European Cluster Observatory

REPORT

European Cluster Panorama 2014

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Enterprise and
Industry

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 that is foremost aimed at European, national, regional and local policy-makers as well as cluster managers and representatives of SME intermediaries. It is an initiative of the "SMEs: Clusters and Emerging Industries" unit of the European Commission's Enterprise and Industry Directorate-General that aims at promoting the development of more world-class clusters in Europe, notably with a view to fostering 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 in designing smart specialisation and cluster strategies to assist companies in developing new, globally competitive advantages in emerging industries through clusters, and in this way strengthen the role of cluster policies for the rejuvenation of Europe's industry as part of the Europe 2020 Strategy.

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 bi-annual "European Cluster Panorama"(cluster mapping)** providing an update and enrichment of 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 of industrial transformations; identifying common interaction spaces; and providing a foresight analysis of industrial and cluster opportunities;

- **a "Regional Eco-system Scoreboard"** setting out strengths and weaknesses of regional and national eco-systems 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;

- **showcase modern cluster policy practice through advisory support services to six selected model demonstrator regions**, including expert analysis, regional survey & benchmarking report, peer-review meeting, and policy briefings in support of emerging industries. The policy advice builds also upon the policy lessons from related initiatives in the area of emerging industries;

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

More information about the European Cluster Observatory is available at the EU Cluster Portal at: http://ec.europa.eu/enterprise/initiatives/cluster/observatory/.

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Key Facts at a Glance

The ten emerging industries

…cover more than 45 million employees in Europe, which corresponds to 22% of all European employment and 35% of European payroll.

…register levels of average wage and value added that are at €30 000 and €76 000 per employee significantly higher than for the economy as a whole, which averages €23 000 and €62 000 respectively.

…individually outperform the average of all traded industries either in terms of dynamism (growth), productivity, or both.

The European hotspots of emerging industries

…include 44 regions that score high on a combination of emerging industry performance metrics.

…account for 22% of Europe's population, 28% of its employment, and 37% of its total GDP.

…are located either in a narrow stretch from Southern Germany to the Benelux and South-western England, a Baltic Sea Region corridor from Denmark and the Swedish west coast to Stockholm and Southern Finland, or selected capital regions in other parts of Europe.

…perform more strongly on a wide range of economic performance indicators, especially those related to innovation, than the average European region

Emerging industries at a glance

- **Advanced Packaging** is an increasingly important input to many other activities, from food processing to automotive supply chains.

- **Biopharmaceuticals** form the scientific basis of the Life Science industries and employ some of the most educated and productive employees.

- **Blue Growth Industries** has been the focus of European policy in the last several years and is an area where interesting new islands of activity might emerge.

- **Creative Industries** is the key sector in future European economy and has been growing faster than any emerging industry in the past two decades.

- **Digital Industries** cover the key parts of the ICT economy: computer hardware, software, e-commerce and wireless services.

- **Environmental Industries** cut through all sectors of the economy as the need for more sustainable operations is realised increasingly more and thus have a high growth potential

- **Experience Industries** cover creation and consumption of 'experiences' and are composed of millions of SMEs at the intersection of arts and business.

- **Logistical Services** are a key service sector in the modern economy and are among the leaders in job creation.

- **Medical Devices** are another core part of the Life Sciences industry and are also connected to large and growing employment in local health care services.

- **Mobility Technologies** are a core part of the European manufacturing industry and despite suffering during the recent crisis they are a clear focus for Europe's strategy to re-industrialize.

Introduction

The European economy is slowly emerging from one of the deepest crisis it experienced in this generation, if not since the European integration process started in 1957. The immediate challenges European countries have been facing since 2008 have triggered a strong response at both the national and the EU level. Regulatory changes have been made to enhance financial market stability and banking supervision and to strengthen the surveillance and sustainability of budget deficits. The European Central Bank has played a strong supporting role in managing the cyclical weakness. While more remains to be done, these reforms have had a visible stabilizing impact on the macroeconomic climate in the European Union.

The European economy is, however, not only facing the repercussions of a global and a European sovereign debt crisis. It will also need to respond to its structural weakness in terms of growth. More robust growth will make achieving macroeconomic stability much easier. And more robust trend growth will be critical for the macroeconomic reforms undertaken to result not only in more stability but also more sustainable prosperity.

Against this background the European Commission has launched a range of initiatives to foster innovation and growth, and to strengthen the underlying competitiveness of the European economy. A key area of interest is the development of emerging industries and their role in driving economic dynamism. Emerging industries can be understood 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".[1] Therefore, emerging industries can but must not always be completely "new" industrial sectors. They are new combinations of narrowly defined activities that can also comprise existing industrial sectors that are evolving into emerging industries in response to new technologies, market demands, and value chain configurations.

Emerging industries thus thrive on cross-sectoral linkages; they combine narrow activities in new ways, and it is this combination rather than the individual activity that generates economic value. Emerging industries are perceived to have a disproportional importance for future growth, both in the medium- and long-term. The current work of the European Cluster Observatory is a central part of this agenda, aimed at supporting efforts to promote the development of more world-class clusters in Europe, notably with a view to fostering competitiveness and entrepreneurship in emerging industries. The main task of the European Cluster Observatory is to offer statistical analysis, mapping tools and policy advice towards the design of more evidence-based cluster policies in Europe. The ultimate objective is to help Member States and regions in designing smart specialisation and cluster strategies to assist companies in developing new, globally competitive advantages in emerging industries through clusters, and in this way strengthen the role of cluster policies for the rejuvenation of Europe's industry as part of the Europe 2020 Strategy.

The European Cluster Panorama 2014 profiles developments in ten selected emerging industries, identified through a data-driven analytical process that focuses on the identification of strong and weak linkages across economic activities. These profiles capture the overall size and growth dynamics within each of these industries, and show their geographic footprint across EU regions. At the EU level,

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[1] *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/Upload/CMS/Docs/Policy_roadmap.pdf.*

they can help search in a more targeted way for narrow hotspots of emerging linkages within these industries. And they can help identify those regions in Europe that have already been able to create the conditions for growth in these industries. At the regional level, the profiles provide key insights into the current patterns of specialisation across and within the ten emerging industries, and thus can help regional authorities to focus on those areas where competences exist and growth is most likely to be achieved.

The data and analytical categories presented in this report provide the foundation for further work by the European Cluster Observatory. All underlying data are available at the European Cluster Observatory web page of the EU Cluster Portal set up by the European Commission's Enterprise and Industry Directorate-General.[2] The ten emerging industries identified in this report form the foundation for the further analysis of cross-sectoral clustering trends that are leading to the identification of three cross-sectoral collaboration spaces that cut across sectors and value chains. The analysis in the Panorama will thus be complemented with further data on knowledge, financial and entrepreneurial spillovers that can cut through traditional industry boundaries and highlight the areas of potential industrial collaboration. This analysis will then also feed into the next version of the European Cluster Panorama to be published in 2016.

The present 2014 European Cluster Panorama is accompanied by two methodological reports, available on the European Cluster Observatory's web pages. The first one, "Methodology and Findings Report for a Cluster Mapping of Related Sectors" provides a detailed description of the process of defining cluster categories and emerging industries and has all the relevant definitions in terms of industrial classification (NACE codes). The second one, "Methodology and findings report for correlation analysis between cluster strength and competitiveness indicators" contains further details on the regional competitiveness indicators and their relationships with emerging industry portfolio strength.

