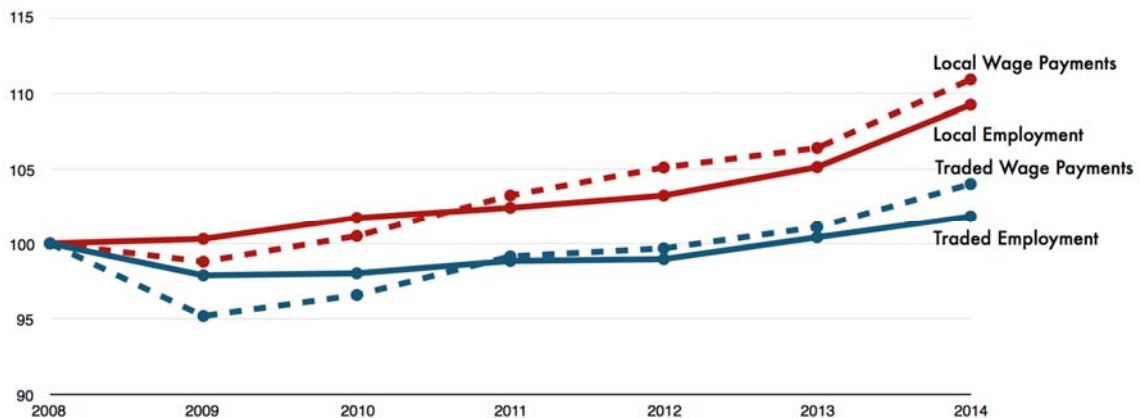
The recent job dynamics, in Europe as well as in the US and other countries for which comparable data is available, has seen employment in traded industries to be decreasing as a share of total employment: Figure 3 above illustrates this by local employment displaying higher growth than traded employment. In Europe there has been a net increase of 522 000 traded industry jobs since 2008 (most of it in non-EU countries, Turkey in particular, covered in our data; employment in traded industries has remained stable within the EU), compared to the net gain of more than 11 million in the rest of the economy.

Productivity and wage dynamics, however, have pointed in the opposite direction. In terms of wages paid traded industries generate a stable 51% of the European total. Lower relative employment numbers have been compensated by higher relative wages. Industries that cluster register an average annual wage of 34 800 Euro in Purchasing Power Parity (PPP; a measure that accounts for differences in local price levels) per full time employee.[20] This is 17% higher than the wage in other industries, called *local* or *non-traded*.

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[18] *For data on the US see the US Cluster Portal at www.clustermapping.us.*

[19] *Note, however, that trade across national borders is not the defining aspect, even though by definition all exporting firms are part of traded industries.*

[20] *The monetary unit used throughout the report is 2010 PPP (i.e. all monetary values are deflated both to account for inflation and relative prices across regions).*

These higher wages in traded industries are likely to be driven by higher levels of productivity, based on higher capital or skill intensity as well as potentially the benefits of clusters. The wage gap between traded and local industries has been slowly rising over time.

Traded industries can be further organised in 51 cluster categories, i.e. groups of industries that exhibit strong linkages in terms of co-location, skill use, and so-called input-out relationships.[21] These cluster categories differ significantly (see Table 1), such as in the absolute number of jobs they represent: The three largest cluster categories Distribution and Electronic Commerce, Business Services, and Hospitality and Tourism, account, with between 15.8 million and 11.2 million employees each, i.e. for about one third of all traded employment Europe-wide and are present essentially everywhere. The smallest, Tobacco, registers only about 38 000 employees, with only 60 regions across Europe accounting for at least 100 employees each.

Table 1: Profile of 51 Traded Cluster categories

Cluster	Plants	Employment (1000)	Avg Wage (PPP)	Manager share	Clerk share	Craft share	Service share
Aerospace Vehicles and Defence	926	297	38 809	50%	9%	31%	11%
Agricultural Inputs and Services	5 479	463	20 270	29%	5%	46%	19%
Apparel	10 302	1 343	12 721	24%	7%	57%	12%
Appliances	1 839	235	26 522	36%	9%	41%	13%
Automotive	19 162	2 528	35 778	33%	7%	51%	9%
Biopharmaceuticals	2 350	518	51 706	58%	9%	21%	12%
Business Services	70 239	11 990	45 574	74%	10%	8%	8%
Coal Mining	955	189	22 975	36%	6%	47%	11%
Communications Equipment and Services	7 242	828	45 220	56%	12%	19%	13%
Construction Products and Services	44 053	3 411	28 279	33%	8%	44%	15%
Distribution and Electronic Commerce	167 110	15 855	34 046	42%	13%	22%	22%
Downstream Chemical Products	22 432	2 572	29 258	39%	9%	33%	19%
Downstream Metal Products	10 500	1 012	32 846	30%	9%	50%	12%
Education and Knowledge Creation	24 299	4 866	35 121	69%	9%	7%	15%
Electric Power Generation and Transmission	10 864	1 078	39 223	44%	11%	36%	10%
Environmental Services	18 252	1 373	27 152	34%	8%	20%	38%
Financial Services	45 084	7 861	40 982	38%	21%	24%	17%
Fishing and Fishing Products	2 698	457	18 068	28%	7%	46%	18%
Food Processing and Manufacturing	37 836	2 370	30 252	31%	9%	42%	18%

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[21] *Delgado, Porter, Stern (2016), Defining Clusters of Related Industries, Journal of Economic Geography, Vol. 16, No. 1. Input-Output relationships measure to what degree the products and services generated by one industry enter into the production processes of another industry.*

Cluster	Plants	Employment (1000)	Avg Wage (PPP)	Manager share	Clerk share	Craft share	Service share
Footwear	3 062	472	17 681	21%	7%	62%	11%
Forestry	5 052	500	17 630	31%	4%	49%	16%
Furniture	35 338	3 688	28 037	26%	6%	60%	8%
Hospitality and Tourism	79 029	11 286	33 574	55%	15%	7%	23%
Information Technology and Analytical Instruments	21 663	1 666	45 583	48%	9%	35%	8%
Insurance Services	16 684	2 841	39 527	39%	22%	23%	16%
Jewellery and Precious Metals	4 286	175	23 758	25%	7%	54%	14%
Leather and Related Products	2 078	118	22 507	24%	7%	58%	11%
Lighting and Electrical Equipment	23 259	2 081	35 340	35%	8%	51%	7%
Livestock Processing	7 679	894	24 317	23%	7%	50%	20%
Marketing, Design, and Publishing	31 558	2 055	37 546	70%	12%	8%	9%
Medical Devices	12 361	726	39 293	49%	7%	35%	8%
Metal Mining	534	47	34 352	36%	8%	40%	16%
Metalworking Technology	22 625	2 987	33 458	27%	6%	60%	7%
Music and Sound Recording	2 835	127	38 165	53%	12%	21%	14%
Nonmetal Mining	5 669	303	28 378	26%	7%	52%	15%
Oil and Gas Production and Transportation	5 140	451	63 698	54%	7%	33%	6%
Paper and Packaging	16 184	1 059	32 638	29%	9%	48%	15%
Performing Arts	21 206	3 354	43 032	83%	5%	7%	5%
Plastics	20 435	1 921	31 612	30%	9%	48%	14%
Printing Services	19 809	1 305	31 745	32%	8%	48%	12%
Production Technology and Heavy Machinery	36 917	3 330	40 642	38%	9%	46%	7%
Recreational and Small Electric Goods	11 912	793	27 266	36%	9%	38%	17%
Textile Manufacturing	17 256	1 185	21 673	28%	8%	50%	13%
Tobacco	496	38	43 391	41%	9%	35%	14%
Transportation and Logistics	23 933	7 112	26 819	26%	12%	47%	14%
Upstream Chemical Products	6 738	418	39 334	38%	8%	41%	13%
Upstream Metal Manufacturing	27 125	1 639	37 797	30%	7%	54%	9%
Video Production and Distribution	6 992	377	46 375	72%	7%	9%	12%
Vulcanised and Fired Materials	34 177	2 100	27 792	28%	8%	49%	15%
Water Transportation	11 711	893	42 380	38%	12%	37%	13%
Wood Products	26 355	2 506	23 667	27%	7%	50%	16%
TRADED	**1 061 720**	**117 693**	**34 782**	**44%**	**11%**	**30%**	**15%**
TOTAL	**1 735 261**	**251 676**	**32 103**	**40%**	**9%**	**23%**	**28%**

Table 1 shows that cluster categories differ significantly in average wage levels – likely reflecting the differences in capital and skill intensity. Across Europe, Oil and Gas is with more than 63 000 Euro in PPP the highest wage cluster category. Its wages are about five times higher than the lowest wages cluster category, which is Apparel.

Table 1 also shows the differences in skill s, by showing the allocation of skills for the four job categories of managers/professionals, clerks, crafts/operators, and service workers. Management and craft tend to be the largest groups but still differ widely in terms of their relative importance for specific cluster categories: cluster categories comprising creative industries (Design, Music, Performing Arts, Video) have around 70% of all jobs among management/professionals, while the footwear cluster category has only 21%. Footwear also has the highest crafts share at 60% of all jobs, while several of the knowledge-intensive services have less than 10%. Environmental services had the highest service share at 38% of their jobs, insurance and financial services the highest clerk share at more than 20%.

3.2   Strong clusters and their performance

In total, 3043 strong regional clusters have been identified in Europe; they are defined to capture the leading 20% of regions by specialisation (i.e. location quotient) in each of the 51 cluster categories. Strong clusters account for 46% of all traded industries employment. Strong clusters have thus on average about twice as much presence of economic activity in a specific cluster category than the European average. Strong clusters register an average wage of 36 100 Euro (PPP), which is about 3% more than all traded industries.[22]

About 2 550 of these strong clusters register at least 500 employees and a location quotient (i.e. number of employees relative to what would be expected on average given the size of the region) larger than 1.5. Most of the strong clusters have two stars (the one for specialisation by the definition of "strong", and another one), while there are 103 four-star clusters.

Table 2: Number of regions by total stars in strong regional clusters

1 Star	2 Stars	3 Stars	4 Stars
618	1 536	786	103

Cluster categories differ in the dispersion of activity across locations, measured by the degree that strong clusters (i.e. the top 20% specialised clusters) dominate overall activity in the cluster category across Europe. For the majority of the sectoral categories strong clusters account for between 40% and 60% of economic activity. But in some larger categories the share is lower, for example about one third for Distribution and Electronic Commerce. Conversely, in categories related to natural resources (coal and metal mining) but also in aerospace vehicles and defence, the share is instead above 80%.

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[22] *While this benefit of being in a strong cluster might seem relatively small, it is obscured by the impact of cross-cluster locational effects on wages. If clusters in a specific cluster-category, for example food processing, are predominantly concentrated in less advanced regions, the average in strong clusters in this cluster category will be lower than in generally higher wage regions with less food processing activity.*

Looking more narrowly at the ten leading clusters by category, one can find that they tend to account for about 25% of all economic activity, again with significant variation. On average, the next 50 locations then account for about the same amount of activity as the leading ten.

Table 3 shows that the profile and performance of strong clusters differs across cluster categories. The size of the average strong cluster in Business Services (91 700 employees) is much larger than those in smaller categories like Jewellery. On the other hand, the wages in Oil are among the highest of all cluster categories at close to 70 000, more than five times those in Apparel (even as all the wage numbers are corrected for price differences across regions).

Table 3: Performance of Strong Clusters in 51 Traded Cluster categories

Cluster	Strong			Other locations		
	Average Employ-ment	Average Wages	Average Annual Empl. Growth 2008-14	Average Employ-ment	Average Wages	Average Annual Empl Growth 2008-14
Aerospace Vehicles and Defence	5 128	35 951	N/A[23]	226	52 749	N/A
Agricultural Inputs and Services	4 013	16 923	5.17%	807	24 432	5.51%
Apparel	14 994	8 167	2.14%	1 354	25 470	-0.59%
Appliances	3 202	22 864	N/A	194	40 366	N/A
Automotive	20 811	32 640	7.03%	4 521	39 389	1.02%
Biopharmaceuticals	5 761	52 259	5.23%	790	50 749	0.33%
Business Services	91 655	50 347	3.23%	22 762	40 713	2.08%
Coal Mining	5 923	19 220	15.26%	78	60 778	1.72%
Communications Equipment and Services	8 744	45 687	5.55%	997	44 194	3.32%
Construction Products and Services	24 197	23 265	-0.01%	6 951	32 694	0.45%
Distribution and Electronic Commerce	77 406	26 688	5.73%	41 035	37 622	0.51%
Downstream Chemical Products	22 508	25 328	4.09%	4 164	34 630	0.64%
Downstream Metal Products	6 422	33 146	1.72%	2 255	32 629	0.42%
Education and Knowledge Creation	28 583	34 671	3.67%	11 460	35 407	4.58%
Electric Power Generation and Transmission	8 853	35 824	7.26%	1 899	43 245	4.62%
Environmental Services	10 194	20 867	3.51%	2 900	32 675	1.02%
Financial Services	62 477	42 217	1.27%	14 320	39 621	1.95%
Fishing and Fishing Products	8 550	16 471	1.27%	294	25 487	2.05%
Food Processing and Manufacturing	10 836	24 814	1.99%	6 357	32 552	1.11%
Footwear	6 848	16 729	2.56%	285	23 306	-1.02%
Forestry	5 523	15 208	N/A	757	21 956	N/A
Furniture	24 739	20 435	0.13%	7 810	34 242	1.46%
Hospitality and Tourism	61 096	36 901	3.77%	27 793	31 724	3.73%

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[23] *N/A = data not available.*

Cluster	Strong			Other locations		
	Average Employ-ment	Average Wages	Average Annual Empl. Growth 2008-14	Average Employ-ment	Average Wages	Average Annual Empl Growth 2008-14
Information Technology and Analytical Instruments	13 419	44 193	3.05%	3 053	47 110	0.97%
Insurance Services	25 051	40 669	2.57%	4 627	37 993	2.42%
Jewellery and Precious Metals	1 951	21 503	-1.66%	264	27 184	-0.02%
Leather and Related Products	2 154	21 086	4.90%	131	26 328	2.50%
Lighting and Electrical Equipment	12 810	30 203	-1.88%	4 751	38 855	0.63%
Livestock Processing	7 053	20 394	0.38%	1 664	28 443	-0.01%
Marketing, Design, and Publishing	17 980	39 017	0.91%	3 325	35 535	1.16%
Medical Devices	5 592	39 467	2.16%	1 460	39 129	0.82%
Metal Mining	1 612	32 163	N/A	54	44 822	N/A
Metalworking Technology	17 553	33 762	0.77%	7 004	33 265	0.42%
Music and Sound Recording	2 735	40 521	-3.92%	137	32 444	3.79%
Nonmetal Mining	2 700	20 925	1.31%	649	34 160	0.42%
Oil and Gas Production and Trans-portation	5 040	68 521	5.24%	543	53 359	0.98%
Paper and Packaging	7 154	30 450	-0.08%	2 268	34 351	0.02%
Performing Arts	24 654	55 817	3.23%	6 640	30 981	1.51%
Plastics	12 106	27 486	3.20%	4 317	34 549	0.13%
Printing Services	9 426	31 747	-2.27%	2 669	31 743	-1.55%
Production Technology and Heavy Machinery	25 179	42 978	2.91%	6 390	38 315	0.18%
Recreational and Small Electric Goods	7 036	25 450	2.40%	1 263	29 833	0.87%
Textile Manufacturing	11 808	17 519	3.53%	1 600	29 306	-0.39%
Tobacco	1 200	39 211	-0.26%	88	49 028	N/A
Transportation and Logistics	47 015	21 431	-0.31%	15 361	30 990	0.81%
Upstream Chemical Products	3 542	36 627	-2.37%	742	42 439	-0.10%
Upstream Metal Manufacturing	11 981	36 361	2.97%	3 310	39 096	0.87%
Video Production and Distribution	4 554	50 409	0.90%	453	37 491	2.13%
Vulcanised and Fired Materials	15 124	21 513	-0.55%	4 221	33 481	0.10%
Water Transportation	9 155	41 664	2.16%	1 171	43 747	0.60%
Wood Products	18 114	17 788	-0.37%	5 040	29 031	0.84%

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. In some cluster categories, strong clusters tend to be in locations with weak business environments; the negative location effect then results in a relatively low wage in strong clusters. Accounting

for this effect, however, wages in strong clusters are higher.[24] When it comes to growth, strong clusters outperform weaker ones in about half the industries. In some clusters (e.g. Automotive) the difference in growth is substantial. Here, the cluster effects are strong enough to compensate for the usual convergence, i.e. the normally faster growth in locations with lower current levels of economic activity, across locations that economic theory predicts.[25]

Clusters are constantly evolving: Market conditions and demand are changing, technologies and business models are changing, and the local cluster and its business environment is changing too. At the same time, there are forces that will drive path-dependency, which means that clusters with strong performance yesterday have capabilities that make it more likely that they will also be strong today. The analysis of the new dataset, which includes comparable time-series data over the 2008-2014 period, allows to track these two forces. To do so, all regions have been categorised into three different groups depending on whether they display weak, medium, and strong cluster strength overall. The share of regions was then calculated that either stayed within the same cluster strength category or changed its position into a different strength category.

Table 4: Regional overall cluster strength development (2008 to 2014)

Cluster strength	Weak 2014	Medium 2014	Strong 2014
Weak 2008	92%	8%	1%
Medium 2008	13%	78%	9%
Strong 2008	2%	14%	85%

Strong: following the definition of strong clusters used above, i.e. top-20% specialised (i.e. location quotient, LQ in short); Medium: capturing clusters above the median LQ, but not in top 20%; Weak: the clusters below the median LQ.

The data in table 4 reveals that there is indeed significant evidence of both churn and path dependency. Between 78% (medium) and 92% (weak) of all clusters by category remain in the same group over this six-year period, which covers the crisis and its aftermath. About 20% of all clusters did change the group they were in. Among strong clusters there was more stability: 89% of the clusters strong in 2014 were already strong in 2008. This data is consistent with a view that locations with little existing assets find developing cluster strength very hard, while among those that have some assets and those that already have strong clusters there is significant mobility in terms of changing market success.

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[24] *A more appropriate comparison is thus to look at the wage in strong clusters taking regional and sectoral effect into account. Controlling for these effects yields the effect of strong cluster equal to approximately a 3% increase in average wage. However, this coefficient is driven down by non-EU countries (where our data is also weaker) and the effect of a strong cluster within EU is close to 8%.*

[25] *Delgado, Porter, Stern (2014), Clusters, Convergence, and Economic Performance, Research Policy, Vol. 43, Issue 10, pp. 1785 – 1799.*

3.3 Regional cluster hotspots

Most regions have between 5 and 15 strong clusters according to the definition applied by the Panorama. 75% of all regions fall into this bracket. Regions then tend to achieve 10 to 30 stars in their strong clusters; 66% of all regions fall into this bracket.

There are roughly 50 regions with fewer than 10 stars, and 50 regions with more than 30 stars. Among the top five regions in terms of total number of stars in strong clusters there are three Polish regions (Slaskie, Wielkopolskie, and Dolnoslaskie), one German region (Mittelfranken), and one from the UK (Western Wales). The roughly 20 regions with five or less stars in strong clusters are predominantly from Southern Europe, especially Greece and Turkey.

Consistent with the analysis conducted in the 2014, figure 4 and table 5 apply a broader measure of regional cluster portfolio strength, counting all stars achieved in individual cluster categories, not just in strong clusters. Locations like the Istanbul region but also Ile de France and Lombardia with a larger overall size, generally display higher growth, or higher overall wage levels. A look at the strong clusters in these regional hotspots (one other measure) reveals that there are many different specialisation profiles that are consistent with an overall strong cluster portfolio. Each region has its own distinct profile of activities supporting value creation and prosperity.