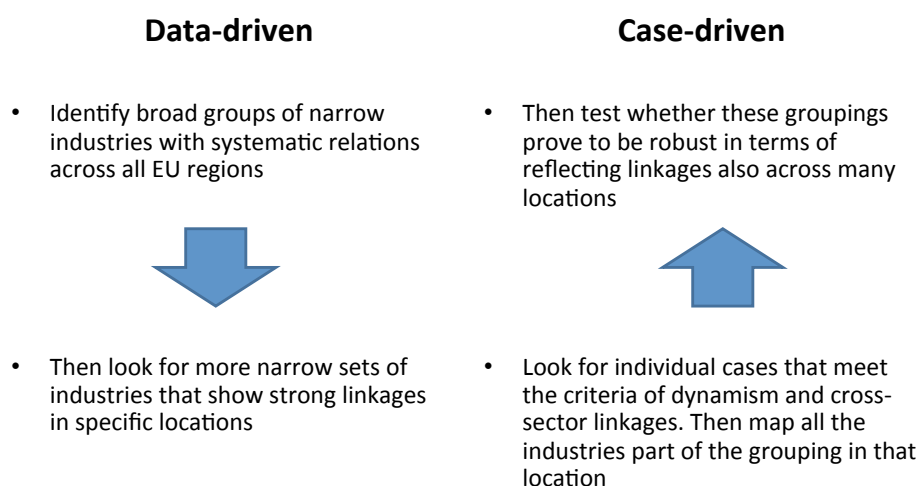[2] *http://ec.europa.eu/enterprise/initiatives/cluster/observatory/*

1. Identifying Emerging Industries: Data and Method

Emerging industries are by their very nature difficult to capture. They intend to capture new development potential that will be realised only in the future. And as with most predictions about the future, there is uncertainty as to whether the potential will indeed be realised. What this reports aim to do is to provide a fact-driven framework that can help policy makers and practitioners to deal with this uncertainty.

The European Cluster Observatory's ambition is to help identify emerging industries in which new cross-sectoral linkages are most likely to materialise. The central underlying hypothesis is that emerging industries with strong cross-sectoral linkages are most likely to occur in the near future where signs of such linkages are already visible today. This hypothesis is anchored in a broader view of regional economic development as what economists call "a path-dependent process of related diversification."[3] They have found that regional economies tend to add new activities in areas that have at least some connection to what they have been doing so far. The idea is that every economic activity requires certain skills and capabilities, and that regions are more successful in new fields in which they can draw on some of their existing capabilities than in new fields entirely unrelated to their past portfolio of activities.

Not all linkages identified by the methodological approach followed will turn out to be economically relevant and become the engine of an emerging industry. And some new linkages will occur elsewhere, where the current data provided little indication that they could develop. But the majority of emerging industries will be captured in the transparent and fact-driven approach taken, informing further analysis of more narrow niches of cross-sectoral linkages.

Figure 1: Identification of cross-sectoral linkages – alternative approaches

Data-driven

- Identify broad groups of narrow industries with systematic relations across all EU regions

- Then look for more narrow sets of industries that show strong linkages in specific locations

Case-driven

- Then test whether these groupings prove to be robust in terms of reflecting linkages also across many locations

- Look for individual cases that meet the criteria of dynamism and cross-sector linkages. Then map all the industries part of the grouping in that location

There are different ways to identify cross-sectoral linkages: One approach draws on large data sets to identify specific patterns that hint at the systemic presence of linkages. Another one starts from individual cases of an emerging industry with cross-sectoral linkages present in a specific region, and uses this to create categories to then look at other regions too. Which one of these alternative ap-
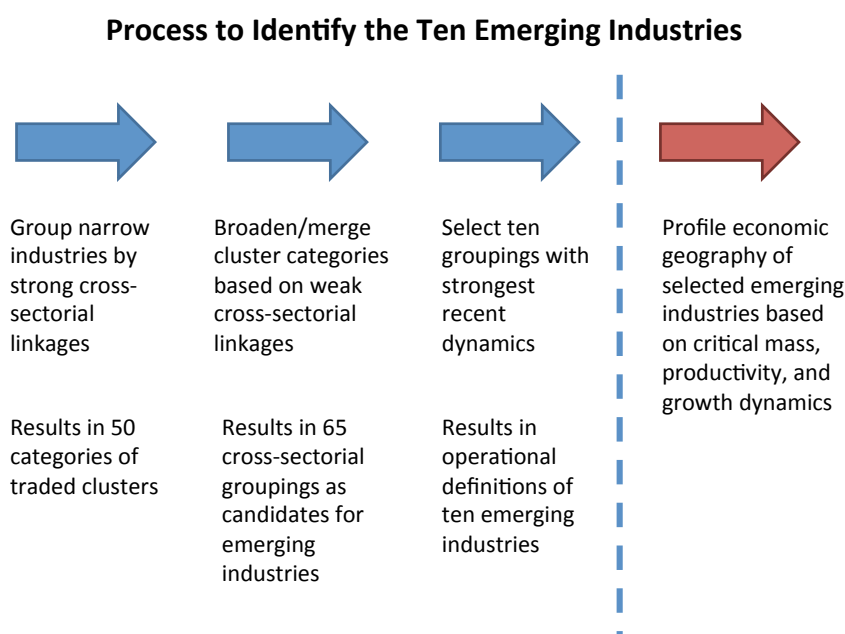
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[3] *See, for example: Frank Neffke, Martin Henning, and Ron Boschma (2011), How Do Regions Diversify over Time? Industry Relatedness and the Development of New Growth Paths in Regions, Economic Geography, Volume 87, Issue 3, pages 237–265, July 2011,*

proaches is the more suited one depends on the specific objective of the analysis and on the data available (see also Figure 1).

The present analysis has chosen the first option of a data-driven approach that leverages a large dataset on the geographic footprint of narrow economic activities across all European regions. The approach was selected because the European Cluster Panorama aims to provide a comparable perspective across European regions on the presence of economic activity in fields with meaningful linkages. The data-driven approach is best suited to identify patterns that are robust and meaningful across Europe.

The not-selected alternative case-driven approach is useful for exploration and idea generation, but it is very likely to lead to a larger number of wrongly identified emerging industries ('false positives') in regions where no cross-sectoral linkages exist between the narrow economic activities grouped together. Case studies will however be used in other parts of the European Cluster Observatory work to better understand the qualitative dynamics within the identified emerging industries.

Figure 2: Process to identify the 'Ten Emerging Industries'

Process to Identify the Ten Emerging Industries

Group narrow industries by strong cross-sectorial linkages	Broaden/merge cluster categories based on weak cross-sectorial linkages	Select ten groupings with strongest recent dynamics	Profile economic geography of selected emerging industries based on critical mass, productivity, and growth dynamics
Results in 50 categories of traded clusters	Results in 65 cross-sectorial groupings as candidates for emerging industries	Results in operational definitions of ten emerging industries	

The analysis then proceeds in three steps (see also Figure 2): First, the strongest current cross-sectoral linkages are identified, drawing on a traditional cluster mapping analysis. Second, the cluster categories of traded industrial sectors are broadened and in some cases merged, to capture an additional layer of weaker linkages beyond the stronger linkages within a given cluster category. Third, a final list of the ten strongest emerging industries are selected from the wider group of candidate emerging industries that have shown the highest economic dynamism in the recent past. Whether the displayed dynamism forms part of a longer industrial development process will be particularly reviewed in the 2016 update of the European Cluster Panorama.

For the *first step*, the analysis drew on definitions of cluster categories recently generated in the US (Delgado et al., 2014).[4] These definitions capture linkages across narrow industries through co-location (employment, establishments), skill use (occupations), and supplier relationships (input-output tables). While these definitions have been constructed based on US data, they are useful also in the European context: The more granular US data allows a more in-depth analysis than is currently possible across Europe, and the geographic footprint of the "single" US economy is less affected by legacy barriers to trade and investment.

The cluster definitions applied in the US context propose 51 traded cluster categories while treating the rest of the economy as local. *Traded clusters* capture those industries that are serving markets beyond their own location and that are fully exposed to competition from other locations. Traded clusters concentrate across regions; their high wages and high levels of innovative activity make them the key engines of regional economies. Local clusters combine those industries that operate mostly only locally (such as local retail and other local services), and that are present in similar density across all regions (i.e. that are evenly spread and not clustered); their high employment numbers make them an important channel for creating shared prosperity in regions.