Figure 4: European regional hotspots for sectoral clusters by number of stars
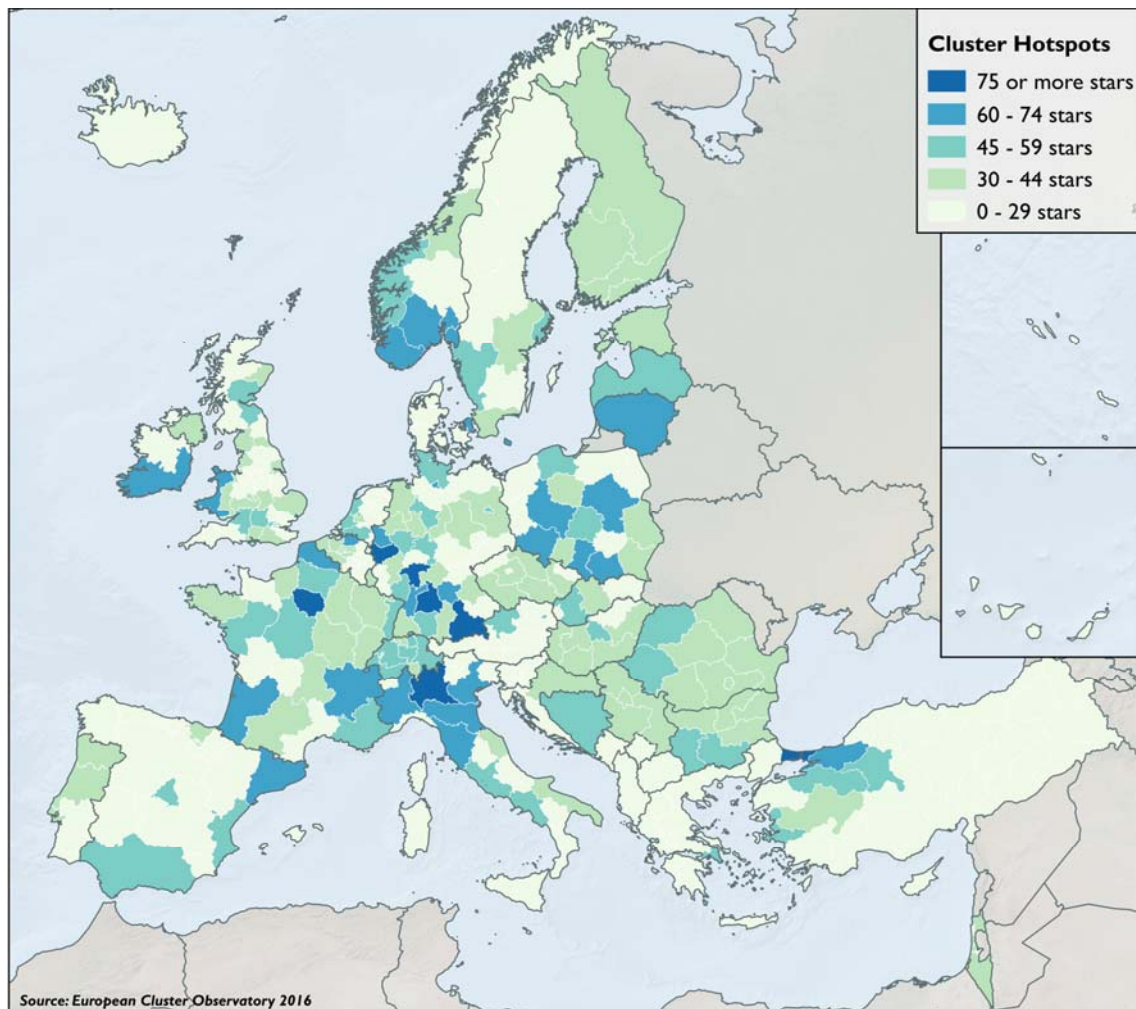
Table 5: Leading Regions by Cluster Stars

Region	Region Name	Largest City	Total Stars	1-star clusters	2-star clusters	3-star clusters	4-star clusters	Empl. Share of Strong Clusters	Top 3 Clusters by LQ
TR10	Istanbul	Istanbul	101	3	31	12	0	58.14%	Appliances Textile Manufacturing Biopharmaceuticals
DE21	Ober-bayern	Munich	92	9	23	11	1	48.34%	Aerospace Vehicles and Defense Biopharmaceuticals Video Production and Distribution
FR10	Île de France	Paris	92	10	32	6	0	63.75%	Performing Arts Video Production and Distribution Marketing, Design, and Publishing
DE11	Stuttgart	Stuttgart	83	10	20	7	3	56.29%	Production Technology and Heavy Machinery Automotive Metalworking Technology
ITC4	Lombar-dia	Milan	80	17	19	7	1	63.65%	Textile Manufacturing Insurance Services Financial Services
DEA2	Köln	Köln	80	7	26	7	0	44.26%	Video Production and Distribution Metalworking Technology Insurance Services
DE71	Darm-stadt	Frankfurt am Main	76	13	21	7	0	53.28%	Biopharmaceuticals Financial Services Insurance Services
DE60	Hamburg	Hamburg	73	13	14	8	2	67.49%	Water Transportation Metal Mining Medical Devices
DEA1	Düssel-dorf	Düssel-dorf	73	16	15	9	0	32.04%	Production Technology and Heavy Machinery Communications Equipment and Services Upstream Chemical Products
PL22	Slaskie	Katowice	72	15	25	1	1	61.61%	Coal Mining Lighting and Electrical Equipment Furniture
PL41	Wielko-polskie	Poznan	72	13	25	3	0	56.89%	Appliances Furniture Livestock Processing

3.4   Entrepreneurship

For the 2016 Cluster Panorama firm-level data was used to identify so-called 'gazelles', i.e. firms that have grown quickly over an extended period of time.[26] **Gazelles** are defined here as companies less than 5 years old that have grown their employment at least 10% annually over a period of three years.

This definition is more inclusive than the common 20% growth requirement used for gazelles, enabling us to capture a larger share of the dynamics of new business formation. At the same time, the focus is placed on traded industries and thus those parts of the economy where companies are not constrained in their growth potential by the size of their local market.[27]

While about half of all gazelles are in local industries, by their nature this activity is more likely to reflect churn and the displacement of less productive existing firms than net addition of economic activity.

Due to the novelty of this data source and differences in coverage across countries, the results have to be interpreted with caution. In particular, it seems likely that country-specific rules and regulations, for example on taxation, have an important influence on the presence of new business formation that is not directly linked to the overall dynamism of the economy.

Table 6: Top regions by presence of Gazelles

Region	Region Name	Largest City	Gazelles	Gazelle Employees	Share of region's employment, %
FR10	Île de France	Paris	1998	57908	1.8%
ES51	Cataluña	Barcelona	1455	33794	2.2%
ES30	Madrid	Madrid	1358	37676	2.7%
FR71	Rhône-Alpes	Lyon	1292	22218	2.2%
HU10	Kozep-Magyarorszag	Budapest	1145	28561	2.6%
ES61	Andalucía	Sevilla	1090	25273	2.4%
ITC4	Lombardia	Milan	1008	63373	2.6%
LT00	Lietuva	Vilnius	979	27927	3.9%
SE11	Stockholm	Stockholm	977	13886	2.3%
ES52	Valencia	Valencia	930	22051	2.3%

There are more than 67 700 gazelles in traded industries in Europe employing 1.9 million workers or 1.6% of all employees. Of these, 25 000 or 38% of gazelles are located in strong clusters. These new firms are also substantially larger in strong clusters: their share of overall gazelle employment is 46% and they employ 35 employees on average compared to 24 outside of strong clusters.

Many of the new enterprises are located in Southern and Eastern European regions, particularly in countries like Spain and Italy that have historically a very high share of small, family-owned enterprises.

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[26] *Similar analysis has recently been presented for regions and broad sectors; see http://ec.europa.eu/euro-stat/documents/2995521/7706167/4-26102016-AP-EN.pdf. The Cluster Panorama puts this data into the context of regional clusters, and focuses more specifically on fast growing firms that have been newly established.*

[27] *Guzman/Stern (2015), Nowcasting and Placecasting Entrepreneurial Quality and Performance, NBER Working Paper No. 20954, MBER: Cambridge, MA, find being part of a traded industry to be a core driver of future growth opportunities for new businesses.*

In some of these regions, the gazelles constitute more than 3% of the overall employment. Since the thresholds are relatively low, it is not clear whether many of these new businesses have ambitions to grow beyond a few employees.

3.5   Reindustrialisation

Manufacturing has in the post-crisis period attracted renewed interest from policy makers, both in Europe and North America. Manufacturing is seen as important for building capabilities over time, helping regions to create more competitive and resilient economies. Cases of 'reshoring' of industrial activity from Asia offered hope that manufacturing could be a driver of growth in the post-crisis period. The European Commission's 2014 Communication 'For a European Industrial Renaissance' stresses in this context the need for Europe to focus on the post-crisis modernisation of its economic structure, especially in industry.[28]

This message was strengthened with the 2016 Communication on "Digitising European Industry".[29] The data set compiled for the Panorama tracks the dynamics of economic activity in manufacturing between 2008 and 2014 by following the traditional narrowly defined sectors for manufacturing activity.[30] The vast majority of manufacturing is included in traded industries, and thus captured in our cluster analysis. Most clusters are fully manufacturing or services driven. This is partly the result of a lack of granularity in the available data. There are a few, however, that mix both types of industries: Communications Equip. & Services, Electric Power Gen. & Transmission, as well as most natural resource driven ones (Mining, Forestry).

Overall, manufacturing accounted for 37.4% of traded industries employment in 2014, down from 39.9% in 2008 (see figure 5). In absolute terms manufacturing employment has decreased from 46.7 million to 44 million in the same period. Despite decreasing employment shares, the share of gross value added (GVA) in manufacturing has remained stable at about 33%, and the share of total wages declined from 35% to 34%. There are strong indications of rising productivity in the sector: wages grew 4% from 33 600 to 35 000, and value added per employee grew from 63 400 to 67 900 (a 7% increase).

These trends have been very similar when looking only at strong clusters in manufacturing and in the economy overall. Manufacturing activity tends to be somewhat more concentrated in strong clusters than other traded industries but experienced a similar decrease from 42.6% to 40.5% as a share of all strong cluster employment.

This data is consistent with the view that (advanced) manufacturing is achieving a rate of productivity growth that is outpacing demand growth for manufacturing goods. Production requires a decreasing number of employees that are more and more productive, and thus able to secure a growing wage premium versus the average worker. Clusters in manufacturing are affected by these broader trends but not differently from manufacturing activities in other locations. The changes in productivity seem to be fairly broad-based across all locations.

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[28] *European Commission (2014), For a European Industrial Renaissance, COM (2014) 14 final.*

[29] *Digitising European Industry - Reaping the full benefits of a Digital Single Market (COM(2016) 180 final), available at https://ec.europa.eu/digital-single-market/en/digitising-european-industry.*

[30] *Traded industries part of section C in the NACE 2.0 classification of economic activities are used as the definition of manufacturing.*

Figure 5: Dynamics of manufacturing in Europe
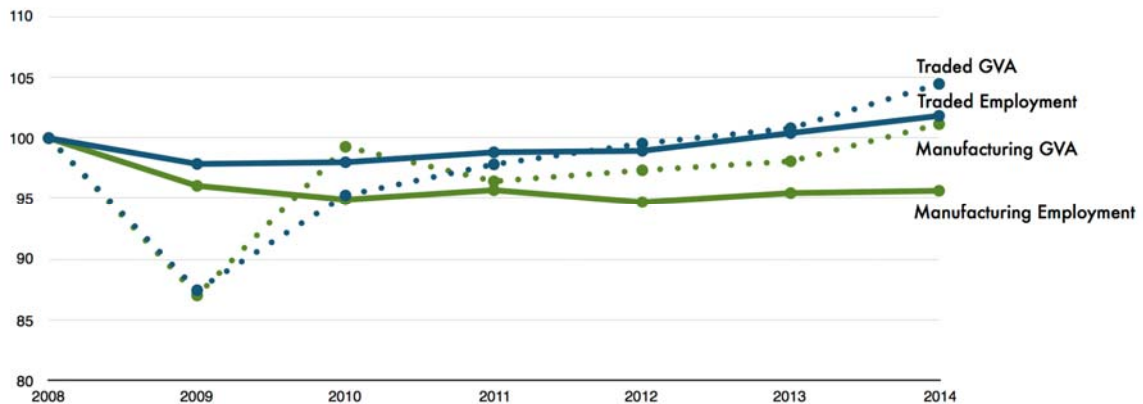
One much discussed aspect is the distribution of manufacturing activity within Europe. With the acces-sion of Eastern European countries in 2004 there was a significant relocation of labour-intensive manu-facturing activity to the East; this was a core driver of their robust catch-up. Our data indicates that this process of west-east relocation of manufacturing activity has largely been completed. While the overall level of manufacturing employment remains larger in Eastern Europe,[31] much in line with their factor endowments, the decrease in the share of manufacturing in traded industry employment has been sim-ilar to the EU overall, dropping from 51.6% to 48.3% between 2008 and 2014.

A look at individual regions within EU confirms these broader trends as the level of cross-region variation is relatively modest. When regions are ranked by their manufacturing employment share in 2008, the top 59 regions have all seen this share decreased. Only 9 regions have increased their manufacturing share by more than one percentage point, while many regions have lost more than 10 percentage points. Very few regions have grown their manufacturing employment share.

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[31] *Defined as the EU members that joined the EU in 2004 and after, excluding Cyprus and Malta.*

4. Emerging Industries in Europe

4.1 Overall Observations

4.1.1   Profiling the Performance of Emerging Industries

The ten emerging industries (see them listed in table 7) identified in the 2014 edition of the European Cluster Panorama continue to play an important role in European economic development. The 492 000 companies comprising the sector employ 54 million employees, or 46% of the overall traded industry employment.[32] The average wage at 37 900 Euro (PPP) is 9% larger than traded industries overall and all but two emerging industries have a higher average wage than traded industries overall.

While the cross-sectoral, emerging industries categories are more similar in size and performance than the sectoral cluster categories due to being broader and partially overlapping, they do exhibit substantial heterogeneity in skill compositions. Creative and Digital industries rely on managerial and professional talent nearly twice as much as traded industries in general. At the same time, Logistical Services and Mobility Technologies employ much more manual craft labour, while Experience Industries focus on service workers.

Table 7: Profile of Emerging Industries

Emerging Industry	Plants	Employment (1000)	Average Wage (PPP)	Manager share	Clerk share	Craft share	Service share
Advanced Packaging	38 913	4 854 023	35 839	29%	8%	53%	10%
Biopharmaceuticals	20 961	2 315 157	47 533	54%	11%	21%	14%
Blue Growth Industries	75 235	12 953 282	32 320	39%	12%	38%	12%
Creative Industries	107 276	14 166 879	44 765	74%	10%	8%	7%
Digital Industries	80 535	9 994 767	44 949	62%	9%	21%	8%
Environmental Industries	71 882	8 725 709	38 466	46%	11%	32%	11%
Experience Industries	113 445	15 248 961	35 323	56%	14%	10%	20%
Logistical Services	28 316	7 614 898	26 390	26%	12%	49%	14%
Medical Devices	43 863	4 826 157	43 527	49%	10%	32%	9%
Mobility Technologies	78 787	10 818 547	38 251	36%	9%	45%	9%

Compared to 2014, figure 6 shows relative wage levels remaining similar while there have unsurprisingly been more significant changes in terms of employment growth.[33] Employment dynamics have improved in traded sectors as the European economy is emerging from the crisis, and the same is true for most emerging industries. Overall the ten emerging industries continue to outperform the average of all traded industries on at least wage level or employment growth. But over the last two years one of them, Logistical Services, has dropped below this benchmark. While the industries captured in this category had

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[32] *Note that since the emerging industry definitions are overlapping, the overall employment across all emerging industries is lower than the simple sum of employment in each industry separately.*

[33] *Comparisons over time are made within the new data set. The figures cannot be directly compared to the data reported in the 2014 Cluster Panorama, even though the patterns are generally similar.*

registered below average traded industry wages before, they also had less dynamic employment growth over the last two years.

Experience industries, a category dominated by tourism including also some business services, per-forming arts, and other industries, is now the emerging industry with the highest employment growth. Medical Devices, a category that includes around a small medical device core large segments of infor-mation technology, production technology and other industries, saw employment growth drop to the lowest level among all emerging industries, falling further behind also the traded industries average.

Figure 6: Performance of Emerging Industries
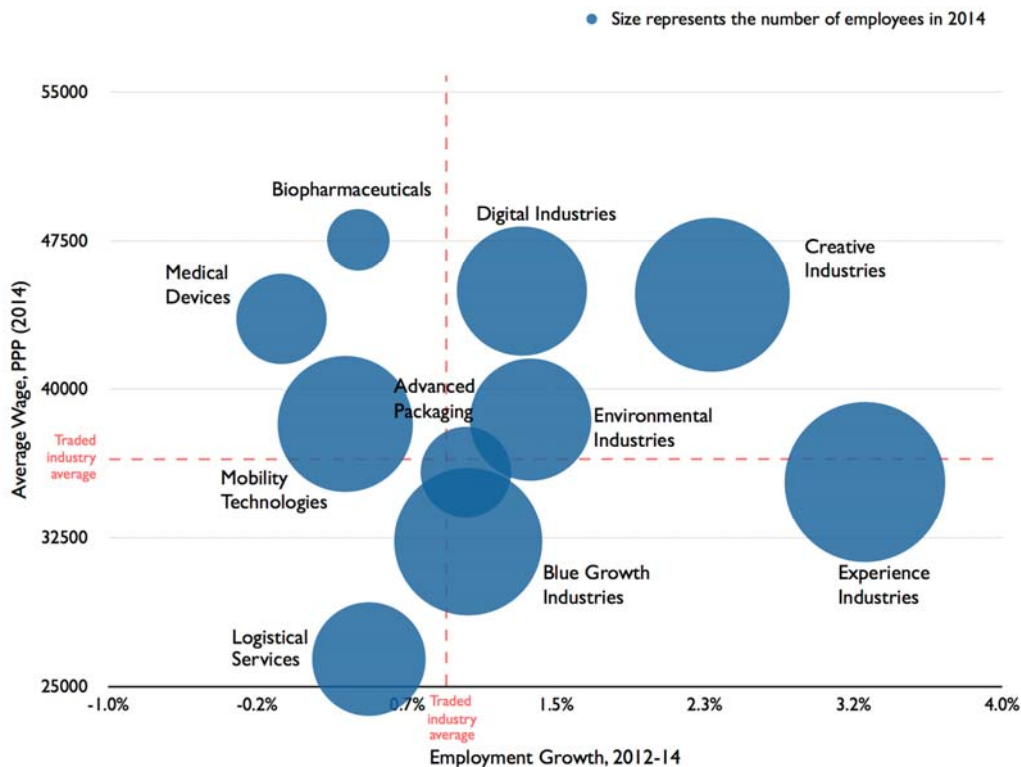
Taking the same strength measure as for cluster categories in the previous section, table 8 profiles the performance in strong emerging industry clusters.[34] Strong emerging industry clusters account for about 51% of employment and 53% of wages paid across all emerging industries. In all categories apart from Blue Growth and Logistical services strong clusters report faster growth than weaker ones, highlighting the possible presence of positive feedback loops. In 8 out of 10 emerging industries the average strong cluster has positive growth, compared to 6 out of 10 among weaker locations. Wages tend to be higher in locations in which the respective emerging industry is strong, but again in some cases these locations are predominantly in less-advanced lower wage regions, dragging down the average; this is just like for the traditional clusters as discussed earlier in this report.

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[34] *Emerging industries are broader conceptual categories than the cluster categories defined in the previous section, and there is no evidence that cluster dynamics extend to the full breadth of cross-sectoral industries they com-prise. The term cluster is here used to characterise the presence of critical mass in the set of more weakly related industries captured by emerging industries.*

Table 8: Performance of strong locations in Emerging Industries

Emerging Industry	Strong			Other Locations		
	Average Employment	Average Wages	Avg Empl Growth 2008-14	Average Employment	Average Wages	Avg Empl Growth 2008-14
Advanced Packaging	34 012	36 393	1.28%	11 093	37 679	-0.17%
Biopharmaceuticals	15 400	58 486	3.80%	4 896	48 409	-0.18%
Blue Growth Industries	53 214	35 314	1.34%	34 605	36 179	0.69%
Creative Industries	116 924	50 199	3.35%	30 217	39 534	1.81%
Digital Industries	71 102	51 790	0.75%	22 041	40 836	0.88%
Environmental Industries	44 917	45 305	1.17%	23 271	38 372	0.47%
Experience Industries	97 663	39 283	3.84%	37 625	33 852	2.80%
Logistical Services	37 870	26 332	-0.30%	16 078	32 205	0.62%
Medical Devices	35 043	48 050	0.19%	10 108	42 829	-1.22%
Mobility Technologies	79 420	39 784	0.51%	23 740	39 764	-0.31%

When it comes to entrepreneurship, emerging industries register 15 100 gazelles in strong clusters (48% of all gazelles in emerging industries) with employment of 415 000 (51%). This corresponds roughly to the geographic footprint of the existing activities in these industries. Among the emerging industries there is a clear pattern that service-dominated sectors, like Creative Industries and Logistical Services, have relatively more high-growth companies and they constitute a larger share of employment. This is driven partially by the recent shift towards services, but also by the generally lower capital requirements and other barriers to entry.

Table 9: Gazelles in Emerging Industries

Emerging Industry	Gazelles	Gazelle Employees	Share of employment in gazelles	Share of gazelles in strong locations	Share of gazelle employees in strong locations
Advanced Packaging	1 567	62 302	1.3%	36.6%	47.9%
Biopharmaceuticals	783	21 023	0.9%	29.9%	33.4%
Blue Growth Industries	8 129	276 568	2.1%	21.6%	25.4%
Creative Industries	14 539	289 810	2.0%	53.2%	49.9%
Digital Industries	5 940	148 834	1.5%	35.6%	42.6%
Environmental Industries	5 172	187 305	2.1%	23.8%	41.6%
Experience Industries	9 027	232 254	1.5%	34.7%	45.8%
Logistical Services	3 975	121 455	1.6%	28.9%	32.5%
Medical Devices	1 518	50 922	1.1%	35.9%	41.8%
Mobility Technologies	3 300	126 157	1.2%	35.5%	44.8%

The geographic distribution of gazelles thus follows roughly the same patterns as the geographic footprint of existing activity in the respective emerging industry: it is the same 20% of clusters that account for twice as much current economic activity and entrepreneurship as the average of all locations.

The share of gazelles in strong clusters varies from nearly one half in Logistics and Creative Industries to one quarter in Environmental Services. These variations likely reflect industry-specific differences in

barriers to entry but potentially also location-specific conditions relevant for entrepreneurship in the type of locations an emerging industry is predominantly found.

4.1.2   Hotspots of Emerging Industries

While the present analysis is generally focused on individual emerging industries, it also identified regions with cluster strengths across all emerging industries. Similar to the hotspots analysis of regional sectoral cluster portfolios, the total number of stars registered across the four cluster performance dimensions for the ten cross-sectoral, emerging industries was also identified for each region.

Table 10 shows strong differences in size and economic performance across groups of regions by their overall number of stars for emerging industries. Regions with more stars are not only significantly larger (this gives them a better chance to capture stars for absolute size) but register also much higher wages, value added, and patenting intensity.

Table 10: Regional competitiveness outcomes and emerging industry cluster portfolio strength

	Cluster star rating range					Average
	0-4	**5-9**	**10-14**	**15-19**	**20+**	
GDP, million €	26 342	37 673	68 883	111 967	181 896	41 815
GDP per capita, PPP	23 450	25 300	30 400	37 200	44 550	27 200
Employment	453 315	535 265	730 730	989 725	2 144 157	570 227
Average Wage, PPP / Employee	30 930	29 126	36 251	42 191	41 641	32 949
Gross Value Added, PPP	21 249	27 214	45 520	77 725	182 879	31 386
Patents per Million People	9 066	10 705	14 402	19 118	41 234	11 405
Number of regions	100	111	77	29	10	

As in the 2014 edition of the Panorama, most of the top regions come from Southern Germany with Stuttgart as the leader in 2016 compared to Darmstadt two years ago. Due to the substantial changes in the underlying datasets it is hard to compare the relative performance of the regions directly, but the stability of the top-10 is a sign of the robustness of the main results.

Many of these hotspots are concentrated in large urban areas and traditional manufacturing regions. This is due to the nature of emerging industries that combine strong service-oriented industries like Creative and ICT and the industries that build upon the accumulated manufacturing knowledge. The former are much more likely to be strong in urban centres, and in fact most of the capitals and large cities in Europe score high on the number of stars. While the latter prosper in historically strong technological areas stretching from Cologne to Milan, as well as some Eastern European regions.