The analysis has matched the new cluster definitions to European codes using the official NAICS 2007 – NACE 2.0 industrial classification concordance tables. A modest number of adjustments had to be made due to differences in the classification systems. The full specification of the new cluster categories adapted to the European context is presented in the annexed methodology report.

For the *second step*, the analysis draws on a mix of Europe-wide and Swedish data sources to capture weaker cross-sectoral linkages that go beyond the cluster categories identified. The following three complimentary methods were used:

a) *Merging cluster categories based on the analysis of cluster-level co-location patterns across European regions.*

   This resulted in eight groups of merged clusters (Figure 3). The scores in the cluster relatedness-tree below indicate the strength of the relationship between clusters as measured by their geographical footprint. The focus is on those above a threshold value of 90 to identify the strongest of these relationships[5].

b) *Broadening cluster categories by adding individual narrow industries based on data about co-location (Europe), skill use (Sweden), and firm activities across industries (Sweden).*

   This approach resulted in 50 'clouds' of clusters plus their related narrow industries. In most cases only one of the three measures indicates a linkage, but there are 13% of the relationships between an individual cluster and an industry that are based on two or three of the indicators. An industry was included in the 'cloud' around a cluster for the analysis when at least one of the linkages was significant. The analysis found related industries for all cluster categories with the exception of 'tobacco', while 'jewellery' and 'oil and gas' only have non-traded related industries. Table 1 below indicates the nature of the clouds relative to the narrower cluster categories in terms of the extent of relatedness to other industries. The clouds constitute a significant broadening of the narrow cluster categories; for the median cluster category the

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[4] *The detailed process and motivation are explained in the "Methodology and Findings Report For a Cluster Mapping of Related Sectors", available at http://ec.europa.eu/enterprise/initiatives/cluster/observatory/index_en.htm.*

[5] *The values represent the approximately unbiased significance of each grouping based on 10 000 simulations. E.g. the value of 95 can be interpreted as the probability of 95% that the grouping is not based on a random fluctuation in the data, but rather represents an actual relationship.*

number of industries covered is increased by 11 and the overall employment is almost five times as large as for the narrow cluster.

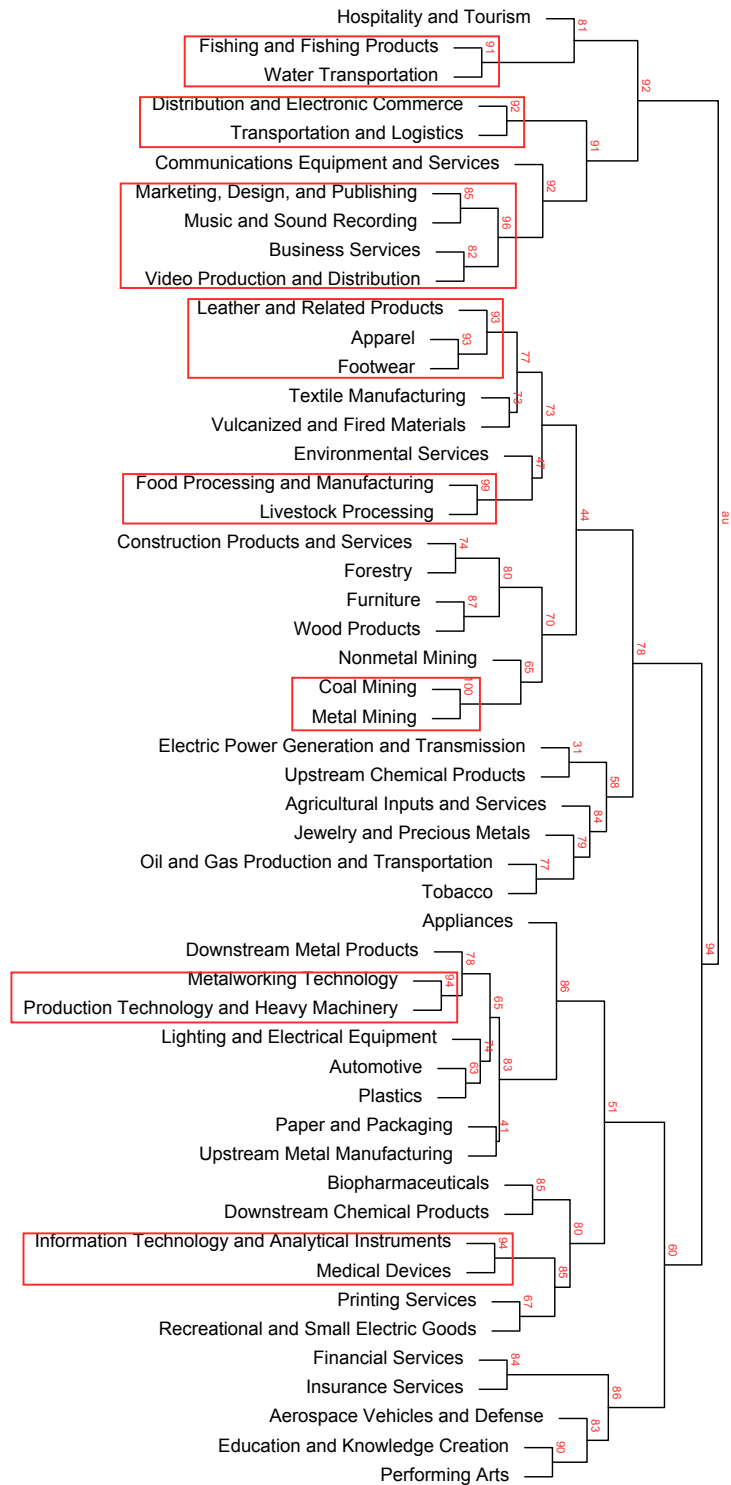**Figure 3: Cluster relatedness tree**

Table 1: Clouds and core cluster categories

Cluster	Number of related traded industries	Employment size of 'cloud' relative to narrow cluster category
Downstream Metal Products	56	14.8
Metalworking Technology	54	4.4
Plastics	51	6.8
Lighting and Electrical Equipment	50	11.2
Appliances	45	38.8
Upstream Metal Manufacturing	38	7.3
Production Technology and Heavy Machinery	37	4.8
Automotive	36	4.1
Furniture	31	9.2
Vulcanized and Fired Materials	31	9.0
Recreational and Small Electric Goods	30	15.3
Business Services	29	1.6
Distribution and Electronic Commerce	29	1.9
Marketing, Design, and Publishing	29	4.4
Music and Sound Recording	28	149.4
Medical Devices	23	8.6
Video Production and Distribution	21	22.4
Wood Products	21	7.4
Forestry	18	25.5
Information Technology and Analytical Instruments	18	6.8
Livestock Processing	18	5.2
Upstream Chemical Products	16	8.0
Textile Manufacturing	15	4.7
Downstream Chemical Products	12	4.0
Communications Equipment and Services	11	5.0
Paper and Packaging	11	6.7
Printing Services	11	3.3
Biopharmaceuticals	10	4.4
Construction Products and Services	9	4.6
Agricultural Inputs and Services	8	2.0
Apparel	8	1.9
Aerospace Vehicles and Defence	7	7.4
Footwear	7	4.9
Metal Mining	7	21.5
Hospitality and Tourism	6	1.2
Leather and Related Products	6	17.1
Education and Knowledge Creation	5	1.1
Financial Services	5	4.3
Fishing and Fishing Products	5	3.8
Insurance Services	5	3.2
Water Transportation	5	1.8
Coal Mining	4	1.8
Non-metal Mining	4	4.7
Performing Arts	4	1.7
Electric Power Generation and Transmission	2	1.4
Environmental Services	2	1.3
Transportation and Logistics	2	1.1