Figure 7: European regional hotspots of cross-sectoral, emerging industry clusters
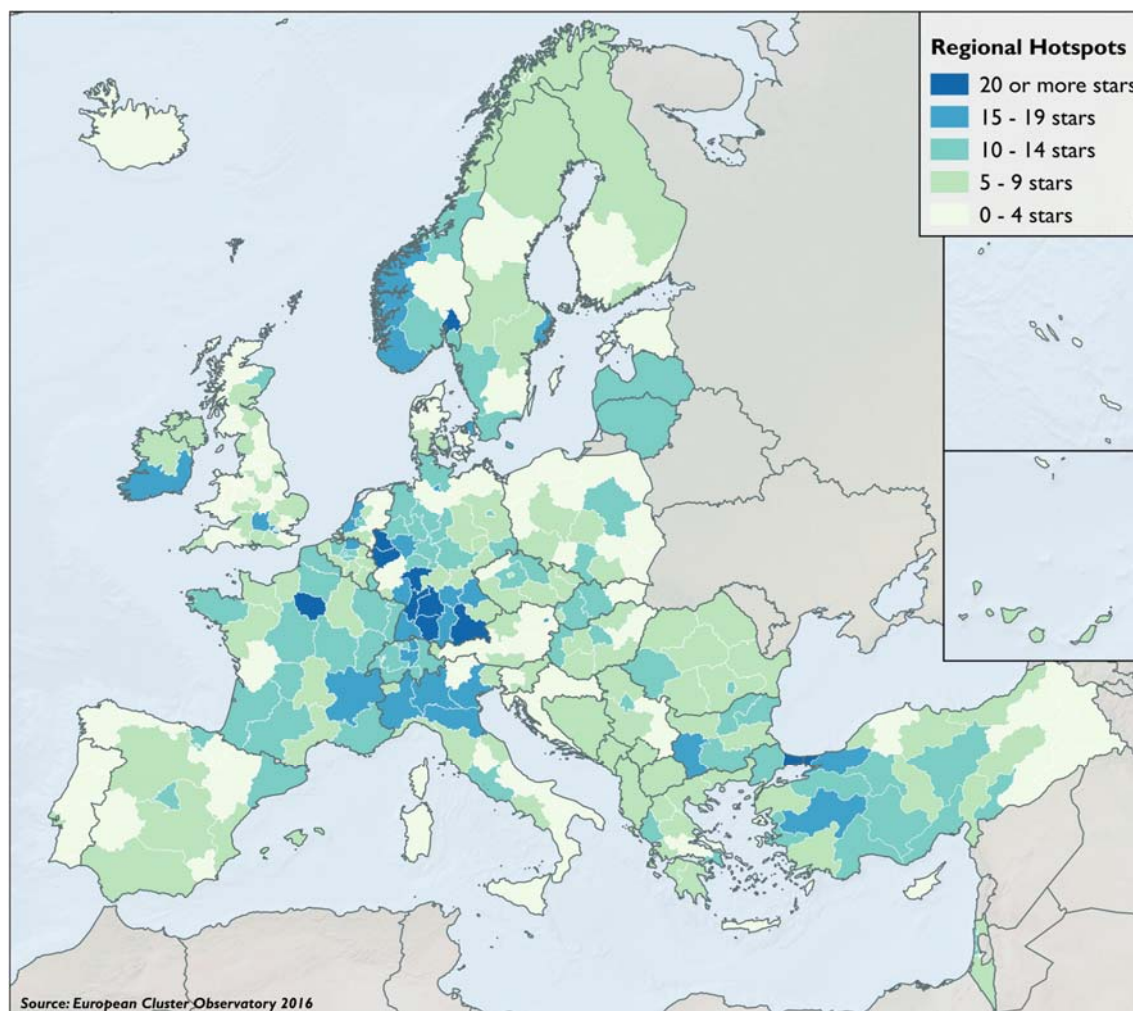
Table 11 profiles the European regions with 15 or more stars for emerging industries. These 39 regions have more than 51% of traded industry employment in emerging industries, compared to 43% in remaining 288 regions. The corresponding shares for wages paid are 57% and 45% respectively. These regions are overall considerably richer and more productive having 37% larger average value added per employee suggesting the possible impact of favourable business environment.

Table 11: Europe's emerging industries hotspots (15 stars or more)

Rank	Region	Region Name	Largest City	Size stars	Spec. stars	Productivity stars	Dynamism Stars	Total stars
1	NO01	Oslo og Akershus	Oslo	5	5	10	5	25
2	DE11	Stuttgart	Stuttgart	10	6	7	1	24
3	DE71	Darmstadt	Frankfurt am Main	10	6	7	0	23
4	DE21	Oberbayern	Munich	10	5	7	0	22
4	DEA1	Düsseldorf	Düsseldorf	10	5	4	3	22
4	DEA2	Köln	Köln	10	3	9	0	22
7	DE12	Karlsruhe	Karlsruhe	10	7	3	1	21
7	DE14	Tübingen	Tübingen	5	5	8	3	21

Rank	Region	Region Name	Largest City	Size stars	Spec. stars	Productivity stars	Dynamism Stars	Total stars
9	FR10	Île de France	Paris	10	3	7	0	20
9	TR10	Istanbul	Istanbul	10	0	0	10	20
11	DE13	Freiburg	Freiburg	7	7	4	1	19
11	DE25	Mittelfranken	Nürnberg	6	6	7	0	19
11	DEA5	Arnsberg	Dortmund	9	5	5	0	19
11	IE02	Southern and Eastern	Dublin	7	5	4	3	19
15	CH06	Zentralschweiz	Luzern	0	4	10	4	18
15	DE60	Hamburg	Hamburg	8	6	4	0	18
15	DEB3	Rheinhessen-Pfalz	Mainz	6	5	6	1	18
15	DK01	Hovedstaden	Copenhagen	5	4	8	1	18
15	ITC4	Lombardia	Milan	10	8	0	0	18
15	SE11	Stockholm	Stockholm	6	4	5	3	18
21	BE21	Antwerpen	Antwerpen	2	4	10	1	17
21	BG41	Yugozapaden	Sofia	7	1	0	9	17
21	DE23	Oberpfalz	Regensburg	3	5	5	4	17
24	AT13	Wien	Wien	4	4	3	5	16
24	DE27	Schwaben	Augsburg	5	6	5	0	16
24	NO04	Agder og Ro-galand	Kristiansand	2	3	9	2	16
24	TR33	Manisa	Manisa	3	6	0	7	16
24	TR42	Kocaeli	İzmit	1	7	0	8	16
24	UKI7	Outer London - West and North West	London	4	3	8	1	16
30	CH04	Zürich	Zürich	3	2	10	0	15
30	FR71	Rhône-Alpes	Lyon	10	2	3	0	15
30	ITC1	Piemonte	Turin	10	4	0	1	15
30	ITH3	Veneto	Venice	9	5	0	1	15
30	ITH5	Emilia-Romagna	Bologna	9	6	0	0	15
30	NL32	Noord-Holland	Amsterdam	7	2	6	0	15
30	NL33	Zuid-Holland	Rotterdam	7	2	5	1	15
30	NO05	Vestlandet	Bergen	1	4	9	1	15
30	UKI6	Outer London - South	London	1	2	8	4	15
30	UKJ1	Berks, Bucks and Oxon	Oxford	5	3	7	0	15

Comparing the regional hotspots for the ten cross-sectoral, emerging industries with those for the 51 sectoral cluster categories, it is evident that while all the emerging industry hotspots are also sectoral cluster hotspots, the reverse is not true. In general, regions in the Eastern and Southern Europe, particularly in Poland, Baltic States and Spain, are much stronger in sector-based cluster measures then they are in emerging industry cluster based ones. This could reflect a different industrial composition of these regions, but also substantial difference in the overall business environment.

There are seven regions (five in Germany) that are in top-10 by cluster stars according to both the emerging industry definition and the sector-based one: Istanbul, Stuttgart, Paris, Düsseldorf, München, Köln, and Frankfurt am Main. Some regions have stronger emerging industry cluster portfolios (Oslo, Dublin, Karlsruhe, Nürnberg, and Dortmund), while others are much stronger in sectoral cluster portfolios (Milan, Hamburg, Lithuania, Poznan, Katowice).

The strongest regions exhibit very different patterns of strength. Some, like Oslo, Antwerpen, and Swiss regions, have high wages in every emerging industry and score high on productivity. Regions in Eastern Europe, particularly Bulgaria, Hungary and Romania, score high on dynamism due to high entrepreneurship indicators. Many regions have reached large sizes in all of the sectors, but it is by definition hard to specialise in many areas. This makes Lombardia's eight emerging industries with high specialisation a particularly strong achievement. Top regions usually combine two or three strong dimensions, but are weaker in the remaining ones. The most balanced regions among the top 25 are Stockholm and Dublin which score at least three stars along each dimension.

4.2 Profiling the Ten Emerging Industries

The following section reports key new data on each of the ten emerging industries that were defined in the 2014 European Cluster Panorama. It also reproduces a basic profile of the activities included in each emerging industry, including a graphic representation of industry composition. For a more qualitative discussion of the emerging industries and key trends that they are exposed to please see the 2014 document.

4.2.1 Advanced Packaging

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	4 854 023	2.01%	4.12%	1.93%
Establishments	38 913	-1.93%	3.67%	2.24%
Average Wage	35 839	2.38%	103.04%	111.64%
Gazelle Employment	62 302	N/A	3.26%	1.65%

Figure 8: Employment over time, 2008 - 2014
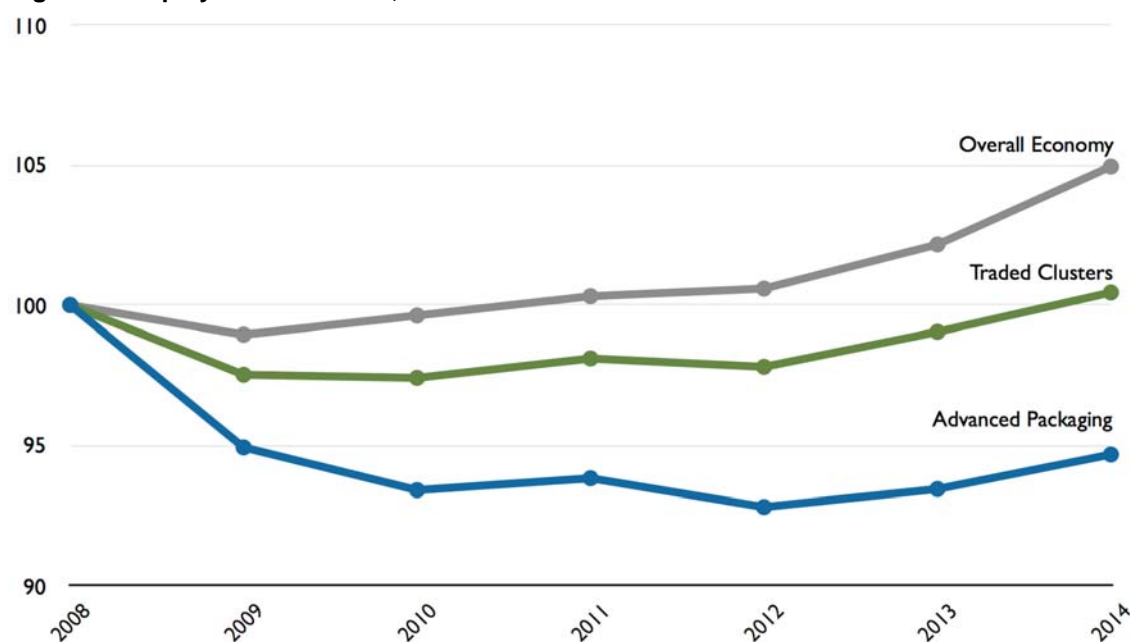
The core of the Advanced Packaging industry is the Paper and Packaging cluster, complemented with packaging-related industries from Plastics, Automotive, Metalworking and other clusters that are often significantly larger in overall employment. Packaging of goods occurs throughout industry value chains, from early steps in manufacturing, any distribution actions (transport packaging) until the end product having arrived at the final user (the consumer package)**.**

Figure 9: Advanced Packaging Industry composition[35]
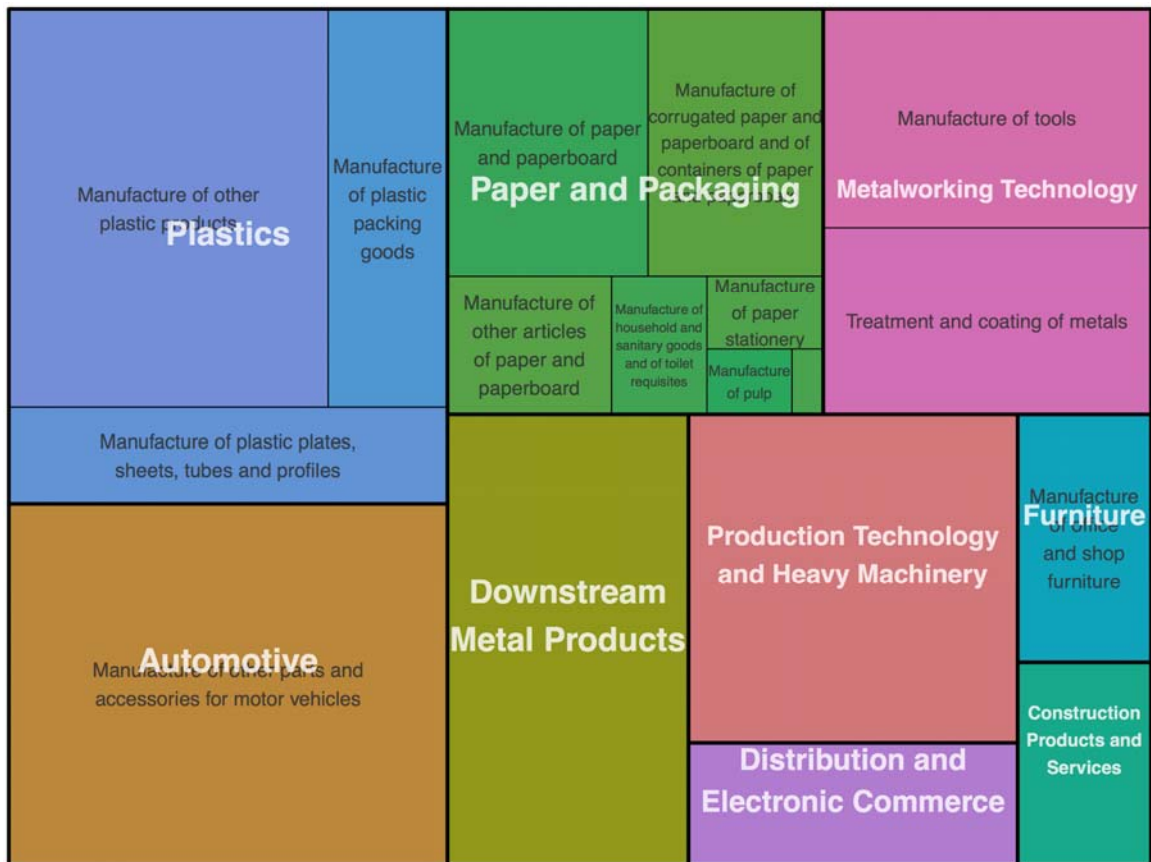
Table 12: Occupational profile of employment in Advanced Packaging

Occupation	Employment	Employment share
Craft, Trade, Operators, Assemblers	**2 161 000**	**53.7%**
Metal, Machinery and Related Trades Workers	769 100	19.1%
Stationary Plant and Machine Operators	663 900	16.5%
Assemblers	214 800	5.3%
Other	513 200	12.8%
Officials, Managers, Professionals, Technicians	**1 157 600**	**28.8%**
Science and Engineering Associate Professionals	353 800	8.8%
Other	803 800	20.0%
Service, Sales, Elementary	**397 200**	**9.9%**
Labourers in Mining, Construction, Manufacturing and Transport	270 200	6.7%
Other	127 000	3.2%
Clerks	**355 300**	**8.8%**
Numerical and Material Recording Clerks	224 800	5.6%
Other	130 500	3.2%

Figure 10: Leading regions in Advanced Packaging

Source: European Cluster Observatory 2016
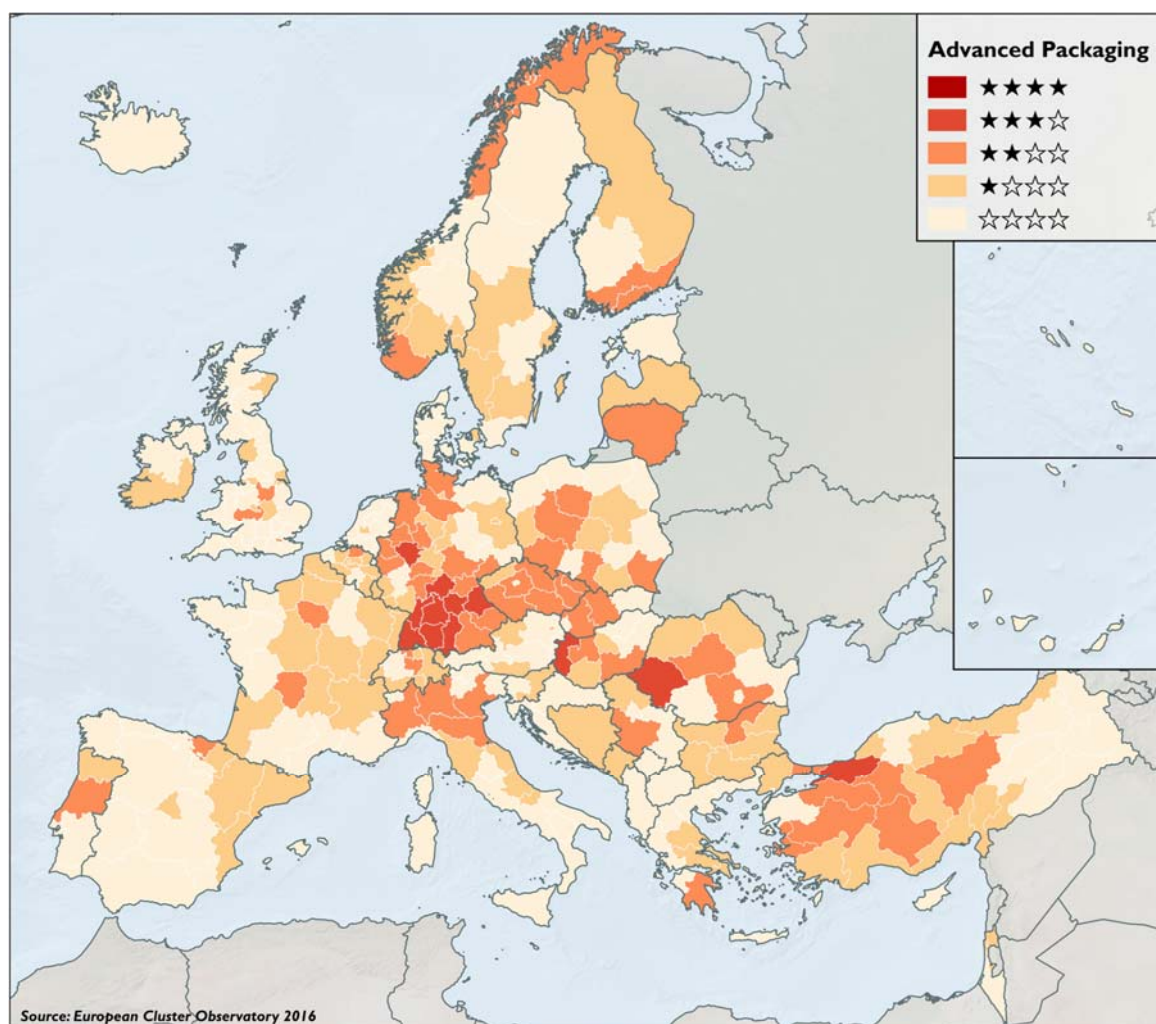
Table 13: Europe's top locations[36] in Advanced Packaging

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	HU22	Nyugat-Dunantul	Györ	45 369	4.69	22 134	19.6%	3.3%	3
2	TR42	Kocaeli	İzmit	26 088	3.52	34 916	40.1%	1.4%	3
3	DE14	Tübingen	Tübingen	39 513	2.43	53 297	-0.3%	0.4%	3
4	DE11	Stuttgart	Stuttgart	102 150	2.38	62 906	-0.1%	0.3%	3
5	DE23	Oberpfalz	Regensburg	24 502	2.27	58 934	0.8%	2.5%	3
6	DE27	Schwaben	Augsburg	34 486	2.15	53 179	-11.6%	1.2%	3
7	RO42	Vest	Timisoara	36 256	2.11	11 888	8.5%	3.2%	3
8	DE26	Unterfranken	Würzburg	24 490	2.07	58 313	-1.8%	1.1%	3
9	DEA5	Arnsberg	Dortmund	59 020	1.95	52 847	2.3%	2.1%	3
10	DE25	Mittelfranken	Nürnberg	33 530	1.93	75 102	7.8%	0.8%	3
11	DE12	Karlsruhe	Karlsruhe	53 226	1.93	81 453	4.7%	1.7%	3
12	DE13	Freiburg	Freiburg	37 830	1.85	54 033	1.6%	0.3%	3

Table 14: Strategic profiles of top locations in Advanced Packaging

Region	Region Name	Largest City	Top 3 Occupations
HU22	Nyugat-Du-nantul	Györ	82 Assemblers 72 Metal, Machinery and Related Trades Workers 81 Stationary Plant and Machine Operators
TR42	Kocaeli	İzmit	75 Food Processing, Woodworking, Garment and Other Craft and Related Trades Workers
DE14	Tübingen	Tübingen	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 81 Stationary Plant and Machine Operators
DE11	Stuttgart	Stuttgart	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 81 Stationary Plant and Machine Operators
DE23	Oberpfalz	Regensburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 81 Stationary Plant and Machine Operators
DE27	Schwaben	Augsburg	72 Metal, Machinery and Related Trades Workers 81 Stationary Plant and Machine Operators 31 Science and Engineering Associate Professionals
RO42	Vest	Timisoara	82 Assemblers 93 Labourers in Mining, Construction, Manufacturing and Transport 72 Metal, Machinery and Related Trades Workers
DE26	Unterfranken	Würzburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 81 Stationary Plant and Machine Operators
DEA5	Arnsberg	Dortmund	72 Metal, Machinery and Related Trades Workers 81 Stationary Plant and Machine Operators 31 Science and Engineering Associate Professionals
DE25	Mittelfranken	Nürnberg	72 Metal, Machinery and Related Trades Workers 81 Stationary Plant and Machine Operators 93 Labourers in Mining, Construction, Manufacturing and Transport

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[36] We sort locations here and in all following sections by the number of stars, followed by LQ.