Figure 4: Core clusters in European Cluster Observatory's "Emerging Industries" report
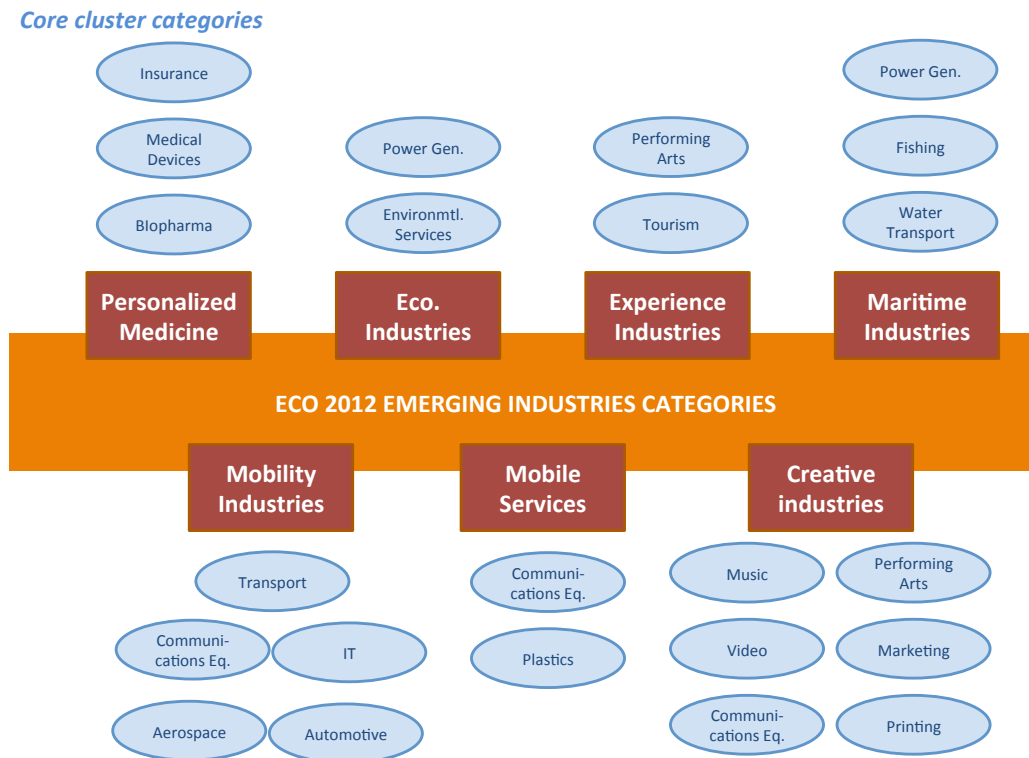
c) Aligning the definitions proposed by earlier analysis of the European Cluster Observatory to the closest combination of core clusters and additional narrow industries.

The analysis of the European Cluster Observatory's earlier, first "Emerging Industries" report (2012) identified seven emerging industries.[6] The 2012 analytical approach – that was developed in close collaboration with the European Forum of Clusters in Emerging Industries – was based, amongst others, on cross-sectoral financial investments and mergers and acquisitions (M&A) as early indicators for the development of emerging industries. The present analysis used the seven emerging industries selected by the 2012 analysis, and then tracked how the narrow industries included in these broader definitions matched up with existing cluster categories based on robust linkages revealed in the data. For each of the earlier identified seven emerging industries, the analysis then used those cluster categories that were the closest matched, and added the narrow industrial sectors included in the definitions of the seven emerging industries identified in 2012.

In total, the combination of these approaches has generated 65 candidates for emerging industries with cross-sectoral linkages. In a *third step*, the analysis selected ten industries based on employment growth and overall size. Employment growth was used as an indicator of dynamism. Overall size was used to capture the relevance for the European economy at large. Since the 65 candidate groupings are by design overlapping, the analysis looked at similar groupings and picked among these the ones

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[6] *The European Cluster Observatory's "Emerging Industries" report (2012) identified the following seven emerging industries: creative industries, eco industries, experience industries, maritime industries, mobile services industries, mobility industries, and personalised medicine industries. The report is available at www.clusterobservatory.eu/system/modules/com.gridnine.opencms.modules.eco/providers/getpdf.jsp?uid=b20af4 e5-581d-4462-a3eb-d178e4754011*

that best met the target criteria of growth and size. This approach led to the selection of ten newly identified emerging industries depicted in Table 2 and Figure 5.

Three out of the ten are grounded in the emerging industries earlier identified and profiled by the European Cluster Observatory (Blue Growth Industries, Experience Industries and Environmental Industries).[7] Creative Industries are based on the merger of cluster categories that are core dimensions of the statistical database available on the European Cluster Observatory website. The remaining six are cluster categories supplemented with a number of related narrow industries (Advanced Packaging, Biopharmaceuticals, Digital Industries, Logistical Services, Medical Devices, and Mobility Industries).

Figure 5: Linkages between clusters and emerging industries
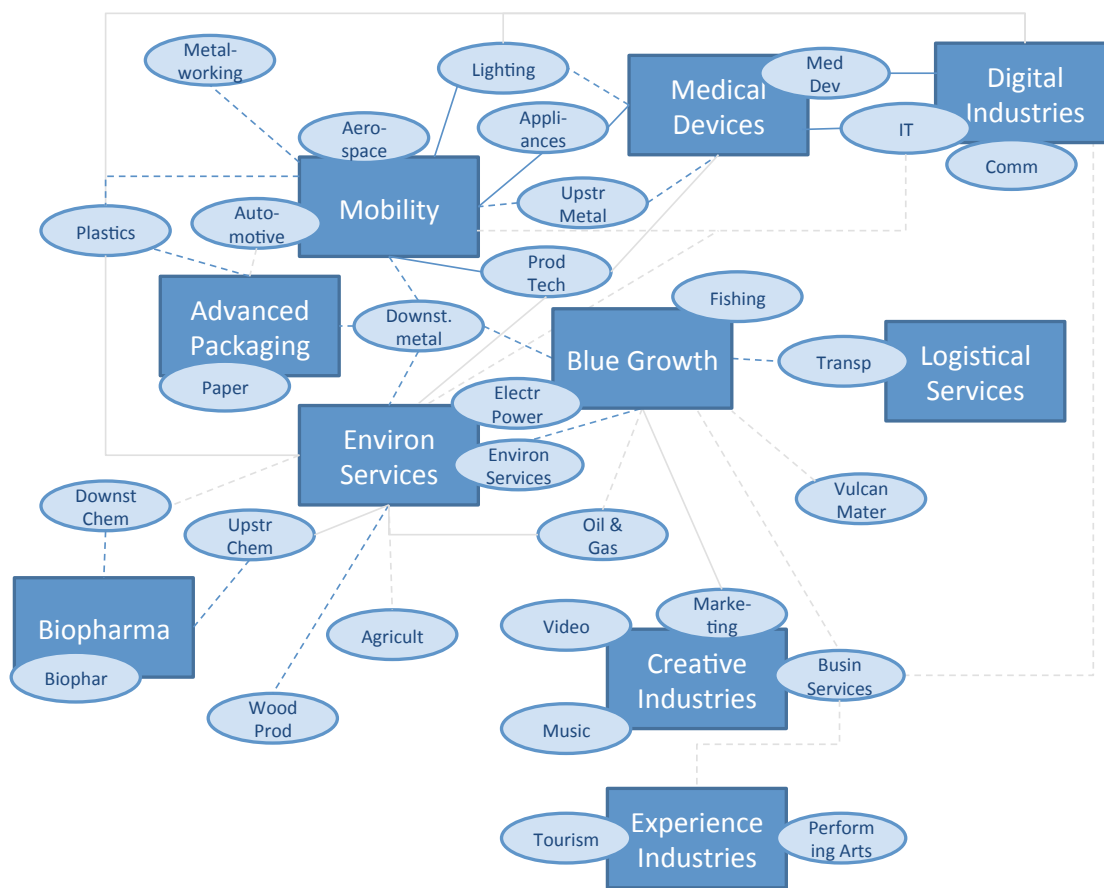
Legend
Box: Emerging industry
Oval: Cluster category
Overlap cluster – industry = cluster is 100% part of industry
Blue line = 100% > overlap >80%

Blue dotted line = 80% > overlap > 50%
Grey line = 50% > overlap > 30%
Grey dotted line = 30% > overlap > 20%
The distances are approximate

The ten emerging industries that were identified are partly overlapping, and thus have clusters that link them. The graphic above depicts some of these linkages between them. Among the ten emerging

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[7] *See the European Cluster Observatory's "Emerging Industries" report (2012) available at www.clusterobservatory.eu/system/modules/com.gridnine.opencms.modules.eco/providers/getpdf.jsp?uid=b20af4 e5-581d-4462-a3eb-d178e4754011. Note that the statistical definitions of the emerging industries are not identical, and results thus are not directly comparable.*

industries (shown as boxes) there are a number of different 'branches'. The clusters (shown as ovals) are the connection between the industries. Some of these connections are relatively narrow, based on only one cluster category. Others are broader, with a range of clusters as 'bridges' between the emerging industries.