4.2.2   Biopharmaceuticals

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	2 315 157	0.79%	1.97%	0.92%
Establishments	20 961	-1.96%	1.97%	1.21%
Average Wage	47 533	1.13%	136.66%	148.06%
Gazelle Employment	21 023	N/A	1.10%	0.56%

Figure 11: Employment over time, 2008 - 2014
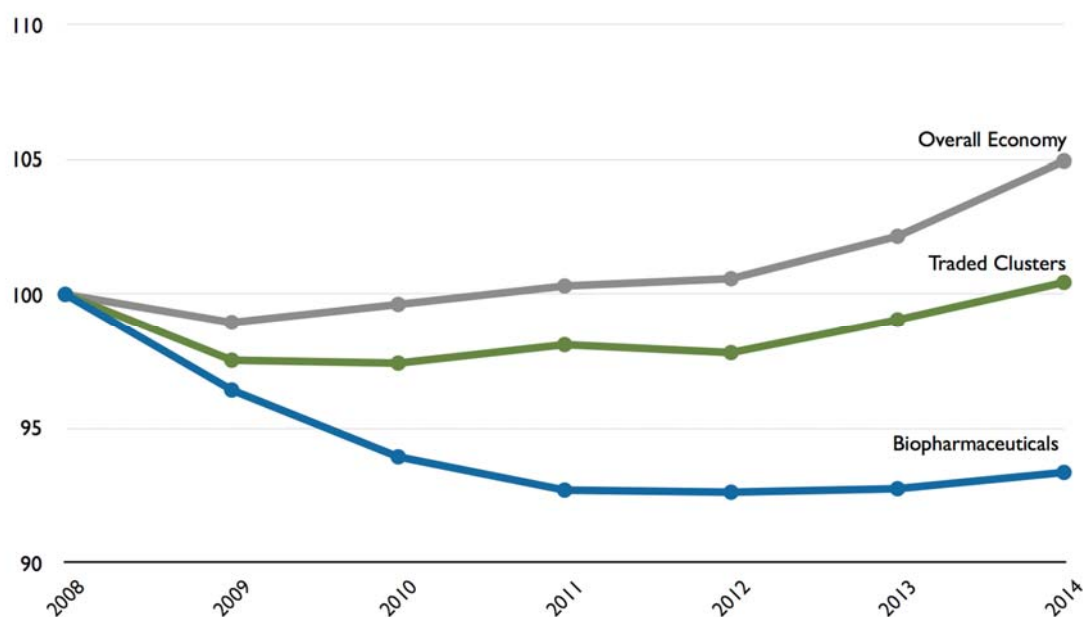
The Biopharmaceutical emerging industry is an expansion of the cluster category with the same name with industries added from upstream (chemical), downstream (wholesale and packaging), as well as the core activities (research and development). The Biopharmaceuticals industry is producing medical drugs by biotechnology methods (involving live organisms or bioprocessing). A basic distinction is made between biopharmaceuticals, manufactured by biotechnology methods and involving complex biological molecules, and drugs, manufactured by chemical (non-biological) means and involving small molecules and other chemical substances. [37] The two largest parts of the Biopharmaceuticals category are research and development and manufacture of pharmaceuticals, which together constitute about one half of the overall wages paid in the industry. This reflects on the strong scientific basis of the sector. The other half consists of roughly equally upstream activities, such as chemical inputs needed for the manufacturing of pharmaceuticals, and downstream activities like packaging and wholesale.

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[37] *There is no consensus on the use of biopharmaceutical or related terms in the scientific community. Those concerned with biopharmaceuticals are divided among a large number of scientific and industrial disciplines and professional associations. None have taken a visible position concerning terminology.*

Figure 12: Biopharmaceuticals Industry composition

Table 15: Occupational profile of employment in Biopharmaceuticals

Occupation	Employment	Employment share
Officials, Managers, Professionals, Technicians	**969 300**	**60.0%**
Science and Engineering Professionals	204 100	12.6%
Business and Administration Associate Professionals	165 700	10.3%
Science and Engineering Associate Professionals	160 700	10.0%
Business and Administration Professionals	103 400	6.4%
Other	335 400	20.8%
Craft, Trade, Operators, Assemblers	**291 500**	**18.1%**
Stationary Plant and Machine Operators	158 200	9.8%
Other	133 300	8.3%
Service, Sales, Elementary	**207 100**	**12.8%**
Labourers in Mining, Construction, Manufacturing and Transport	89 000	5.5%
Other	118 100	7.3%
Clerks	**189 000**	**11.7%**
Numerical and Material Recording Clerks	104 500	6.5%
Other	84 500	5.2%

Figure 13: Leading regions in Biopharmaceuticals

Source: European Cluster Observatory 2016
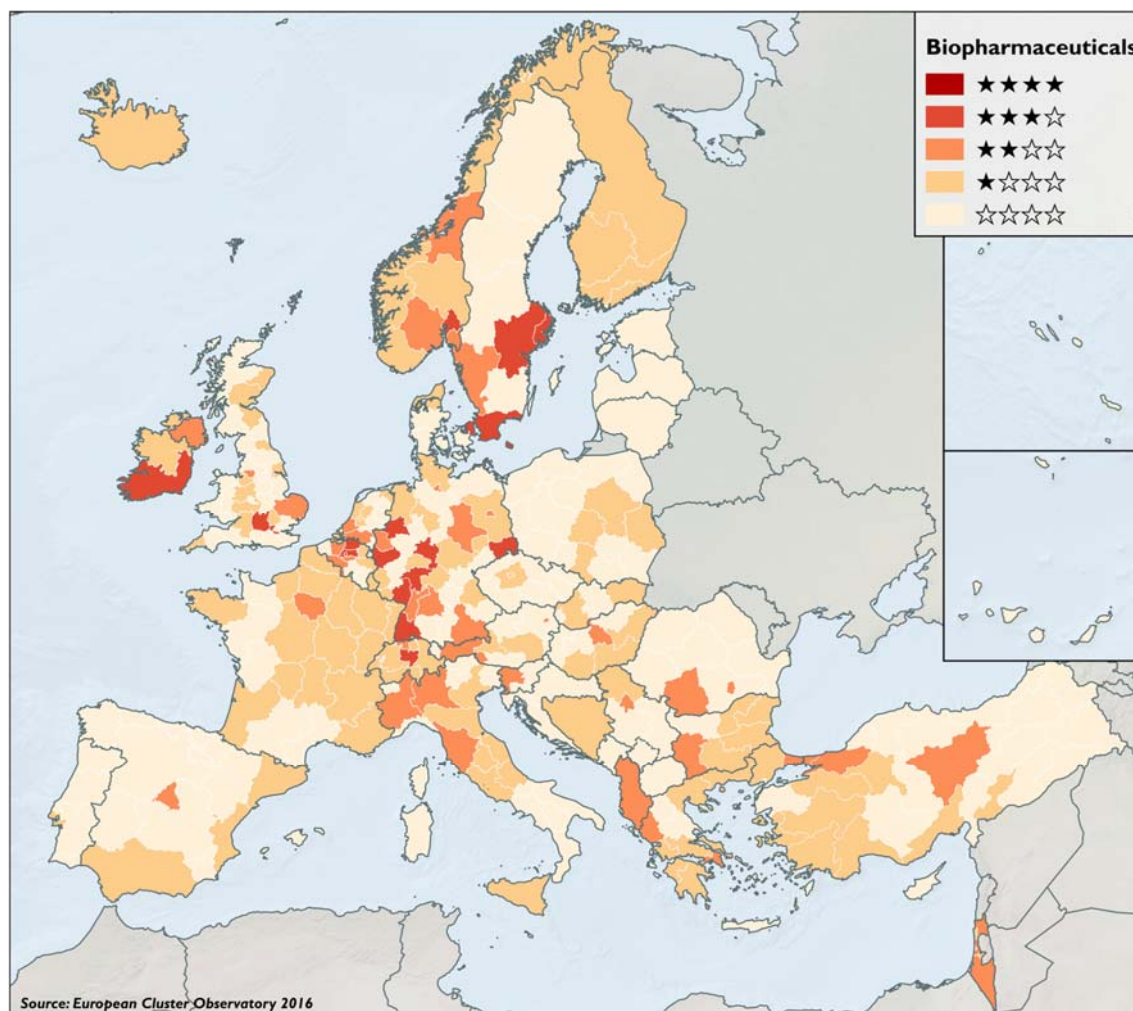
Table 16: Europe's top locations in Biopharmaceuticals

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	DEB3	Rheinhessen-Pfalz	Mainz	29 046	3.38	78 772	-1.5%	0.0%	3
2	BE24	Vlaams-Brabant	Leuven	9 771	2.84	97 897	-0.8%	0.7%	3
3	DK01	Hovedstaden	Copenhagen	23 113	2.79	67 934	1.7%	0.3%	3
4	BE10	Brussels	Brussels	15 062	2.63	86 890	1.7%	0.1%	3
5	DE71	Darmstadt	Frankfurt am Main	43 449	2.51	79 307	-0.4%	0.3%	3
6	BE21	Antwerpen	Antwerpen	15 368	2.36	98 449	-1.3%	0.0%	3
7	UKI6	Outer London - South	London	13 250	2.04	54 251	-5.3%	0.0%	3
8	IE02	Southern and Eastern	Dublin	35 300	1.99	56 931	18.4%	0.4%	3
9	UKI7	Outer London - West and North West	London	15 638	1.66	93 380	-21.4%	1.0%	3

| #	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
10	DE13	Freiburg	Freiburg	16 202	1.66	81 545	0.4%	1.3%	3
11	UKJ1	Berks, Bucks and Oxon	Oxford	22 299	1.66	69 881	-0.2%	0.0%	3
12	SE22	Sydsverige	Malmö	10 590	1.58	137 469	-7.3%	0.2%	3
13	SE11	Stockholm	Stockholm	19 230	1.55	68 171	0.6%	0.4%	3
14	NO01	Oslo og Akershus	Oslo	10 223	1.52	79 579	4.0%	0.0%	3
15	DED2	Dresden	Dresden	10 007	1.48	27 935	26.6%	0.9%	3
16	CH06	Zentralschweiz	Luzern	6 891	1.39	81 115	-16.4%	0.1%	3
17	DEA2	Köln	Köln	23 003	1.33	74 636	-5.0%	2.0%	3
18	DEA3	Münster	Münster	12 857	1.29	67 779	1.2%	0.3%	3
19	DE73	Kassel	Kassel	6 592	1.24	64 437	11.7%	4.3%	3
20	SE12	Östra Mellans-verige	Uppsala	9 404	1.24	63 646	5.3%	0.4%	3

Table 17: Strategic profiles of top locations in Biopharmaceuticals

Region	Region Name	Largest City	Top 3 Occupations
DEB3	Rheinhessen-Pfalz	Mainz	81 Stationary Plant and Machine Operators 21 Science and Engineering Professionals 31 Science and Engineering Associate Professionals
DE71	Darmstadt	Frankfurt am Main	31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks 21 Science and Engineering Professionals
UKI6	Outer London - South	London	33 Business and Administration Associate Professionals 12 Administrative and Commercial Managers 26 Legal, Social and Cultural Professionals
IE02	Southern and Eastern	Dublin	24 Business and Administration Professionals 33 Business and Administration Associate Professionals 75 Food Processing, Woodworking, Garment and Other Craft and Related Trades Workers
UKI7	Outer London - West and North West	London	33 Business and Administration Associate Professionals 12 Administrative and Commercial Managers 13 Production and Specialised Services Managers
DE13	Freiburg	Freiburg	21 Science and Engineering Professionals 81 Stationary Plant and Machine Operators 31 Science and Engineering Associate Professionals

4.2.3 Blue Growth Industries

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	12 953 282	2.03%	11.01%	5.15%
Establishments	75 235	-1.45%	7.09%	4.34%
Average Wage	32 320	1.63%	92.92%	100.68%
Gazelle Employment	276 568	N/A	14.45%	7.34%

Figure 14: Employment over time, 2008 - 2014
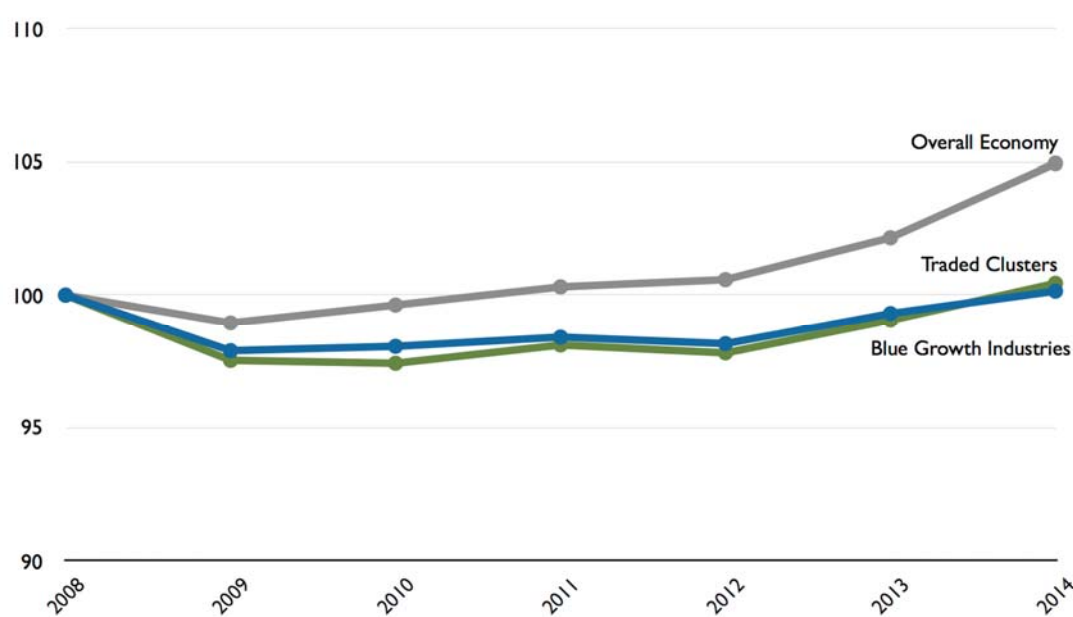
"Blue Growth" is here defined as the development and use of the potential of oceans, seas, and related infrastructures as well as of any inland fresh-water sources and their exploitation. The "Blue Growth Industries" therefore include all sectors and industries related to a maritime environment as well as sectors producing, making use of, and treating fresh-water sources.

Figure 15: Blue Growth Industries Industry composition

Table 18: Occupational profile of employment in Blue Growth Industries

Occupation	Employment	Employment share
Officials, Managers, Professionals, Technicians	**3 915 100**	**40.9%**
Science and Engineering Professionals	1 011 600	10.6%
Science and Engineering Associate Professionals	822 000	8.6%
Business and Administration Associate Professionals	618 400	6.5%
Other	1 463 000	15.3%
Craft, Trade, Operators, Assemblers	**3 673 600**	**38.3%**
Drivers and Mobile Plant Operators	2 284 400	23.8%
Metal, Machinery and Related Trades Workers	582 700	6.1%
Other	806 400	8.4%
Clerks	**1 209 300**	**12.6%**
Numerical and Material Recording Clerks	639 600	6.7%
Other	569 700	5.9%
Service, Sales, Elementary	**893 200**	**9.3%**

Figure 16: Leading regions in Blue Growth Industries
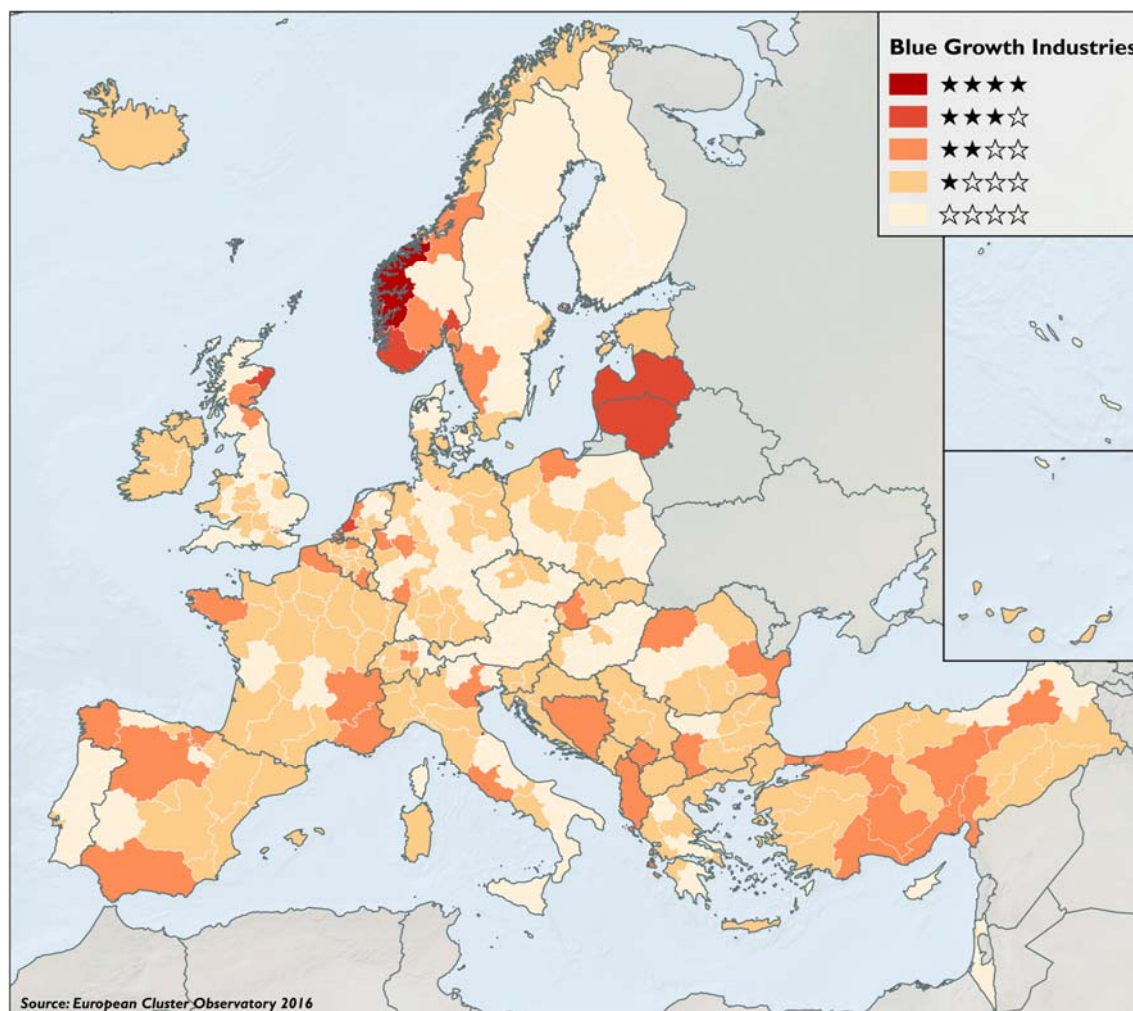
Table 19: Europe's top locations in Blue Growth Industries

#	Re-gion	Region Name	Largest City	Employ-ment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	NO05	Vestlandet	Bergen	112 801	4.41	59 470	8.5%	5.2%	4
2	UKM5	NE Scotland	Aberdeen	45 646	3.57	60 220	20.0%	0.6%	3
3	NO04	Agder og Rogaland	Kristiansand	66 248	2.91	51 170	-8.4%	3.3%	3
4	NO01	Oslo og Akershus	Oslo	64 946	1.73	75 048	-0.1%	3.7%	3
5	NL33	Zuid-Holland	Rotterdam	95 617	1.34	49 930	-5.3%	0.4%	3
6	LV00	Latvija	Riga	77 249	1.28	16 368	6.6%	4.5%	3
7	LT00	Lietuva	Vilnius	99 918	1.24	22 378	1.5%	8.9%	3

Table 20: Strategic profiles of top locations in Blue Growth Industries

| Region	Region Name	Largest City	Top 3 Occupations
NO05	Vestlandet	Bergen	31 Science and Engineering Associate Professionals
			81 Stationary Plant and Machine Operators
			72 Metal, Machinery and Related Trades Workers
UKM5	NE Scotland	Aberdeen	21 Science and Engineering Professionals
			81 Stationary Plant and Machine Operators
			72 Metal, Machinery and Related Trades Workers
NO04	Agder og Rogaland	Kristiansand	31 Science and Engineering Associate Professionals
			72 Metal, Machinery and Related Trades Workers
			81 Stationary Plant and Machine Operators
NO01	Oslo og Akershus	Oslo	21 Science and Engineering Professionals
			33 Business and Administration Associate Professionals
			31 Science and Engineering Associate Professionals
NL33	Zuid-Holland	Rotterdam	21 Science and Engineering Professionals
			83 Drivers and Mobile Plant Operators
			31 Science and Engineering Associate Professionals
LV00	Latvija	Riga	75 Food Processing, Woodworking, Garment and Other Craft and Related Trades Workers
			31 Science and Engineering Associate Professionals
			42 Customer Services Clerks
LT00	Lietuva	Vilnius	83 Drivers and Mobile Plant Operators
			33 Business and Administration Associate Professionals
			72 Metal, Machinery and Related Trades Workers

4.2.4 Creative Industries

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	14 166 879	4.82%	12.04%	5.63%
Establishments	107 276	-0.45%	10.10%	6.18%
Average Wage	44 765	1.56%	128.70%	139.44%
Gazelle Employment	289 810	N/A	15.15%	7.70%

Figure 17: Employment over time, 2008 - 2014
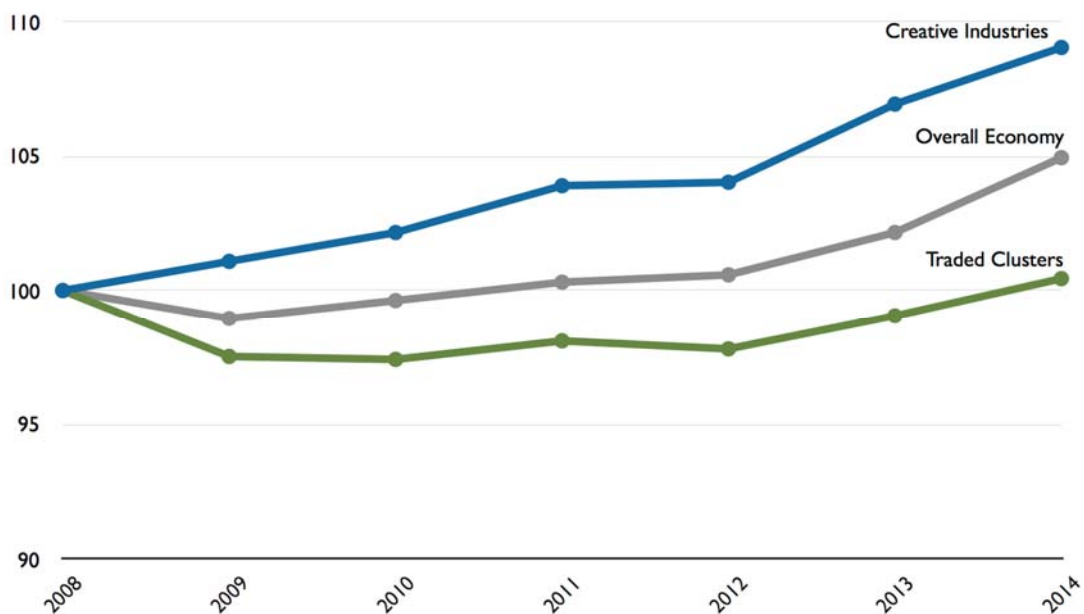
The European Commission's 2010 Green Paper defines creative industries as "industries which use culture as an input and have a cultural dimension, although their outputs are mainly functional. They include architecture and design, which integrate creative elements into wider processes, as well as sub-sectors such as graphic design, fashion design or advertising."[38] For this report any further activities driven by intellectual inputs and which are delivering intellectual outputs only (not being complemented with delivery of any hardware or product), are also be considered as part of this industry. Such activities include market research, opinion polling, translation, business and management consulting.

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[38] *European Commission (2010) Green paper – Unlocking the potential of cultural and creative industries, Communication COM (2010) 183.*

Figure 18: Creative Industries Industry composition

Table 21: Occupational profile of employment in Creative Industries

Occupation	Employment	Employment share
Service, Sales, Elementary	**893 200**	**9.3%**
Officials, Managers, Professionals, Technicians	**8 988 300**	**77.3%**
Information and Communications Technology Professionals	1 591 000	13.7%
Science and Engineering Professionals	1 424 100	12.3%
Business and Administration Professionals	1 361 600	11.7%
Business and Administration Associate Professionals	978 600	8.4%
Administrative and Commercial Managers	685 800	5.9%
Legal, Social and Cultural Professionals	649 500	5.6%
Other	2 297 700	19.8%
Clerks	**1 255 000**	**10.8%**
Craft, Trade, Operators, Assemblers	**885 400**	**7.6%**
Service, Sales, Elementary	**771 200**	**6.6%**

Figure 19: Leading regions in Creative Industries
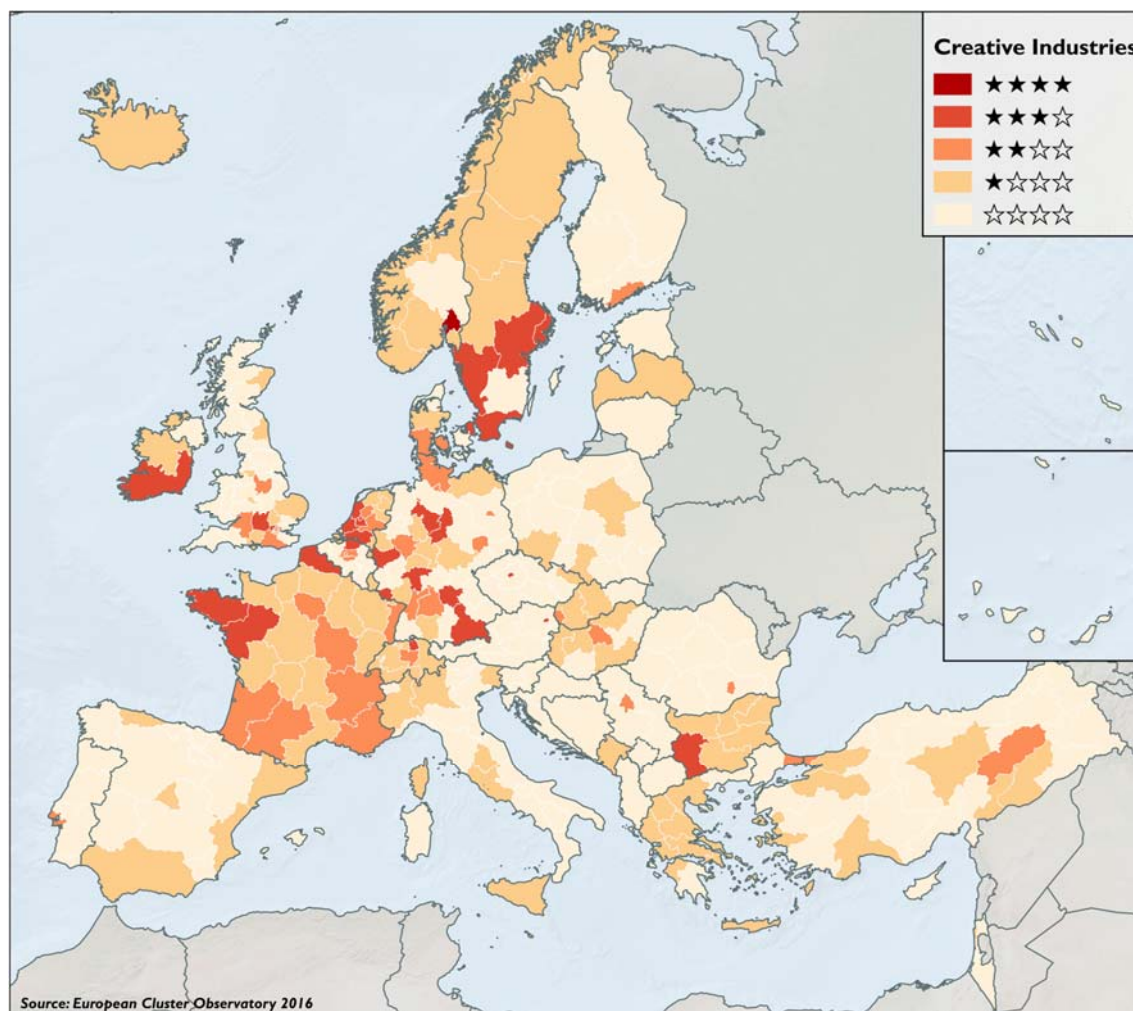

Source: European Cluster Observatory 2016

Table 22: Europe's top locations in Creative Industries

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	NO01	Oslo og Akershus	Oslo	87 023	2.12	69 441	14.7%	0.5%	4
2	DEC0	Saarland	Saarbrücken	113 459	3.43	53 484	-0.7%	0.6%	3
3	NL31	Utrecht	Utrecht	105 843	3.22	53 438	4.5%	1.4%	3
4	NL32	Noord-Holland	Amsterdam	207 979	3.12	59 597	2.5%	0.4%	3
5	UKI3	Inner London - West	London	148 831	2.85	73 969	10.3%	1.9%	3
6	SE11	Stockholm	Stockholm	181 114	2.39	47 704	3.1%	3.2%	3
7	CZ01	Praha	Praha	132 762	2.27	28 704	17.3%	3.1%	3
8	NL33	Zuid-Holland	Rotterdam	171 456	2.20	59 476	1.3%	2.2%	3
9	UKI4	Inner London - East	London	143 248	2.15	85 149	5.6%	0.5%	3
10	NL41	Noord-Brabant	Eindhoven	92 092	1.95	54 192	-1.1%	0.7%	3

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
11	CH04	Zürich	Zürich	101 483	1.92	57 785	-0.5%	1.1%	3
12	UKI7	Outer London - West and North West	London	108 023	1.88	90 219	7.0%	0.4%	3
13	DE91	Braunschweig	Braunschweig	78 656	1.88	51 244	67.3%	3.0%	3
14	IL05	Tel Aviv District	Tel Aviv	63 592	1.79	42 421	21.2%	7.4%	3
15	DE71	Darmstadt	Frankfurt am Main	185 020	1.75	55 440	7.3%	1.0%	3
16	DE21	Oberbayern	Munich	220 908	1.71	62 546	2.4%	3.1%	3
17	IE02	Southern and East-ern	Dublin	185 852	1.71	40 058	21.5%	2.8%	3
18	UKJ1	Berks, Bucks and Oxon	Oxford	132 447	1.61	61 913	19.0%	0.1%	3
19	DK01	Hovedstaden	Copenhagen	79 423	1.57	56 508	-6.0%	2.2%	3
20	DEA2	Köln	Köln	163 972	1.55	67 327	3.4%	0.7%	3

Table 23: Strategic profiles of top locations in Creative Industries

Re-gion	Region Name	Largest City	Top 3 Occupations
NO01	Oslo og Akershus	Oslo	25 Information and Communications Technology Pro-fessionals 24 Business and Administration Professionals 21 Science and Engineering Professionals
DEC0	Saarland	Saarbrücken	31 Science and Engineering Associate Professionals 25 Information and Communications Technology Pro-fessionals 33 Business and Administration Associate Professionals
NL31	Utrecht	Utrecht	24 Business and Administration Professionals 25 Information and Communications Technology Pro-fessionals 33 Business and Administration Associate Professionals
NL32	Noord-Holland	Amsterdam	24 Business and Administration Professionals 25 Information and Communications Technology Pro-fessionals 21 Science and Engineering Professionals
UKI3	Inner London - West	London	24 Business and Administration Professionals 43 Numerical and Material Recording Clerks 12 Administrative and Commercial Managers
SE11	Stockholm	Stockholm	24 Business and Administration Professionals 25 Information and Communications Technology Pro-fessionals 33 Business and Administration Associate Professionals

Re-gion	Region Name	Largest City	Top 3 Occupations
CZ01	Praha	Praha	21 Science and Engineering Professionals 25 Information and Communications Technology Professionals 26 Legal, Social and Cultural Professionals
NL33	Zuid-Holland	Rotterdam	24 Business and Administration Professionals 25 Information and Communications Technology Professionals 41 General and Keyboard Clerks
UKI4	Inner London - East	London	13 Production and Specialised Services Managers 24 Business and Administration Professionals 25 Information and Communications Technology Professionals
NL41	Noord-Brabant	Eindhoven	24 Business and Administration Professionals 25 Information and Communications Technology Professionals 11 Chief Executives, Senior Officials and Legislators

4.2.5   Digital Industries

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	9 994 767	2.64%	8.49%	3.97%
Establishments	80 535	-2.23%	7.59%	4.64%
Average Wage	44 949	1.39%	129.23%	140.01%
Gazelle Employment	148 834	N/A	7.78%	3.95%

Figure 20: Employment over time, 2008 - 2014
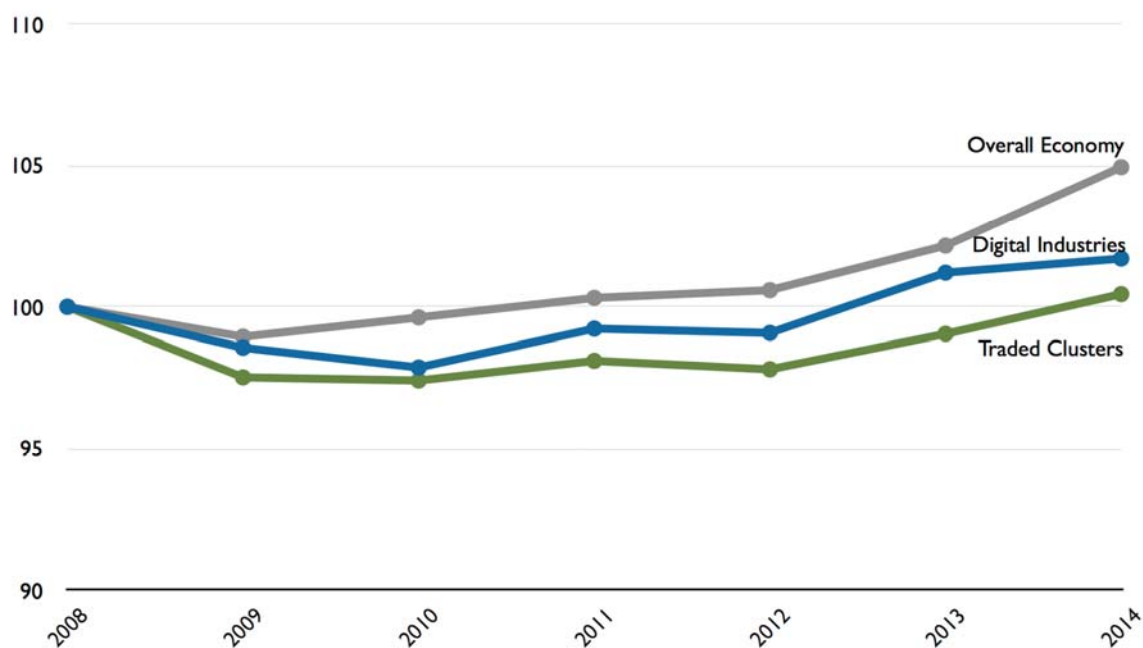
Digital industries cover some of the core sectors in the information age. They combine services related to information technologies with the hardware they use. As an increasingly cross-cutting generic tech- nology, IT has become an element of most parts of economic activity. Digital Industries capture the sectors that are at the heart of these trends.
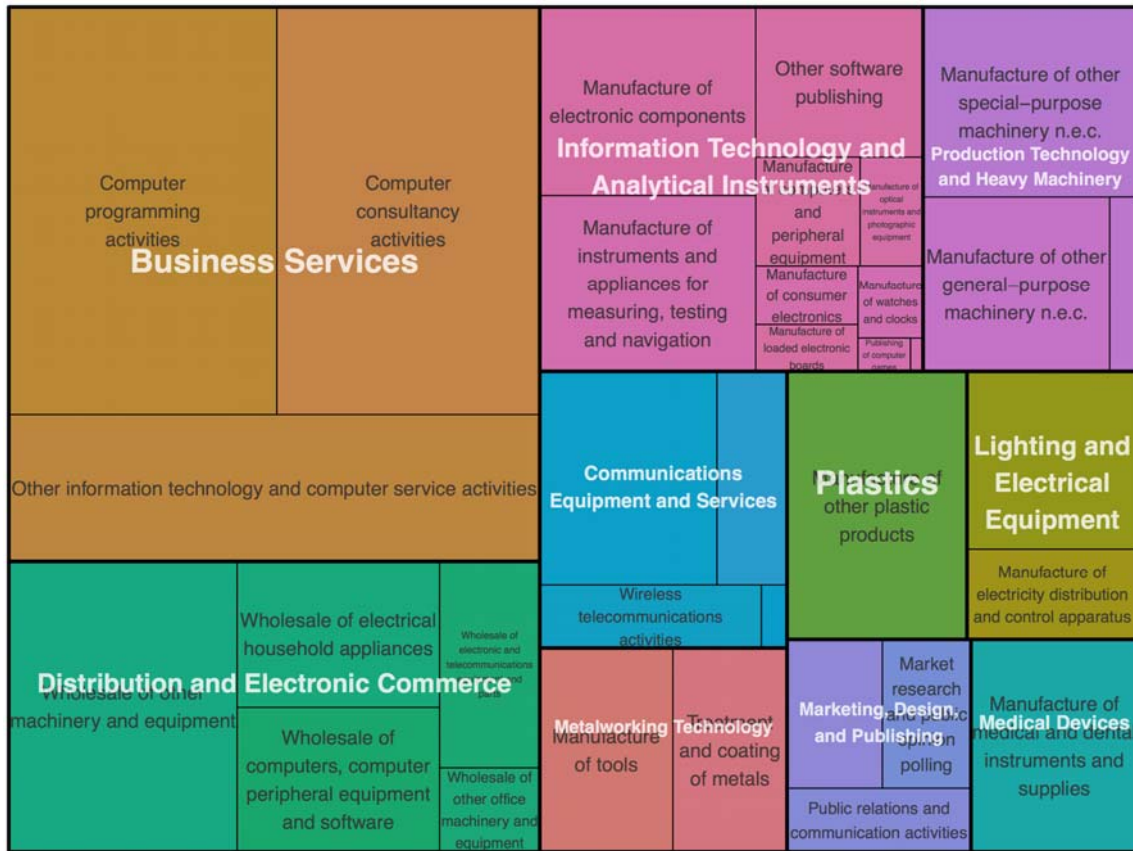
Figure 21: Digital Industries Industry composition

Table 24: Occupational profile of employment in Digital Industries

Occupation	Employment	Employment share
Officials, Managers, Professionals, Technicians	**5 193 200**	**64.3%**
Information and Communications Technology Professionals	1 434 900	17.8%
Business and Administration Associate Professionals	654 500	8.1%
Science and Engineering Professionals	539 900	6.7%
Science and Engineering Associate Professionals	486 600	6.0%
Information and Communications Technicians	467 800	5.8%
Business and Administration Professionals	461 300	5.7%
Other	1 148 200	14.2%
Craft, Trade, Operators, Assemblers	**1 834 900**	**22.7%**
Metal, Machinery and Related Trades Workers	627 200	7.8%
Other	1 207 700	15.0%
Clerks	**793 000**	**9.8%**
Service, Sales, Elementary	**549 900**	**6.8%**

Figure 22: Leading regions in Digital Industries
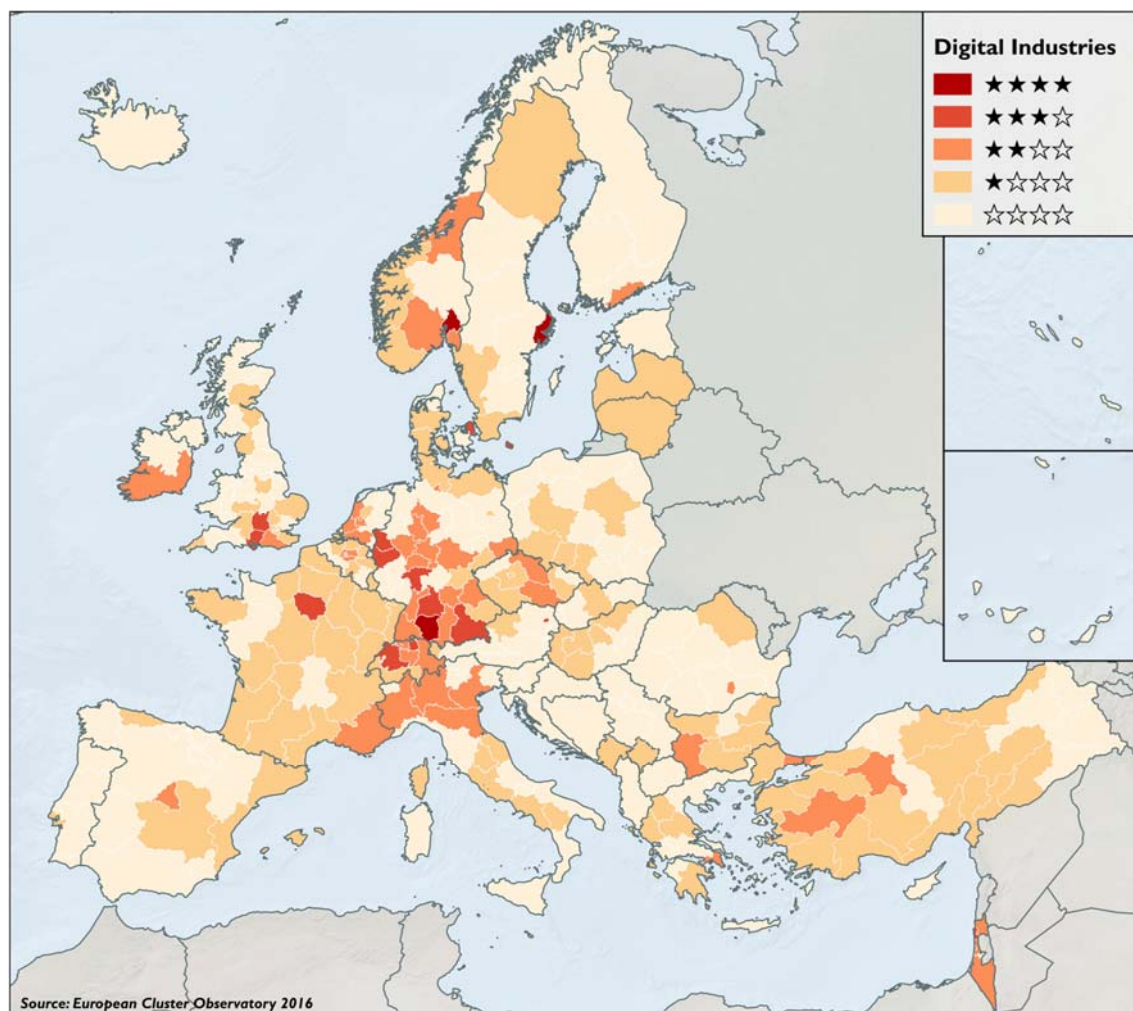

Source: European Cluster Observatory 2016

Table 25: Europe's top locations in Digital Industries

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Ga-zelle Empl. Share	Stars
1	NO01	Oslo og Akershus	Oslo	69 058	2.38	68 867	15.2%	1.0%	4
2	DE14	Tübingen	Tübingen	70 901	2.12	56 532	3.1%	4.6%	4
3	SE11	Stockholm	Stockholm	86 538	1.62	63 546	5.4%	2.8%	4
4	IL03	Haifa District	Haifa	44 155	2.67	24 280	9.2%	0.0%	3
5	DE11	Stuttgart	Stuttgart	215 739	2.44	66 434	11.4%	0.7%	3
6	AT13	Wien	Wien	68 743	1.91	48 125	26.4%	1.9%	3
7	DK01	Hovedstaden	Copenhagen	65 200	1.82	58 260	-5.2%	1.1%	3
8	UKJ1	Berks, Bucks and Oxon	Oxford	102 599	1.77	70 758	-0.2%	0.1%	3
9	CH04	Zürich	Zürich	64 523	1.73	75 473	-12.7%	0.6%	3
10	CH02	Espace Mittelland	Bern	59 442	1.72	79 363	-7.8%	0.6%	3

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Ga-zelle Empl. Share	Stars
11	DE21	Oberbayern	Munich	151 964	1.67	66 720	1.4%	0.8%	3
12	DE71	Darmstadt	Frankfurt am Main	118 021	1.58	60 303	-0.7%	0.7%	3
13	DEA1	Düsseldorf	Düsseldorf	133 607	1.42	58 197	1.4%	1.4%	3
14	DEA2	Köln	Köln	101 449	1.36	57 550	2.8%	1.1%	3
15	FR10	Île de France	Paris	341 822	1.31	60 221	8.3%	2.1%	3
16	UKJ3	Hants and Isle of Wight	Southampton	51 900	1.29	57 369	6.0%	0.1%	3