Table 2: Emerging industries

Industry	Type*	Industry	Type*
Advanced Packaging	Cloud	Environmental Industries	Emerging
Biopharmaceuticals	Cloud	Experience Industries	Emerging
Blue Growth Industries	Emerging	Logistical Services	Cloud
Creative Industries	Merged	Medical Devices	Cloud
Digital Industries	Cloud	Mobility Technologies	Cloud

* The types Merged, Cloud, and Emerging correspond to approaches a), b), and c) respectively as described in text above.

The remainder of this report is divided into two main sections: the next section takes the perspective of regions, and looks at the overall presence of the aggregate of the ten emerging industries across European locations. The first part identifies the leading European regions on this measure, and discusses their specific patterns of economic specialisation. The second part compares the overall economic performance of these regions with the European average. A third part then analyses more systematically the regional factors statistically associated with strong performance.

The final section of the report provides more detail on each of the ten emerging industries. It first provides some basic overall statistics on aggregate size and growth over time, as well as a breakdown by main clusters and industries. It then describes each emerging industry qualitatively in the type of activities it contains. After that, the final section identifies the leading regions for each emerging industries. In the following, information is provided on the cluster organisations with relevance for the emerging industry. Finally, some short overall commentary on the patterns observed is provided.

2. Profiling Hotspots of Emerging Industries

The European economy[8] is made up of 302 (sub-national) regions, each with its own profile and economic performance. 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[9]. This part of the European Cluster Panorama takes an additional step and explores the presence of emerging industries as build up from core clusters and further related industries across European regions. More specifically, the analysis intends to identify which European regions have the strongest position across all ten emerging industries identified through the methodology discussed in the previous chapter.

This section starts with a discussion of the overall measure of emerging industry-strength that is used. Further developing a methodology previously used, a new measure of regional cluster strength is created that can be applied to measuring the strength of the ten emerging industries across locations. In the second part those regions in Europe are identified that score highest on this overall measure of the strength of emerging industries. A brief discussion of the patterns observed is provided. The final part of this section then shows the initial results from a quantitative analysis across the full dataset of regions, linking the presence of clusters and emerging industries to a range of economic performance indicators.

2.1   Assessment of Cluster Strength

The strength of a cluster is a complex multi-faceted concept, capturing aspects of overall size, specialisation, productivity, and dynamism. A new indicator of cluster strength is presented here that captures all of these dimensions.

Absolute *size* of the cluster, measured in terms of number of employees or enterprises, is important because it affects the number and intensity of linkages that are feasible. However, since regions and industries vary in size, a relative indicator of *specialisation*, such as location quotient (LQ)[10], is often used as an additional measure. These two employment-based indicators[11] formed the basis of the

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[8] *In this report 'Europe' is defined as nations participating in the Entrepreneurship and Innovation Programme of the Competitiveness and Innovation Programme (excluding Montenegro due to data availability): EU28 as well as Albania, Former Yugoslav Republic of Macedonia, Iceland, Israel, Liechtenstein, Norway, Serbia, and Turkey. NUTS 2 regions were used in most of the cases, though due to data availability NUTS 1 level was used instead in Croatia, Ireland, Israel, Slovenia, as well as two states in Germany: Niedersachsen and Rheinland-Pfalz. In Italy two regions Trentino and Alto Adige were merged as well since the data was only available for their combination.*

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

[10] *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.*

[11] *Together with a related measure of focus, which was dropped here, since it does not add any information beyond location quotient when only analysing a single industry/cluster category.*

'three-star' methodology used by the European Cluster Observatory as part of the first European cluster mapping in 2007.[12]

Over the last several years it has become apparent that purely employment level-based measures should be complemented with new indicators as data availability and comparability improves. As a result, first, the initial third employment-based regional 'focus' indicator used since 2007 was dropped to make place for new indicators. Secondly, as the strength of a cluster is not just reflected in its static level, but also in the *dynamism* of its development, an additional measure of annual growth[13] has been incorporated to capture these dynamics.

The third aspect that can complement the original 'stars' definition is employee *productivity*. Since the productivity levels vary drastically across Europe and could be more than an order of magnitude apart, these differences should be captured as part of the cluster strength measure. To achieve this, average wages per employee was includes as the most widely available and comparable productivity metric across Europe. This cluster strength indicator reflects the accumulated competiveness 'level'. Thus it also complements the dynamism indicator that may only capture 'catch-up' effects (i.e. improvements) but not the full level of cluster strength.

Figure 6: Measuring cluster strength
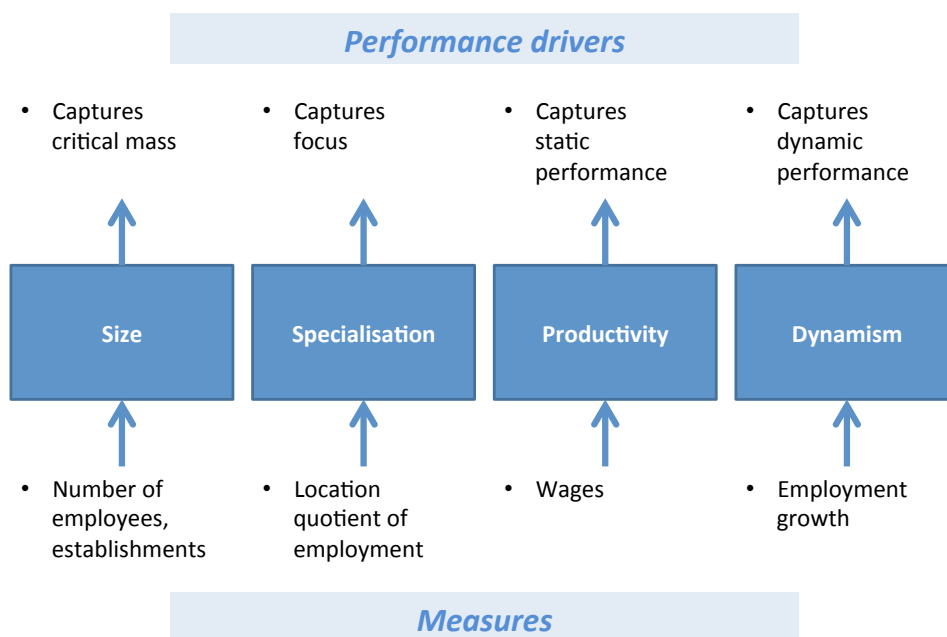
Thus, there are four dimensions along which a cluster's performance varies and that serve as the basis for a single cluster performance indicator. To make the methodology as straightforward as possible a star is assigned for each of the four dimensions to regions that are in top-20% in Europe[14] and these

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[12] 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.*

[13] *Computed as a Compound Annual Growth Rate in 2007-2012 or closest years depending on data availability.*

[14] *Since there are 302 regions in Europe this leads to about 60 regions getting a star in each dimension.*

contributions are then summed up[15] to arrive at the final 'star' rating. This is the core measure of cluster strength and is explored in more detail when analysing the individual industries.