**Table 26: Strategic profiles of top locations in Digital Industries**

Region	Region Name	Largest City	Top 3 Occupations
NO01	Oslo og Akershus	Oslo	25 Information and Communications Technology Professionals 24 Business and Administration Professionals 35 Information and Communications Technicians
DE14	Tübingen	Tübingen	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 21 Science and Engineering Professionals
SE11	Stockholm	Stockholm	25 Information and Communications Technology Professionals 33 Business and Administration Associate Professionals 24 Business and Administration Professionals
DE11	Stuttgart	Stuttgart	72 Metal, Machinery and Related Trades Workers 43 Numerical and Material Recording Clerks 31 Science and Engineering Associate Professionals
AT13	Wien	Wien	25 Information and Communications Technology Professionals 33 Business and Administration Associate Professionals 35 Information and Communications Technicians
DK01	Hovedstaden	Copenhagen	25 Information and Communications Technology Professionals 35 Information and Communications Technicians 24 Business and Administration Professionals
UKJ1	Berks, Bucks and Oxon	Oxford	25 Information and Communications Technology Professionals 33 Business and Administration Associate Professionals 24 Business and Administration Professionals
CH04	Zürich	Zürich	25 Information and Communications Technology Professionals 21 Science and Engineering Professionals 12 Administrative and Commercial Managers
CH02	Espace Mittel-land	Bern	25 Information and Communications Technology Professionals 73 Handicraft and Printing Workers 72 Metal, Machinery and Related Trades Workers

4.2.6   Environmental Industries

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	8 725 709	2.74%	7.41%	3.47%
Establishments	71 882	-1.33%	6.77%	4.14%
Average Wage	38 466	0.49%	110.59%	119.82%
Gazelle Employment	187 305	N/A	9.79%	4.97%

Figure 23: Employment over time, 2008 - 2014
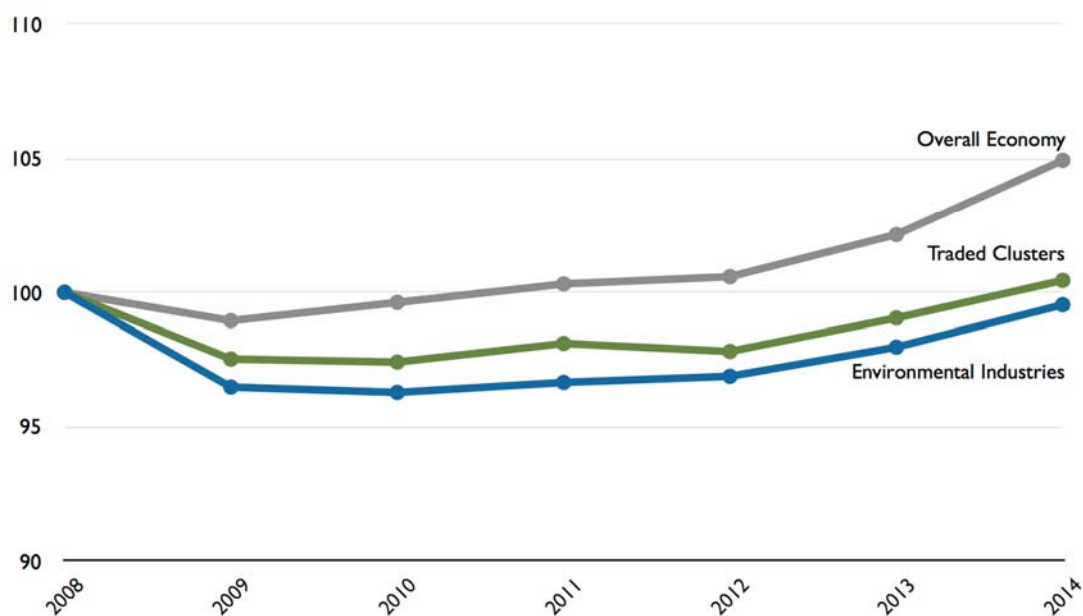
Environmental Industries are the most crosscutting of the ten selected industries, containing parts of 20 of the 51 cluster categories overall. The area of the 'green economy' is defined as encompassing all economic activities that lead to reducing environmental pressures of human activity. The latter is expected to result from the more efficient use of natural resources and from reducing harmful emissions across the lifecycle. Green economy includes a range of products, services, technologies and processes serving many different economic sectors.

Figure 24: Environmental Industries Industry composition

Table 27: Occupational profile of employment in Environmental Industries

Occupation	Employment	Employment share
Officials, Managers, Professionals, Technicians	**3 360 200**	**48.3%**
Science and Engineering Professionals	986 900	14.2%
Science and Engineering Associate Professionals	830 700	11.9%
Business and Administration Associate Professionals	428 900	6.2%
Other	1 113 700	16.0%
Craft, Trade, Operators, Assemblers	**2 249 400**	**32.3%**
Metal, Machinery and Related Trades Workers	651 800	9.4%
Stationary Plant and Machine Operators	481 800	6.9%
Drivers and Mobile Plant Operators	396 200	5.7%
Other	719 600	10.3%
Clerks	**767 100**	**11.0%**
Numerical and Material Recording Clerks	440 600	6.3%
Other	326 400	4.7%
Service, Sales, Elementary	**665 800**	**9.6%**

Figure 25: Leading regions in Environmental Industries
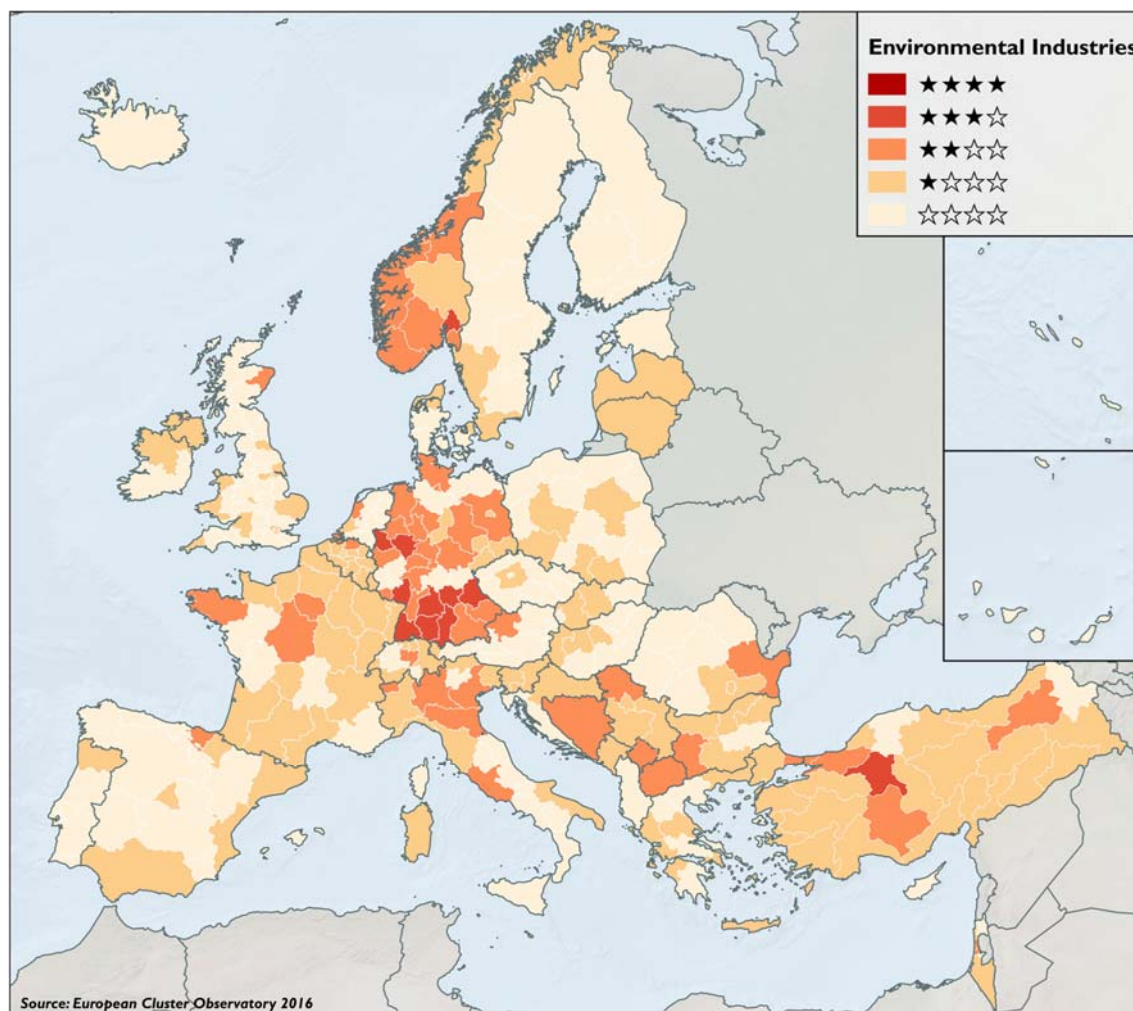

Source: European Cluster Observatory 2016

Table 28: Europe's top locations in Environmental Industries

| #	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	TR51	Ankara	Ankara	87 628	2.14	29 291	66.2%	23.3%	3
2	DEB3	Rheinhessen-Pfalz	Mainz	59 964	1.85	57 684	-1.7%	0.3%	3
3	DE14	Tübingen	Tübingen	51 550	1.76	53 768	-0.1%	0.6%	3
4	NO01	Oslo og Akershus	Oslo	42 962	1.70	83 262	-5.4%	1.3%	3
5	DE27	Schwaben	Augsburg	46 987	1.63	52 978	-8.4%	0.8%	3
6	DE13	Freiburg	Freiburg	57 441	1.56	52 702	2.6%	0.4%	3
7	DE11	Stuttgart	Stuttgart	116 852	1.52	58 768	-0.3%	1.0%	3
8	DE25	Mittelfranken	Nürnberg	46 137	1.48	55 143	-4.1%	1.2%	3
9	DE23	Oberpfalz	Regensburg	28 207	1.45	55 853	3.7%	4.6%	3
10	DEA5	Arnsberg	Dortmund	77 357	1.42	53 668	1.9%	1.5%	3
11	DEA1	Düsseldorf	Düsseldorf	112 407	1.37	59 151	4.3%	1.0%	3

Table 29: Strategic profiles of top locations in Environmental Industries

Re-gion	Region Name	Largest City	Top 3 Occupations
DEB3	Rheinhessen-Pfalz	Mainz	21 Science and Engineering Professionals 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DE14	Tübingen	Tübingen	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 21 Science and Engineering Professionals
NO01	Oslo og Akershus	Oslo	21 Science and Engineering Professionals 81 Stationary Plant and Machine Operators 31 Science and Engineering Associate Professionals
DE27	Schwaben	Augsburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DE13	Freiburg	Freiburg	21 Science and Engineering Professionals 72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals
DE11	Stuttgart	Stuttgart	21 Science and Engineering Professionals 31 Science and Engineering Associate Professionals 72 Metal, Machinery and Related Trades Workers
DE25	Mittelfranken	Nürnberg	21 Science and Engineering Professionals 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DE23	Oberpfalz	Regensburg	31 Science and Engineering Associate Professionals 72 Metal, Machinery and Related Trades Workers 21 Science and Engineering Professionals
DEA5	Arnsberg	Dortmund	72 Metal, Machinery and Related Trades Workers 43 Numerical and Material Recording Clerks 31 Science and Engineering Associate Professionals
DEB3	Rheinhessen-Pfalz	Mainz	21 Science and Engineering Professionals 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks

4.2.7   Experience Industries

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	15 248 961	6.57%	12.96%	6.06%
Establishments	113 445	-0.28%	10.69%	6.54%
Average Wage	35 323	0.54%	101.55%	110.03%
Gazelle Employment	232 254	N/A	12.14%	6.17%

Figure 26: Employment over time, 2008 - 2014
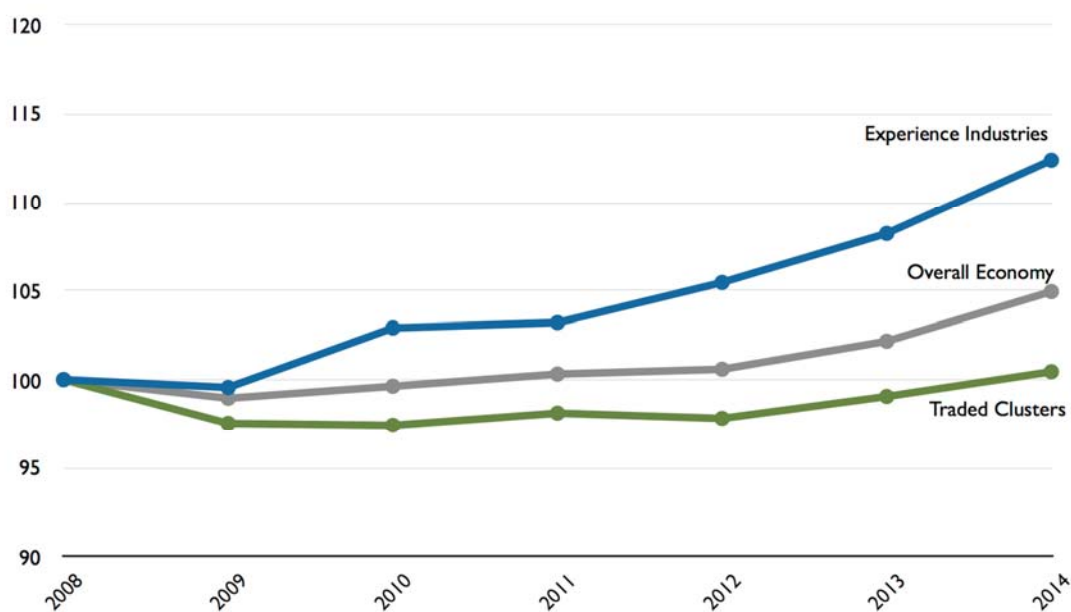
Experience Industries combine creation and consumption of cultural products and services. According to earlier analysis of the European Cluster Observatory, "Experience Industries comprise companies whose activities supply innovative products and services to provide customers with 'experiences' that stimulate emotions and senses, move, entertain and surprise, thrill, enthuse and involve". In its separate 2011 priority sector report, experience Industries are defined "as the combination of six sub-sectors: Accommodation and tours, Food and drink, Gambling, Museums and parks, Sports and leisure, and Arts".

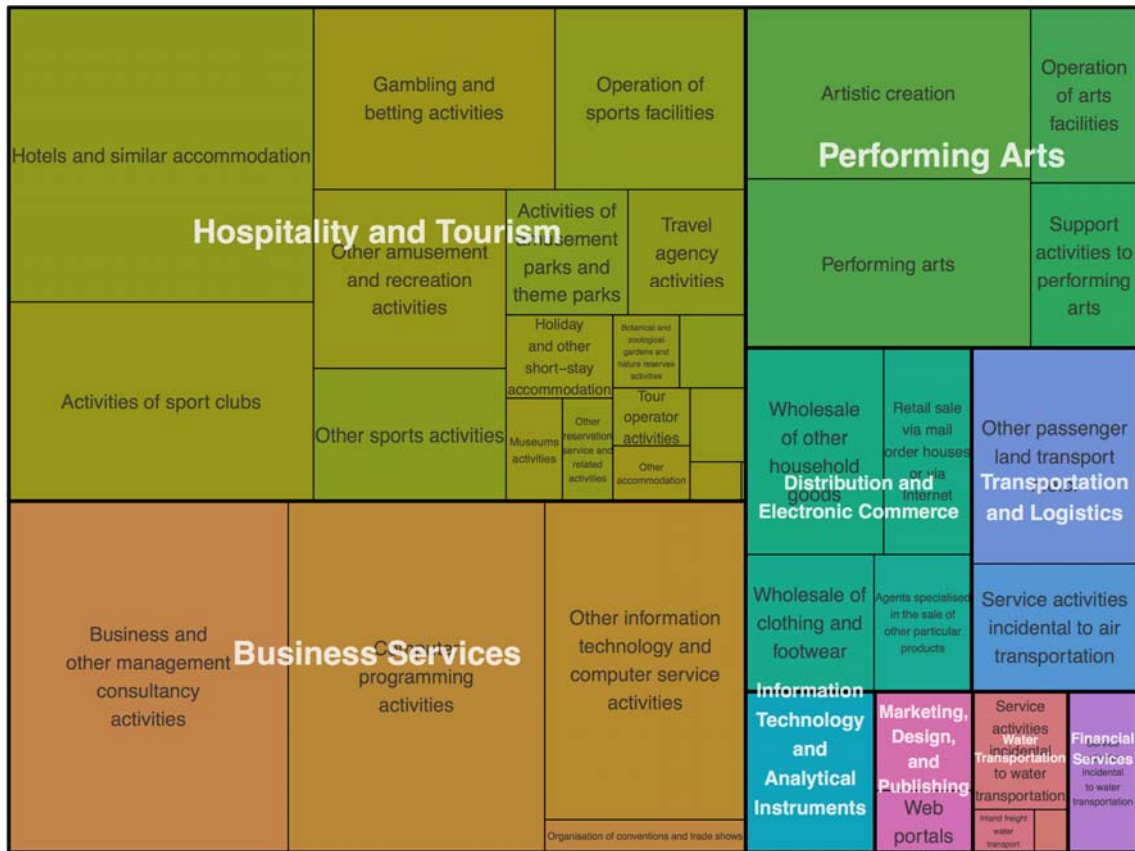**Figure 27: Experience Industries Industry composition**

Table 30: Occupational profile of employment in Experience Industries

Occupation	Employment	Employment share
Officials, Managers, Professionals, Technicians	**7 428 800**	**58.7%**
Legal, Social and Cultural Professionals	1 074 400	8.5%
Legal, Social, Cultural and Related Associate Professionals	996 500	7.9%
Information and Communications Technology Professionals	979 400	7.7%
Business and Administration Professionals	905 300	7.2%
Business and Administration Associate Professionals	886 700	7.0%
Hospitality, Retail and Other Services Managers	787 800	6.2%
Other	1 798 800	14.2%
Service, Sales, Elementary	**2 664 600**	**21.1%**
Personal Services Workers	1 043 700	8.3%
Other	1 620 900	12.8%
Clerks	**1 705 900**	**13.5%**
Customer Services Clerks	846 700	6.7%
Other	859 100	6.8%
Craft, Trade, Operators, Assemblers	**1 118 700**	**8.8%**

Figure 28: Leading regions in Experience Industries
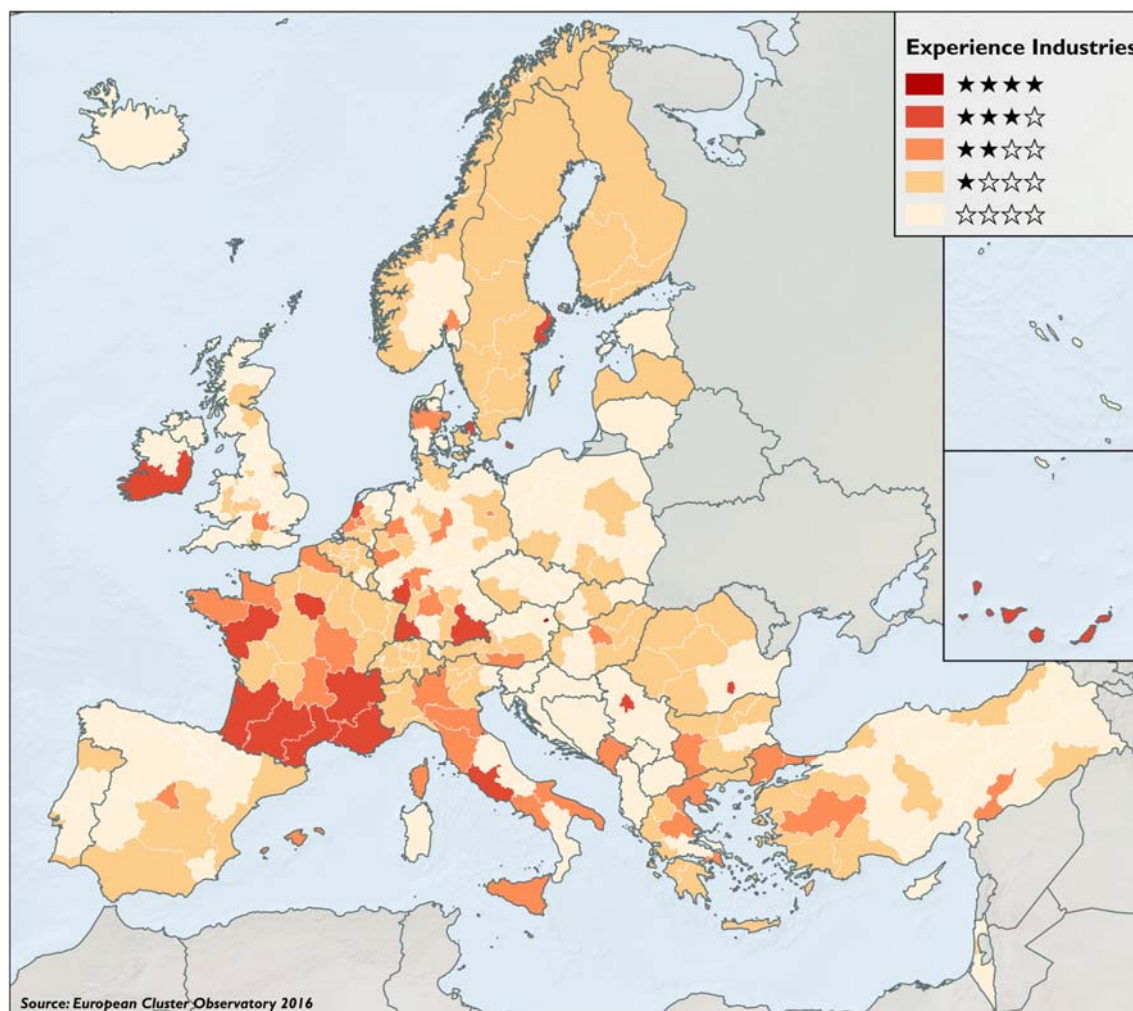

Source: European Cluster Observatory 2016

Table 31: Europe's top locations in Experience Industries

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	AT13	Wien	Wien	75 419	1.37	54 670	24.5%	1.7%	4
2	ITI4	Lazio	Rome	349 589	2.55	20 164	19.1%	8.8%	3
3	FR10	Île de France	Paris	921 772	2.32	49 368	11.8%	0.9%	3
4	ES70	Canarias	Tenerife	74 789	1.68	33 969	3.8%	4.0%	3
5	NL32	Noord-Holland	Amsterdam	110 761	1.55	52 220	6.5%	0.7%	3
6	SE11	Stockholm	Stockholm	123 194	1.51	42 641	8.9%	2.3%	3
7	FR82	Provence-Alpes-Côte d'Azur	Marseille	167 334	1.46	59 547	7.1%	0.6%	3
8	FR61	Aquitaine	Bordeaux	99 476	1.45	80 394	4.0%	0.5%	3
9	FR62	Midi-Pyrénées	Toulouse	90 307	1.43	59 895	6.7%	0.5%	3
10	DE21	Oberbayern	Munich	190 752	1.38	43 755	9.0%	1.5%	3
11	DEB3	Rheinhessen-Pfalz	Mainz	76 271	1.35	27 373	66.4%	0.7%	3

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
12	DE13	Freiburg	Freiburg	85 131	1.33	32 429	67.5%	0.5%	3
13	FR71	Rhône-Alpes	Lyon	190 119	1.31	61 058	5.6%	1.3%	3
14	FR51	Pays de la Loire	Nantes	105 217	1.30	62 073	7.9%	0.7%	3
15	FR81	Languedoc-Roussil-lon	Montpellier	68 319	1.29	73 095	8.0%	0.7%	3
16	DK01	Hovedstaden	Copenhagen	68 594	1.26	47 749	-3.2%	1.7%	3
17	RO32	Bucuresti - Ilfov	Bucharest	113 751	1.26	21 796	7.8%	2.8%	3
18	IE02	Southern and East-ern	Dublin	145 529	1.24	49 356	1.0%	1.3%	3
19	RS11	Belgrade	Belgrade	71 979	1.24	18 013	2.4%	7.5%	3

**Table 32: Strategic profiles of top locations in Experience Industries**

Region	Region Name	Largest City	Top 3 Occupations
AT13	Wien	Wien	25 Information and Communications Technology Professionals 26 Legal, Social and Cultural Professionals 51 Personal Services Workers
ITI4	Lazio	Rome	14 Hospitality, Retail and Other Services Managers 41 General and Keyboard Clerks 26 Legal, Social and Cultural Professionals
FR10	Île de France	Paris	26 Legal, Social and Cultural Professionals 12 Administrative and Commercial Managers 34 Legal, Social, Cultural and Related Associate Professionals
ES70	Canarias	Tenerife	91 Cleaners and Helpers 51 Personal Services Workers 42 Customer Services Clerks
NL32	Noord-Holland	Amsterdam	24 Business and Administration Professionals 25 Information and Communications Technology Professionals 52 Sales Workers
SE11	Stockholm	Stockholm	24 Business and Administration Professionals 25 Information and Communications Technology Professionals 33 Business and Administration Associate Professionals
FR82	Provence-Alpes-Côte d'Azur	Marseille	34 Legal, Social, Cultural and Related Associate Professionals 33 Business and Administration Associate Professionals 42 Customer Services Clerks
FR61	Aquitaine	Bordeaux	34 Legal, Social, Cultural and Related Associate Professionals 42 Customer Services Clerks 33 Business and Administration Associate Professionals
FR62	Midi-Pyrénées	Toulouse	34 Legal, Social, Cultural and Related Associate Professionals 26 Legal, Social and Cultural Professionals 33 Business and Administration Associate Professionals

4.2.8   Logistical Services

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	7 614 898	0.91%	6.47%	3.03%
Establishments	28 316	-1.67%	2.67%	1.63%
Average Wage	26 390	0.87%	75.87%	82.20%
Gazelle Employment	121 455	N/A	6.35%	3.23%

Figure 29: Employment over time, 2008 - 2014
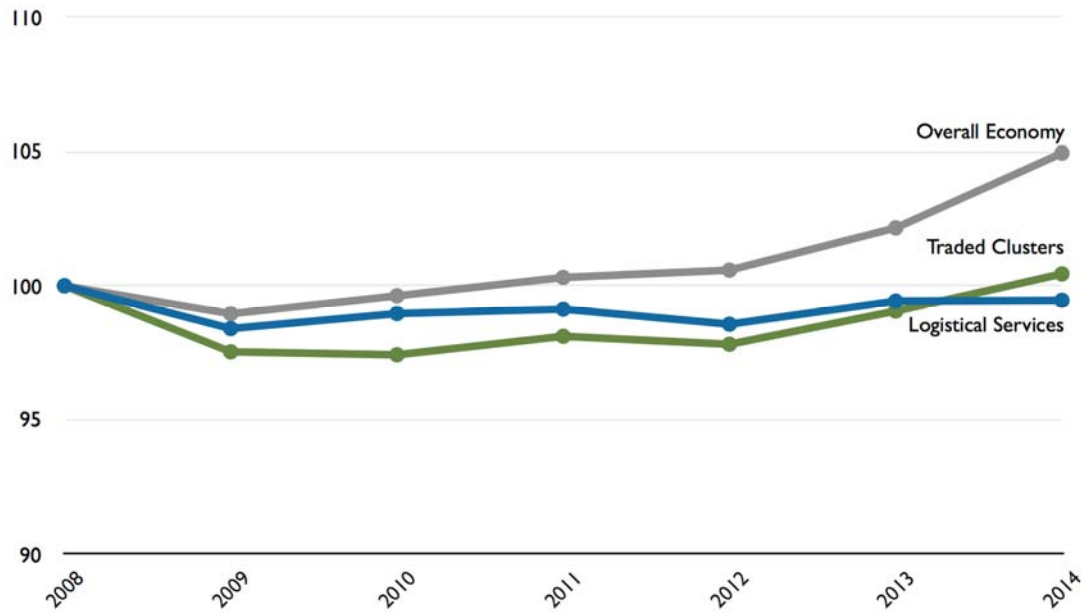
Logistical Services is an industry based on Transportation and Logistics cluster with addition of several supporting industries. Logistics is the management of the flow of goods or people and the actual process of transport between a starting point and a specific destination land-, air-based or space-based. Furthermore all auxiliary services making available the smooth operation of the transport and the provision of carriers or vehicles can be considered as part of the "Logistical Services Industry". On one hand, this includes the logistics operation provision (terrestrial or via satellite), on the other hand, the development and provision of IT-systems for the logistics planning, organisation, and management.
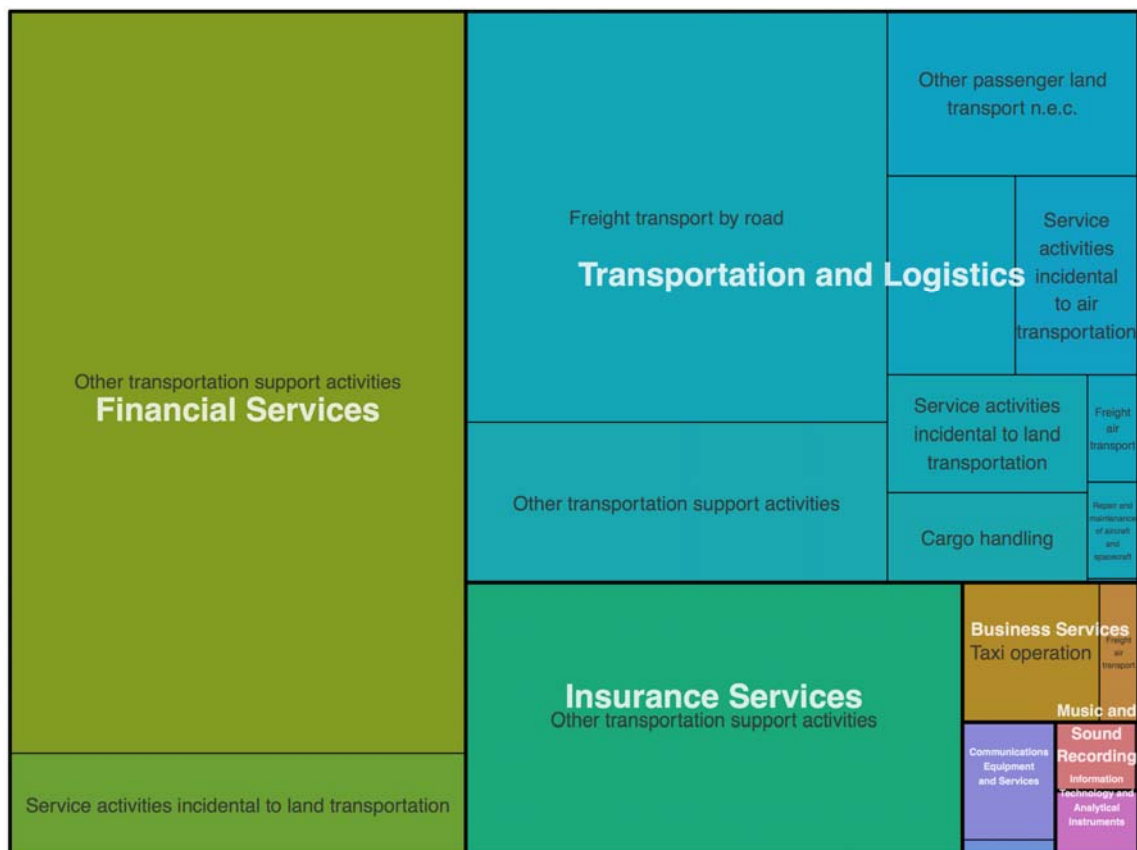
Figure 30: Logistical Services Industry composition

Table 33: Occupational profile of employment in Logistical Services

Occupation	Employment	Employment share
Craft, Trade, Operators, Assemblers	**3 027 600**	**58.7%**
Drivers and Mobile Plant Operators	2 792 200	54.2%
Other	235 400	4.6%
Officials, Managers, Professionals, Technicians	**980 100**	**19.0%**
Business and Administration Associate Professionals	281 000	5.5%
Other	699 200	13.6%
Clerks	**664 800**	**12.9%**
Numerical and Material Recording Clerks	424 800	8.2%
Other	240 000	4.7%
Service, Sales, Elementary	**575 900**	**11.2%**

Figure 31: Leading regions in Logistical Services
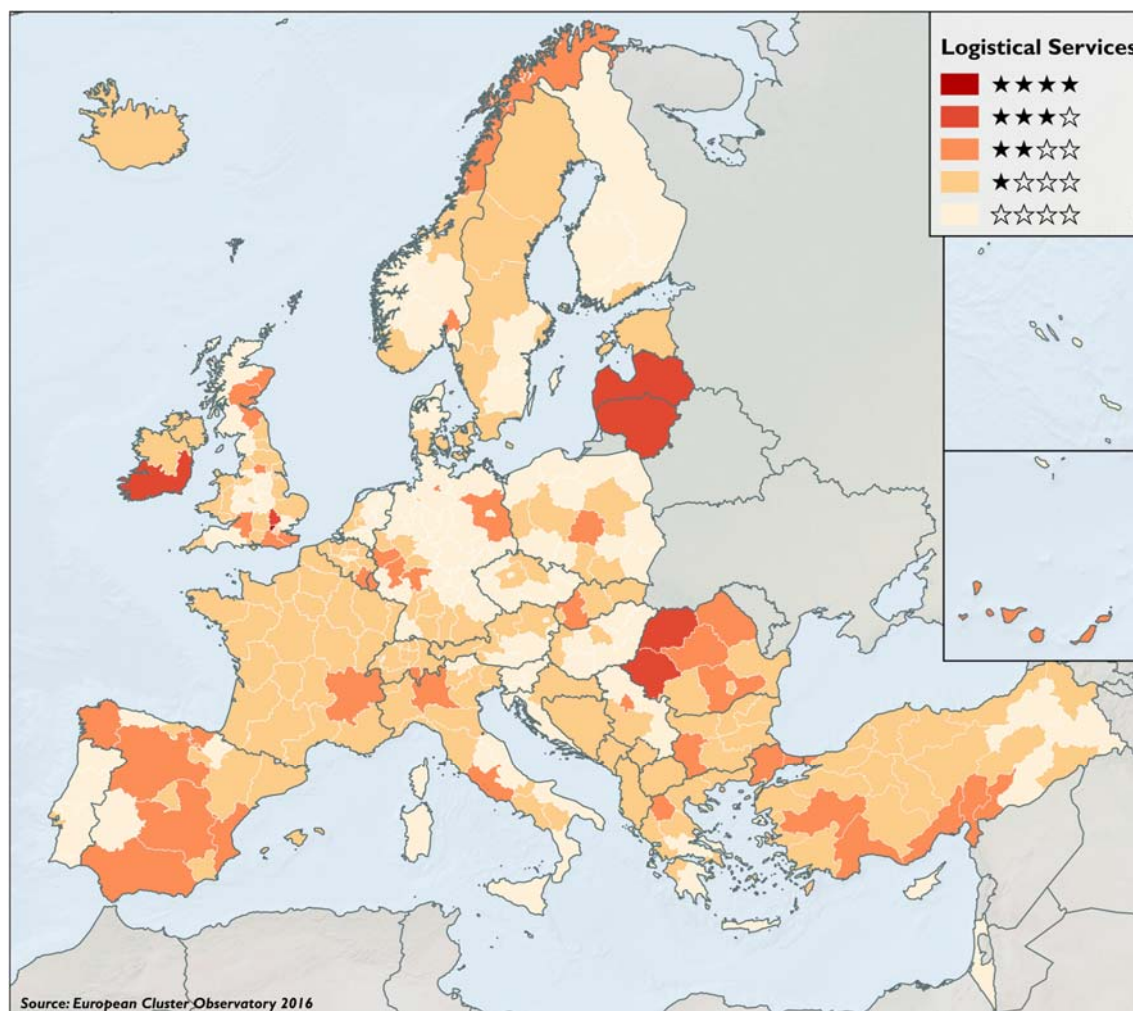

Source: European Cluster Observatory 2016

Table 34: Europe's top locations in Logistical Services

| #	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	UKI7	Outer London - W and NW	London	35 480	1.15	59 266	14.9%	0.2%	4
2	LV00	Latvija	Riga	59 633	1.68	15 097	8.1%	2.7%	3
3	RO11	Nord-Vest	Cluj	46 220	1.40	6 767	7.6%	3.2%	3
4	LT00	Lietuva	Vilnius	62 276	1.32	24 948	2.9%	11.3%	3
5	IE02	Southern and Eastern	Dublin	73 853	1.26	42 945	-24.6%	0.5%	3
6	UKH2	Beds and Herts	Luton	39 368	1.24	50 919	-2.2%	0.2%	3
7	RO42	Vest	Timisoara	31 819	1.18	9 395	6.1%	2.6%	3

Table 35: Strategic profiles of top locations in Logistical Services

Region	Region Name	Largest City	Top 3 Occupations
UKI7	Outer London - West and North West	London	83 Drivers and Mobile Plant Operators 93 Labourers in Mining, Construction, Manufacturing and Transport 51 Personal Services Workers
RO11	Nord-Vest	Cluj	83 Drivers and Mobile Plant Operators 72 Metal, Machinery and Related Trades Workers 33 Business and Administration Associate Professionals
LT00	Lietuva	Vilnius	83 Drivers and Mobile Plant Operators 33 Business and Administration Associate Professionals 24 Business and Administration Professionals
UKH2	Beds and Herts	Luton	83 Drivers and Mobile Plant Operators 31 Science and Engineering Associate Professionals 13 Production and Specialised Services Managers
RO42	Vest	Timisoara	83 Drivers and Mobile Plant Operators 72 Metal, Machinery and Related Trades Workers 93 Labourers in Mining, Construction, Manufacturing and Transport

4.2.9   Medical Devices

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	4 826 157	-0.07%	4.10%	1.92%
Establishments	43 863	-2.79%	4.13%	2.53%
Average Wage	43 527	1.95%	125.14%	135.58%
Gazelle Employment	50 922	N/A	2.66%	1.35%

Figure 32: Employment over time, 2008 - 2014
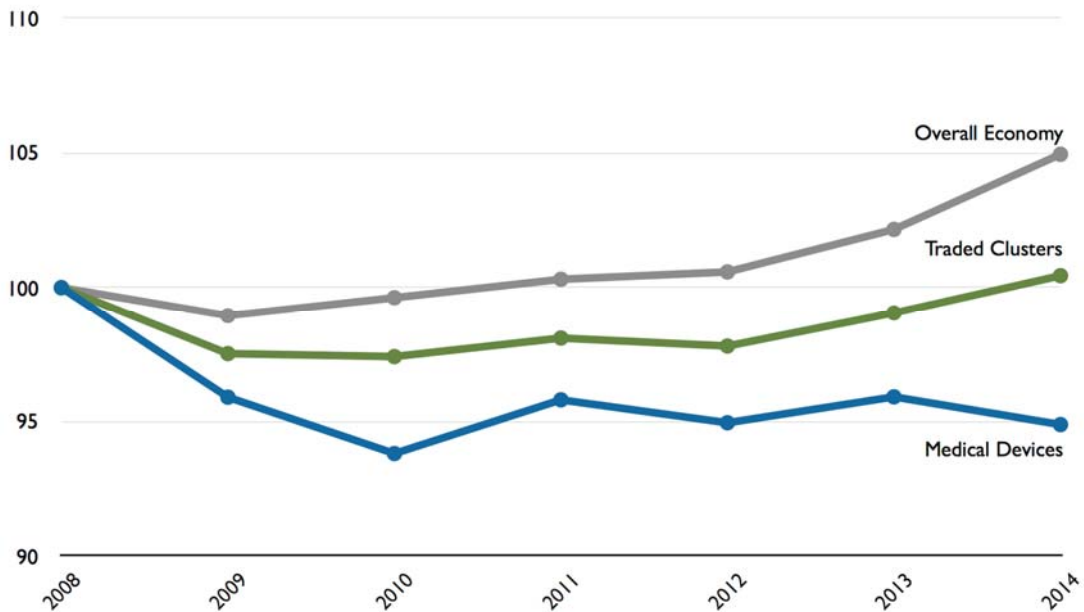
The Medical Devices emerging industry extends the cluster category of the same name to include precision instruments, machinery, and supporting services. The Medical Device industry is an industrial sector, manufacturing products which are generally based on biomedical engineering, and which are developed through mechanical, electrical and/or materials engineering, leading to products that permanently or temporarily replace or support a function of the body.
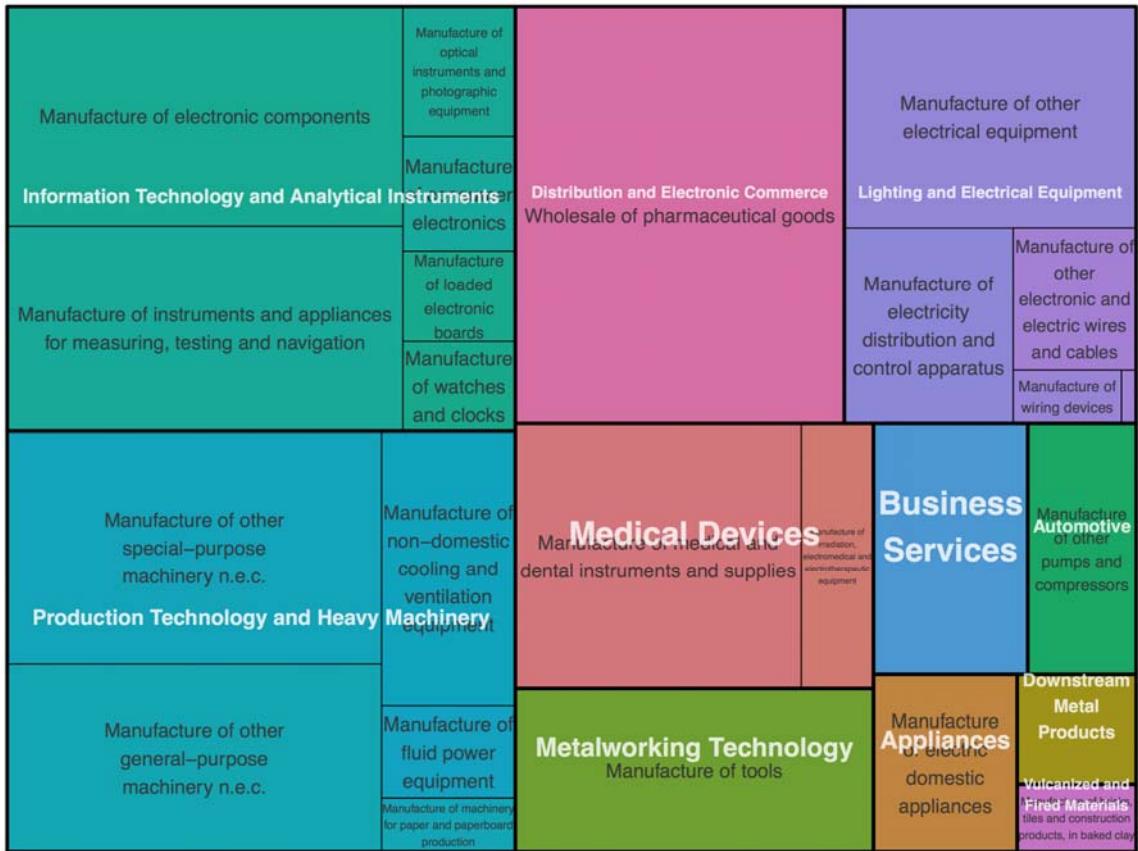
Figure 33: Medical Devices Industry composition

Table 36: Occupational profile of employment in Medical Devices

Occupation	Employment	Employment share
Officials, Managers, Professionals, Technicians	**1 816 300**	**48.6%**
Science and Engineering Associate Professionals	388 000	10.4%
Science and Engineering Professionals	308 100	8.2%
Business and Administration Associate Professionals	287 100	7.7%
Other	833 100	22.3%
Craft, Trade, Operators, Assemblers	**1 368 400**	**36.6%**
Metal, Machinery and Related Trades Workers	515 700	13.8%
Assemblers	284 900	7.6%
Electrical and Electronic Trades Workers	202 200	5.4%
Other	365 600	9.8%
Clerks	**393 700**	**10.5%**
Numerical and Material Recording Clerks	229 400	6.1%
Other	164 300	4.4%
Service, Sales, Elementary	**299 900**	**8.0%**