For the analysis of overall regional performance, the total number of stars across all emerging industries is used as the core measure. When analysing ten emerging industries along the four dimensions, the maximum total number of stars is thus 40. Following this methodology, the region with the best cluster strength in Europe (Darmstadt in Germany) scores 29 stars (see next section).

While this new measure provides a better sense of cluster strength compared to simple raw quantity, some weaknesses remain: First, some indicators, particularly the two new ones, are measured with error and depend on changes in how industries are reported or different systems used in different countries[16]. Second, all four of the indicators have some biases, though they work in opposite direction and could cancel each other out: 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[17]. 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. With these different possible 'biases' often working in different directions, the four-star clusters really stand out with strong performance across all dimensions.

2.2   Regional Hotspots

Innovation activity is highly concentrated geographically; a relatively small number of locations dominates overall innovative activities and provide an image of 'spiked' innovation landscape. Productivity, or high rates of value added per worker, is also highly unequal across regions, but not quite as concentrated in a few places. With these empirical patterns are well established through prior research, this section of the European Cluster Panorama aims to look at the geographic footprint of emerging industries. How concentrated are the emerging industries across locations, focusing on the aggregate of all ten emerging industries identified? What characteristics do regional hotspots have that lead the European rankings on emerging industry-strength?

Using the 'total number of stars' measure of cluster portfolio strength outlined in the previous section the geographical patterns of emerging industry concentration can be explored and the hotspots identified. From Figure 7 it can be seen that the majority of regional hotspots are concentrated in the strip between Amsterdam and Munich, the core of the traditional 'European pentagon' that economic geographers have identified as the centre of Europe's economic activity. This reflects that many of these emerging industries rely on recombination of existing production technology Southern and Western Germany is famous for. In addition, the list of top regions also includes a number of capital cities, particularly in Northern Europe. This reflects the presence of industries based on innovative and creative activities that are often over-represented in large cities.[18]

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[15] *Only clusters that fall into top-80% by employment size in each industry are used to avoid spuriously high specialisation, growth and wages in very small regions.*

[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] *Since it is harder to have a large specialised region than a small one.*

[18] *Ireland appears an outlier but is heavily dominated by the Dublin region; the other Irish regions are by an order of magnitude smaller, which is why the whole country is treated as one region for the purposes of our analysis.*

Figure 7: Regional hotspots

Source: European Cluster Observatory 2014
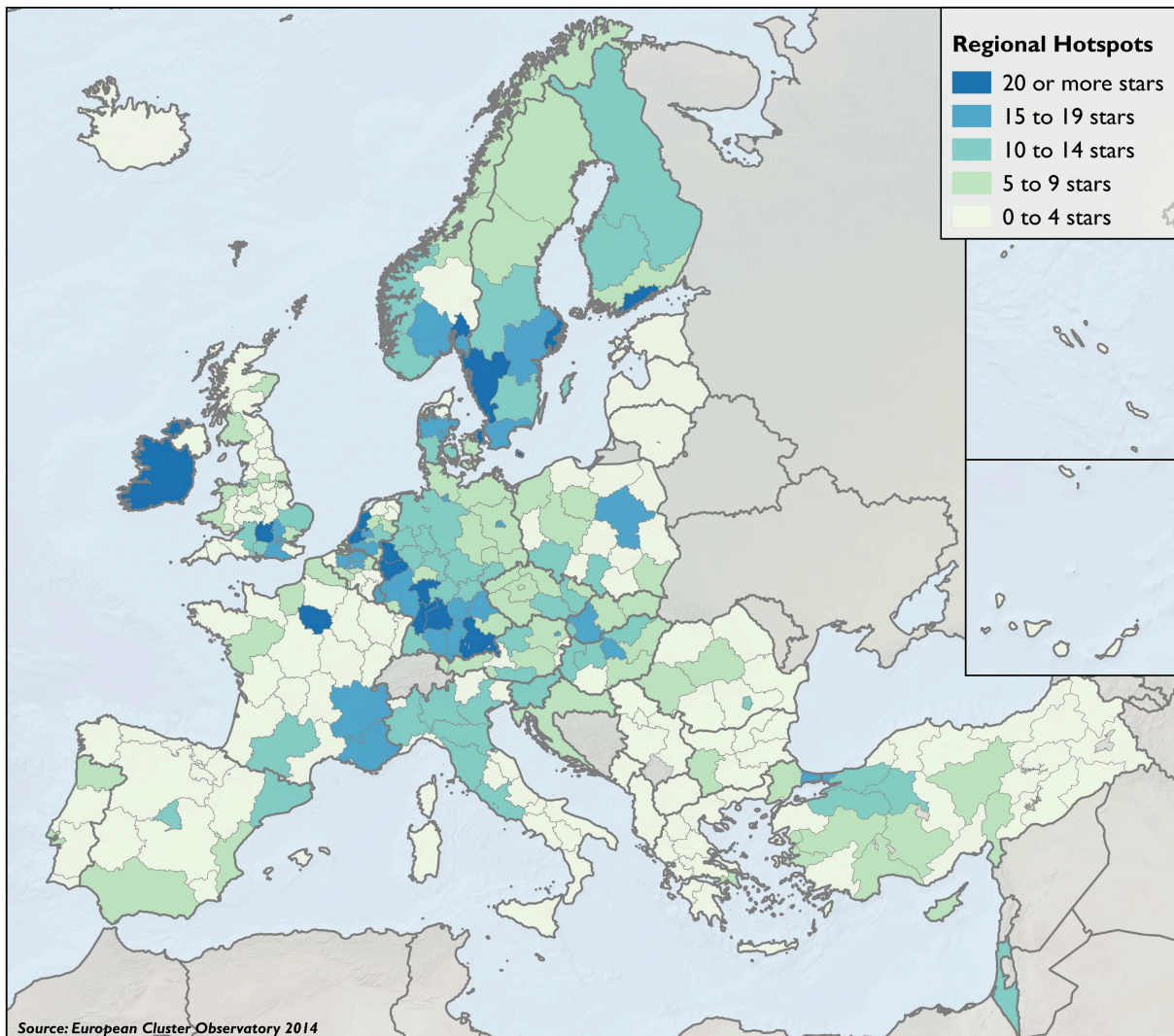
The hotspots of emerging industries activities across Europe fall broadly into three categories:

■ Europe's traditional centre of economic activity, located in a narrow band from Southern Germany through the Benelux to Southern England

■ Europe's innovation leaders in the western and central Baltic Sea Region, stretching from Denmark through Western Sweden and Stockholm towards Southern Finland and Helsinki

■ Some European urban centres elsewhere, where the benefits of urban density overcome the burden of an otherwise weaker economic context

Using 15 stars as a cut-off point for identifying strong regions, emerging industries constitute 30.2% of these 44 regions' overall employment compared to 26.4% in Europe as a whole. The results are similar when using payroll instead of employment. The 44 regions represent 28% of European employment and 37% of European GDP. The median European region has an employment share in emerging industries of 25% and a payroll share of 39%.

**Table 3: Europe's regional cluster hotspots (15 stars or more)**

Rank	Region	Name	Largest City	Size Stars	Spe-cialis. Stars	Produ-ctivity Stars	Dyna-mism Stars	Total Stars
1	DE71	Darmstadt	Frankfurt	10	7	10	2	29
2	DE12	Karlsruhe	Karlsruhe	9	6	6	3	24
3	NL33	Zuid-Holland	Rotterdam	7	4	8	5	24
4	NO01	Oslo og Akershus	Oslo	4	5	9	6	24
5	DEA2	Köln	Köln	10	4	6	3	23
6	FR10	Île de France	Paris	10	3	10	0	23
7	DE11	Stuttgart	Stuttgart	10	5	6	1	22
8	DE21	Oberbayern	München	10	5	6	1	22
9	DEA1	Düsseldorf	Düsseldorf	10	3	8	0	21
10	UKJ1	Berks, Bucks and Oxon	Oxford	7	4	9	1	21
11	SE23	Västsverige	Göteborg	6	5	10	0	21
12	SE11	Stockholm	Stockholm	6	4	10	1	21
13	NL32	Noord-Holland	Amsterdam	5	4	7	5	21
14	IE00	Ireland	Dublin	8	4	8	0	20
15	DK01	Hovedstaden	Copenhagen	7	3	10	0	20
16	FI1B	Helsinki-Uusimaa	Helsinki	5	5	10	0	20
17	DE60	Hamburg	Hamburg	8	2	7	2	19
18	UKI2	Outer London	Outer London	7	4	7	1	19
19	DE14	Tübingen	Tübingen	6	6	3	4	19
20	NL41	Noord-Brabant	Eindhoven	2	2	9	6	19
21	LU00	Luxembourg	Luxembourg	0	4	9	6	19
22	DEB0	Rheinland-Pfalz	Mainz	9	5	2	2	18
23	HU10	Kozep-Magyarorszag	Budapest	8	4	0	6	18
24	AT13	Wien	Wien	5	3	10	0	18
25	FR71	Rhône-Alpes	Lyon	10	3	4	0	17
26	DE30	Berlin	Berlin	8	5	1	3	17
27	FR82	Provence-Alpes-Côte d'Azur	Marseille	7	3	7	0	17
28	DE25	Mittelfranken	Nürnberg	6	4	4	3	17
29	UKJ2	Surrey, E and W Sussex	Brighton	6	3	8	0	17
30	SE12	Östra Mellansverige	Uppsala	2	5	10	0	17
31	NL31	Utrecht	Utrecht	0	3	6	8	17
32	TR10	Istanbul	Istanbul	10	0	0	6	16
33	DE27	Schwaben	Augsburg	5	5	1	5	16
34	UKI1	Inner London	Inner London	5	2	7	2	16
35	BE21	Antwerpen	Antwerpen	2	3	10	1	16
36	PL12	Mazowieckie	Warszawa	10	1	0	4	15
37	DE23	Oberpfalz	Regensburg	4	5	1	5	15
38	UKH2	Beds and Herts	Luton	4	4	6	1	15
39	SK02	Zapadne Slovensko	Nitra	4	3	0	8	15
40	SE22	Sydsverige	Malmö	0	5	10	0	15
41	NO03	Sør-Østlandet	Skien	0	5	10	0	15
42	BE24	Vlaams-Brabant	Leuven	0	4	10	1	15
43	BE23	Oost-Vlaanderen	Gent	0	3	10	2	15
44	DK04	Midtjylland	Aarhus	0	3	10	2	15

The top region in Europe is Darmstadt (Frankfurt am Main is its largest city) with a total of 29 stars (Table 3) – it is very strong in all emerging industries and along all dimensions, but dynamism. Most regions in the top-10 follow the same pattern with Rotterdam and Oslo being exceptions and also exhibiting high growth rates[19]. Most regions represent Northern and Central Europe, though there are exceptions in Southern France with Lyon and Marseille, and in Eastern Europe with Budapest, Istanbul, Warsaw, and Nitra.

2.3   Emerging Industries and Regional Performance: Initial Results

The analysis of emerging industries is based on the hypothesis that their presence is likely to result in higher rates of innovation and (future) economic performance. In this section some initial results are presented that look at this relationship. While future economic performance is by definition unknown, the analysis explores whether current performance is related to the (past) presence of emerging industries. This analysis does thus not provide a test as to whether the presence of emerging industries drives growth – a core underlying assumption of the general focus on emerging industries. It is instead better viewed as an exercise to better understand the current nature of the regions in which the identified emerging industries have their strongest presence.

Figure 8: Regional competitiveness framework
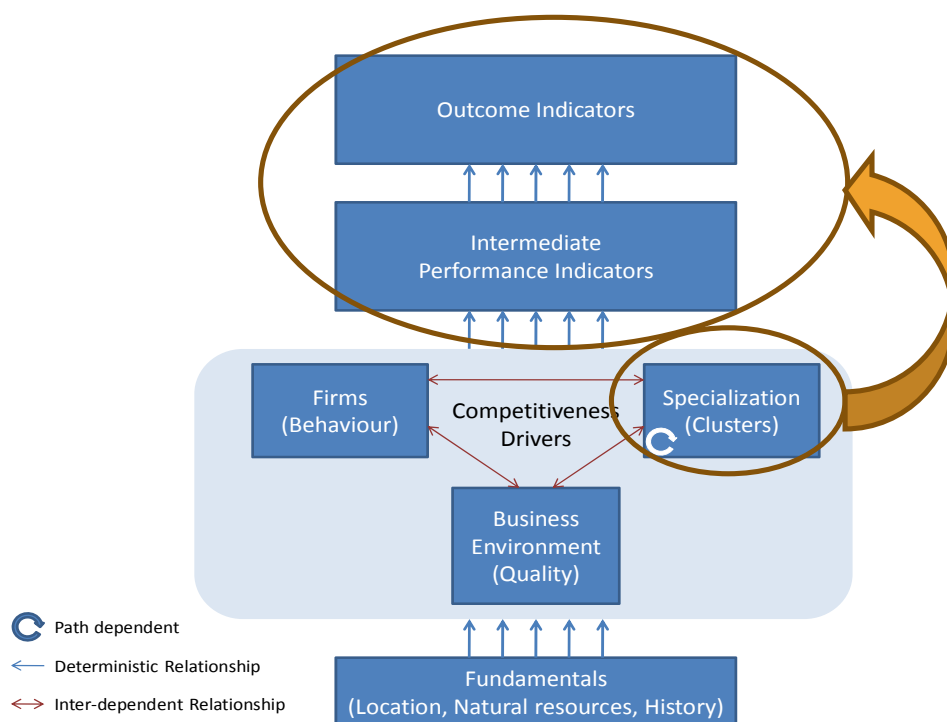
As described in the regional competitiveness framework developed by the European Cluster Observatory (Figure 8), the presence of emerging industries and clusters is likely to have an impact on inter-

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[19] *It has to be noted that growth numbers are not always very reliable due to changes in the classifications and data collection methods. In particular all regions in Netherlands exhibit high growth, which could be an artefact of this.*

mediate performance and outcome indicators. As a measure of emerging industry presence in the region the total number of stars derived by the four-star classification method described in chapter 2.2 is used. Various indicators have been selected to measure intermediate and final outcomes of competitiveness in economic, innovation, social and environmental terms. The choice of indicators has been limited by the availability of data at regional level.[20]

Table 4: Regional competitiveness outcomes and emerging industry portfolio strength

	Indicator	Median						Correlation with portfolio strength
		Star rating range					Overall	
		0-4	5-9	10-14	15-19	20+		
Economic	GDP per capita	20 150	22 200	26 850	27 500	35 400	**22 600**	**0.55**
	Disposable income	13 600	14 600	16 600	17 800	18 900	**14 900**	**0.38**
	Labour Force Participation	0.55	0.58	0.58	0.61	0.62	**0.58**	**0.42**
	Youth Labour Force Particip.	0.36	0.42	0.48	0.50	0.52	**0.41**	**0.27**
	Labour cost	30 670	31 345	35 070	41 040	44 945	**33 560**	**0.38**
	Labour cost manufacture	31 330	34 610	43 170	49 500	53 080	**38 930**	**0.46**
	Productivity	49 290	53 800	56 877	59 336	71 605	**54 513**	**0.44**
	Employment growth	-1.19	-0.30	-0.55	0.82	-0.65	**-0.48**	**0.15**
	Exports over GDP	0.17	0.28	0.28	0.23	0.12	**0.20**	**0.27**
Innovation	Patents per inhabitant	23	53	104	149	223	**54**	**0.61**
	Patents per employee	57	118	219	321	460	**125**	**0.59**
	Patents per emp. in S&T	357	643	1 342	1 223	1 998	**686**	**0.55**
	Sale of new to market and new to firm innovations	0.49	0.50	0.50	0.40	0.54	**0.50**	**N/S***
	SMEs market or organisation innovations	0.22	0.35	0.40	0.42	0.39	**0.34**	**0.34**
	SMEs product or process innovations	0.25	0.38	0.54	0.59	0.66	**0.37**	**0.38**
Social	At risk of poverty rate	18.78	15.40	14.15	13.10	11.60	**15.50**	**-0.37**
	Long term unemployment	3.40	3.10	2.45	1.90	1.50	**3.00**	**-0.32**
	Youth unemployment	24.46	21.15	14.55	16.65	10.48	**21.03**	**-0.41**
	Unemployment rate	9.22	9.79	7.14	6.36	5.78	**8.41**	**-0.30**
	Life satisfaction rate	6.55	6.62	7.12	7.64	7.75	**6.81**	**0.36**
Env	Heavy environmental land use	3.05	3.91	4.50	5.99	6.43	**3.83**	**0.45**

Shaded cells indicate that smaller medians and negative correlation coefficients imply good performance. Spearman correlation coefficient is used. [21]

* Not significant at 5% level.