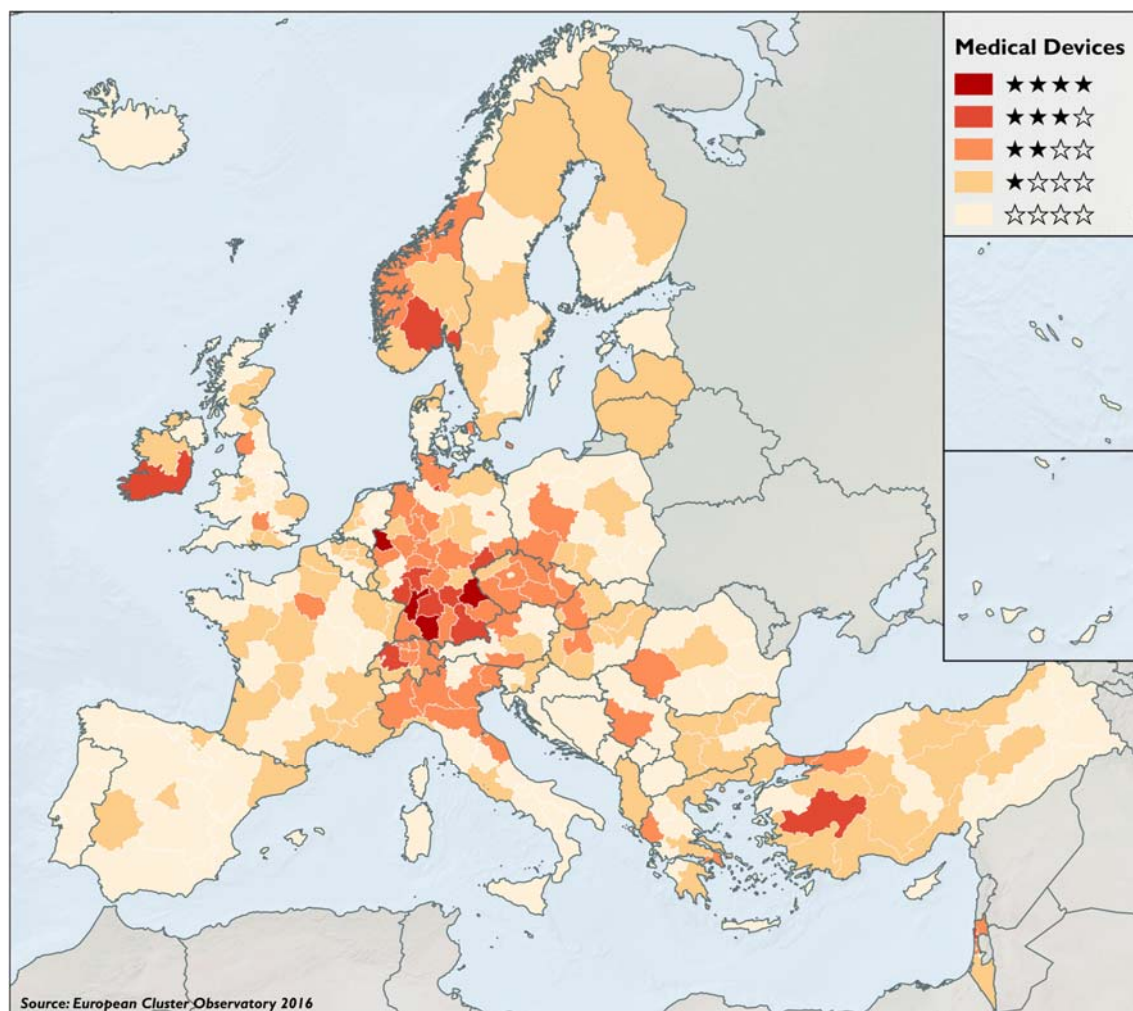**Figure 34: Leading regions in Medical Devices**

Table 37: Europe's top locations in Medical Devices

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	DE14	Tübingen	Tübingen	53 947	3.34	57 345	3.2%	5.5%	4
2	DE23	Oberpfalz	Regensburg	29 728	2.77	61 294	-9.0%	5.2%	4
3	DE12	Karlsruhe	Karlsruhe	70 157	2.55	58 003	0.8%	0.1%	4
4	DEA1	Düsseldorf	Düsseldorf	69 953	1.54	62 588	1.2%	2.4%	4
5	TR33	Manisa	Manisa	28 653	5.62	6 626	104.4%	0.0%	3
6	NO03	Sør-Østlandet	Skien	28 909	3.36	64 440	-3.5%	0.2%	3
7	DE11	Stuttgart	Stuttgart	131 977	3.10	69 861	2.5%	0.6%	3
8	IL03	Haifa District	Haifa	24 108	3.02	17 431	41.8%	0.0%	3
9	CH02	Espace Mittelland	Bern	40 384	2.42	74 850	-15.4%	0.7%	3
10	DE25	Mittelfranken	Nürnberg	40 856	2.37	60 753	3.1%	1.5%	3
11	DE21	Oberbayern	Munich	89 424	2.04	72 933	-1.0%	0.1%	3
12	DED4	Chemnitz	Chemnitz	22 581	1.76	31 753	0.1%	2.6%	3

#	Region	Region Name	Largest City	Employment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
13	DE71	Darmstadt	Frankfurt am Main	60 464	1.68	61 265	-1.5%	0.7%	3
14	DEB3	Rheinhessen-Pfalz	Mainz	25 317	1.42	59 180	5.7%	0.6%	3
15	DE60	Hamburg	Hamburg	27 463	1.40	73 702	-2.4%	0.5%	3
16	IE02	Southern and Eastern	Dublin	42 461	1.15	64 296	34.6%	0.7%	3

Table 38: Strategic profiles of top locations in Medical Devices

Region	Region Name	Largest City	Top 3 Occupations
DE14	Tübingen	Tübingen	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 21 Science and Engineering Professionals
DE23	Oberpfalz	Regensburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 74 Electrical and Electronic Trades Workers
DE12	Karlsruhe	Karlsruhe	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DEA1	Düsseldorf	Düsseldorf	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
NO03	Sør-Østlandet	Skien	31 Science and Engineering Associate Professionals 25 Information and Communications Technology Professionals 72 Metal, Machinery and Related Trades Workers
DE11	Stuttgart	Stuttgart	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
CH02	Espace Mittelland	Bern	73 Handicraft and Printing Workers 72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals
DE25	Mittelfranken	Nürnberg	72 Metal, Machinery and Related Trades Workers 21 Science and Engineering Professionals 43 Numerical and Material Recording Clerks

4.2.10 Mobility Technologies

Basic Facts	Level in 2014	Change since 2012	Share of traded clusters	Share of overall economy
Employment	10 818 547	0.64%	9.19%	4.30%
Establishments	78 787	-2.86%	7.42%	4.54%
Average Wage	38 251	2.02%	109.97%	119.15%
Gazelle Employment	126 157	N/A	6.59%	3.35%

Figure 35: Employment over time, 2008 - 2014
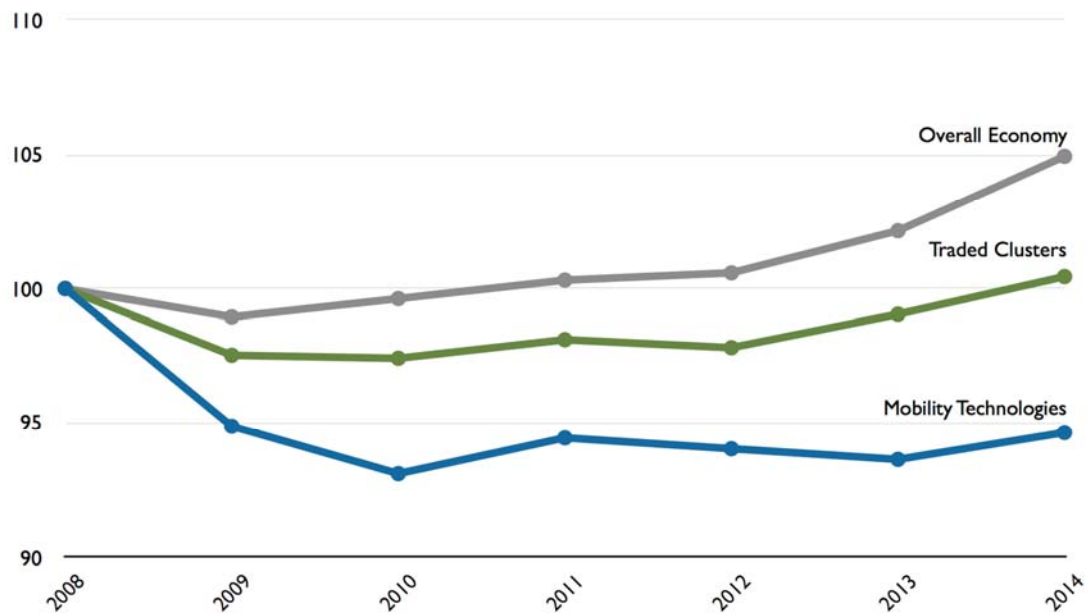
Mobility Technologies stem from the Automotive cluster as a core and expands it with related technologies from the Production Technology and Aerospace cluster as well as few related upstream activities like Metalworking and Plastics. Mobility technologies are developed with the purpose of moving people and goods and hence for the manufacturing of transport vehicles, construction of transport infrastructures and the operation of transport services. Topics dealt with by technological innovation in the field of mobility include road vehicle engineering, internal combustion engines, batteries and motors, electric and hybrid power-trains, urban and high speed rail transportation, aircraft types and aerodynamics, radar, navigation, GPS, GIS, etc. (MIT, 2011).

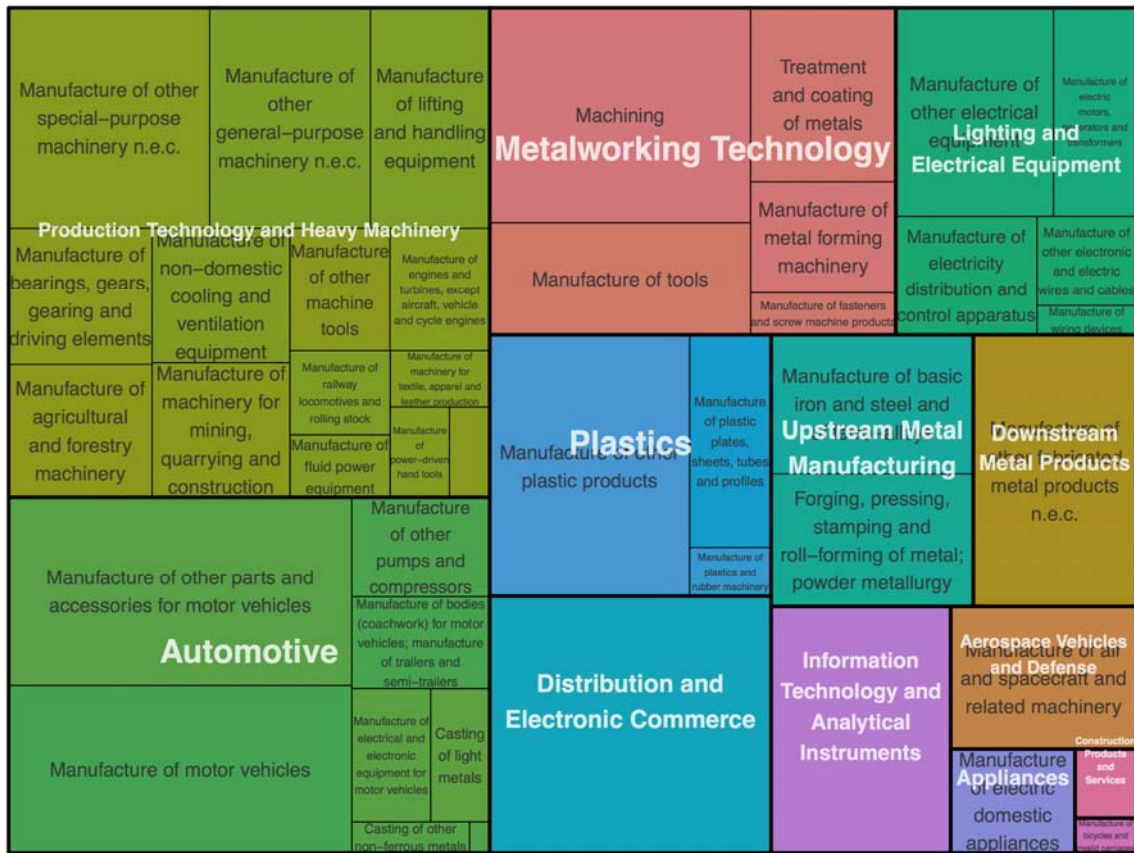**Figure 36: Mobility Technologies Industry composition**

Table 39: Occupational profile of employment in Mobility Technologies

Occupation	Employment	Employment share
Craft, Trade, Operators, Assemblers	**4 365 200**	**49.7%**
Metal, Machinery and Related Trades Workers	2 078 800	23.7%
Stationary Plant and Machine Operators	768 600	8.8%
Assemblers	619 400	7.1%
Other	898 300	10.2%
Officials, Managers, Professionals, Technicians	**3 180 100**	**36.2%**
Science and Engineering Associate Professionals	959 100	10.9%
Science and Engineering Professionals	595 700	6.8%
Business and Administration Associate Professionals	495 600	5.6%
Other	1 129 600	12.9%
Clerks	**762 800**	**8.7%**
Numerical and Material Recording Clerks	464 200	5.3%
Other	298 600	3.4%
Service, Sales, Elementary	**651 200**	**7.4%**

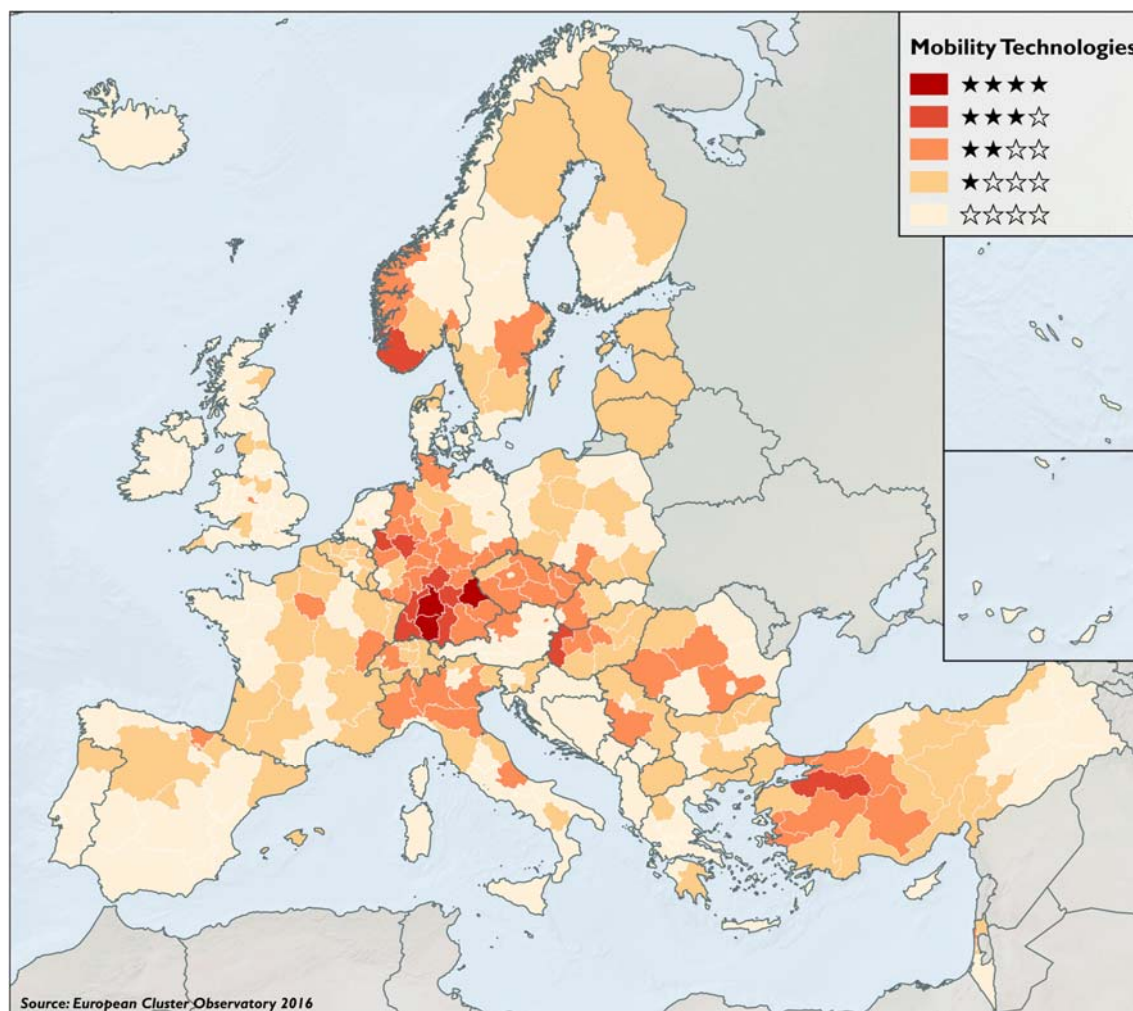**Figure 37: Leading regions in Mobility Technologies**

Table 40: Europe's top locations in Mobility Technologies

#	Region	Region Name	Largest City	Employ-ment	LQ	Avg. Wage, PPP	Annual Growth	Gazelle Empl. Share	Stars
1	DE11	Stuttgart	Stuttgart	303 216	3.17	64 365	8.9%	0.3%	4
2	DE14	Tübingen	Tübingen	101 107	2.79	59 692	1.5%	3.1%	4
3	DE23	Oberpfalz	Regensburg	52 074	2.16	62 783	-1.4%	4.4%	4
4	HU22	Nyugat-Dunantul	Györ	69 517	3.22	19 614	16.9%	1.9%	3
5	DE13	Freiburg	Freiburg	104 280	2.29	53 394	0.2%	0.5%	3
6	DE27	Schwaben	Augsburg	80 516	2.25	54 939	-3.3%	0.6%	3
7	DEA5	Arnsberg	Dortmund	137 527	2.04	56 429	-1.5%	1.3%	3
8	DE12	Karlsruhe	Karlsruhe	122 628	1.99	57 693	1.0%	0.9%	3
9	DE26	Unterfranken	Würzburg	50 994	1.94	54 077	-5.4%	0.6%	3
10	DEA1	Düsseldorf	Düsseldorf	177 448	1.75	49 009	39.9%	1.8%	3
11	TR41	Bursa	Bursa	52 074	1.75	22 549	28.3%	0.0%	3
12	DE25	Mittelfranken	Nürnberg	67 320	1.74	65 055	4.5%	2.4%	3
13	NO04	Agder og Rogaland	Kristiansand	31 493	1.65	74 933	6.2%	2.5%	3

Table 41: Strategic profiles of top locations in Mobility Technologies

Re-gion	Region Name	Largest City	Top 3 Occupations
DE11	Stuttgart	Stuttgart	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DE14	Tübingen	Tübingen	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 21 Science and Engineering Professionals
DE23	Oberpfalz	Regensburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 74 Electrical and Electronic Trades Workers
HU22	Nyugat-Dunantul	Györ	82 Assemblers 72 Metal, Machinery and Related Trades Workers 81 Stationary Plant and Machine Operators
DE13	Freiburg	Freiburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DE27	Schwaben	Augsburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 81 Stationary Plant and Machine Operators
DEA5	Arnsberg	Dortmund	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 81 Stationary Plant and Machine Operators
DE12	Karlsruhe	Karlsruhe	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DE26	Unterfranken	Würzburg	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks
DEA1	Düsseldorf	Düsseldorf	72 Metal, Machinery and Related Trades Workers 31 Science and Engineering Associate Professionals 43 Numerical and Material Recording Clerks

Methodological Appendix

The 2016 European Cluster Panorama is based on a brand-new dataset, derived from firm-level figures. The data is sourced mostly from Bureau van Dijk's Orbis Historical database, though it was complimented by a few secondary sources.

The key firm- and plant-level variables of relevance for our analysis are: location, industry, legal form, ownership and activity history, as well as periodic financial reports. Industry and legal form were available nearly universally, while the region for each firm could be computed from the postal code or city information. While detailed activity history has not always been available, the registration date was very common and it was assumed that the firm was active from registration date up to its dissolution (or until current time if no dissolution events were present).

Financial information contains data on turnover, material expenses, fixed assets, labour expenses, and number of employees. The coverage varies country to country, though turnover and employees have very high availability, while material expenses have the worst coverage. All of the numbers were deflated with industry-specific output deflators (turnover), industry-specific input deflators (materials, constructed from output deflators and input-output shares), and consumer prices (wages and assets). All of the values have also been adjusted for inflation and converted to 2010 Euro. All of the data for these adjustments came from Eurostat.

We then used the Business Demography statistics from Eurostat to obtain the number of firms by legal form and added synthetic firms where no full coverage was available (this was predominantly done for sole traders in countries where we had no coverage of them). A statistical model was then used to impute all of the missing values and convert firm financials to annualised values even where the accounts were not perfectly aligned with calendar years. Finally, the resulting figures were calibrated against the regional economic accounts statistics from Eurostat to ensure that the numbers are compatible with official statistics and corrected for cross-country differences in definitions and coverage.

The data on gazelles was compiled from the same data source and relied on the ownership links between firms. This was crucial to differentiate between genuinely new firms and new subsidiaries of the existing ones. A firm was considered as new if the firm itself, as well as its domestic ultimate owner are both less than 5 years old. All sole traders and non-profits, all foreign-owned firms, all firms where the ultimate owner is the government, as well as several specific firms identified by inspection were eliminated from the results. This data was then merged with the dataset obtained in the previous step to arrive at the final numbers. Note that none of the synthetic firms were counted among gazelles (it had to be an actual record from the register), which has relatively small impact outside Turkey (since it was the only country with substantial numbers of synthetic firms that were not sole traders).

Finally, the data on occupations were sources from Eurostat's Labour Force Survey (LFS) data that covered the intersection of 3-digit industries and 2-digit occupations per year and region. Due the nature of LFS as a sample survey and the large number of industry-occupation pairs that were zero, some of the missing values were imputed, though they should be inconsequential. The share in each occupation from LFS was then combined with our main data on employment to arrive at the estimates of the number of employees in each skill class.

For further information, please consult the European Cluster Observatory Website:

http://ec.europa.eu/growth/smes/cluster/observatory/

Internal Market,
Industry, Entre-
preneurship and
SMEs