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[20] *Information about the sources and regional coverage of each indicator can be found in the accompanying "Methodology and findings report for correlation analysis between cluster strength and competitiveness indicators" of the European Cluster Observatory (2014).*

[21] *A 5% significance level has been considered. The relationship between emerging industries strength and competitiveness indicators might be affected by time lags. Hence, the correlation tests have been implemented not only for the same year in each variable, but also with one and two year lags, but only the results for same year correlation are reported here. The complete results can be found in the accompanying European Cluster Observatory (2014) "Methodology and findings report for correlation analysis between cluster strength and competitiveness indicators".*

Table 4 summarises the results of the analysis. First of all regions are classified according to the number of stars they accumulate and they are profiled according to the median values for each of the outcome indicators. The overall median is also presented. Each of the competitiveness indicators has also been correlated with the indicator of strength of emerging industries. The results show that the overall presence of emerging industries appears to be associated with strong economic, innovation and social performance, and with negative environmental performance:[22]

■ Regarding *economic outcomes*, it can be observed that the larger the number of stars, the higher the levels of GDP per capita and disposable income are. Labour force participation (both overall and among young people) also increases with the number of stars. Regions with more stars also exhibit larger productivity levels, which are likely to be associated with higher wages. This is likely to contribute to larger labour costs, both generally in the economy and in the manufacturing sectors. Employment levels decreased in the period considered due to the crisis and, while the correlation coefficient points to the right direction, the detailed profile of the star-classified regions show that the behaviour was uneven: while regions with 0-4 stars present the highest average rate of employment destruction and regions with 15-19 stars managed on average to create employment, regions in the top category (20+ stars) could not avoid employment reductions. Export behaviour was also uneven, with exports peaking in the regions with 5-14 stars, though there was no clear pattern to explain neither of these two phenomena.

■ The presence of emerging industries is also associated with positive *innovation outcomes*. This is particularly the case when these outcomes are measured in terms of patenting, either scaled by population, employment or employment in science and technology. It also holds true when the results are measured on the basis of SMEs innovating behaviour, more markedly regarding product or process innovations than market or organisation innovations. What is not clear, on the basis of these results, is whether more innovations translate into more sales, as the correlation coefficient is not significant and there is no distinctive behaviour associated with the star classification of regions.

■ Specialisation in emerging industries is generally associated with positive *social outcomes* such as lower poverty and unemployment rates and higher life satisfaction rates.

■ The picture is quite different in terms of *environmental outcomes* as specialisation in emerging industries is generally associated with a more intensive use of land with heavy environmental impact. This is likely driven by the nature of these regions; they are heavily urbanized and have high levels of population density.

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[22] *The same is generally true for each of the emerging industries, although there is some variation in the direction of correlations in a handful of them. The results for each of the emerging industries is not presented here but can be found in "Methodology and findings report for correlation analysis between cluster strength and competitiveness indicators" European Cluster Observatory Report.*

2.4   Concluding Observations

The analysis in this chapter has the aim of measuring the expected potential of emerging industries, rather than the performance achieved. The European Cluster Observatory work is based on assumptions about the linkages between the presence of what has been identified as emerging industries today and growth tomorrow. Given such assumptions, the above results reinforce the idea that support for these emerging industries may produce positive outcomes at regional level in the future, although they may come with a cost in terms of environmental impact. The hotspots of current prosperity overlap to a large degree with the hotspots of emerging industries of tomorrow. On first sight, there seems to be no trade-off between the two. Whether this turns out to be correct remains to be analysed further in subsequent studies looking at, for example, time-series data. The current work is based on the hypothesis that current linkages provide opportunities for future emergence of new clusters; it does not (and cannot) test this hypothesis.

If the hypothesis on the nature and role of emerging industries is correct, this implies that the findings on regional hotspots pose a significant challenge to European regional policy. Over time, the stronger presence of emerging industries in the identified hotspots is likely to enable them to reach higher levels of growth than the average of all European regions. Given that these hotspots already report higher levels of economic performance, these dynamics would further increase the differences between regions. European regional policy will need to carefully monitor these trends, and consider how to make emerging industries a powerful driver of growth also in currently lagging regions.

3. Profiling the Emerging Industries

This section of the European Cluster Panorama provides more detail on the ten emerging industries that have been identified. Each of the emerging industries outperforms (Table 5) the average of all traded industries either in terms of dynamism (measured by annual employment growth over the last four years) or productivity (measured by average wage). Four of them – Digital Industries, Creative Industries, Experience Industries, and Medical Devices – register both higher dynamism and higher productivity. In the aggregate, the narrow industries covered in these ten emerging industries account for about two-thirds of the total employment in the traded industries sector of the economy captured in the traditional 51 cluster categories.

Table 5: Emerging industries overview in Europe

Industry	Employment 2012	Annual Growth 2007-12	Average Wage 2012
Advanced Packaging	4 353 336	0.08%	26 302
Biopharmaceuticals	2 507 906	-0.08%	41 003
Blue Growth Industries	11 825 652	0.31%	27 098
Creative Industries	12 175 055	1.61%	31 789
Digital Industries	8 775 778	1.07%	36 532
Environmental Industries	8 597 431	-0.05%	31 803
Experience Industries	10 043 510	0.50%	26 045
Logistical Services	6 344 855	0.42%	22 390
Medical Devices	4 373 575	0.16%	33 606
Mobility Technologies	10 658 541	-0.59%	30 907
Total Emerging Industries*	**45 685 106**	**0.27%**	**29 654**
Total Traded Clusters	**68 758 784**	**-0.21%**	**27 101**
Total All Industries	**172 887 399**	**0.22%**	**22 671**

* Total Emerging Industries are computed as the sum of all narrow industries belonging to at least one emerging industry to avoid double counting industries that are part of several sectors.

The average annual employment growth of the ten emerging industries is at 0.27% quite low though slightly higher than for the average of the European economy in total. This data reflects a combination of structural and cyclical factors. Structurally the share of employees in the traded part of the economy that is represented by clusters is stagnating or even shrinking in many advanced economies; this is a result of the high productivity growth in these sectors that outperforms demand growth. In line with these dynamics, the GDP (or value added) share of the traded activities is not shrinking. Cyclically the traded sectors have been hit particularly hard by the global economic crisis. While the emerging industries weathered this storm better than the average of traded clusters, local industries, which were exposed to these shocks more indirectly, reported more resilience.

Figure 9 below captures in one image the employment size, growth, and wage level of the ten emerging industries; the axes represent average wage and annual employment growth, while the bubble size represents employment size. The highly positioned emerging Biopharmaceuticals industry thus shows the highest productivity in terms of average wages, while the emerging Creative Industries with the biggest bubble positioned furthest to the right show the highest dynamism and employment concentration for its more widely defined grouping of related sectors.

Figure 9: Emerging industries overview
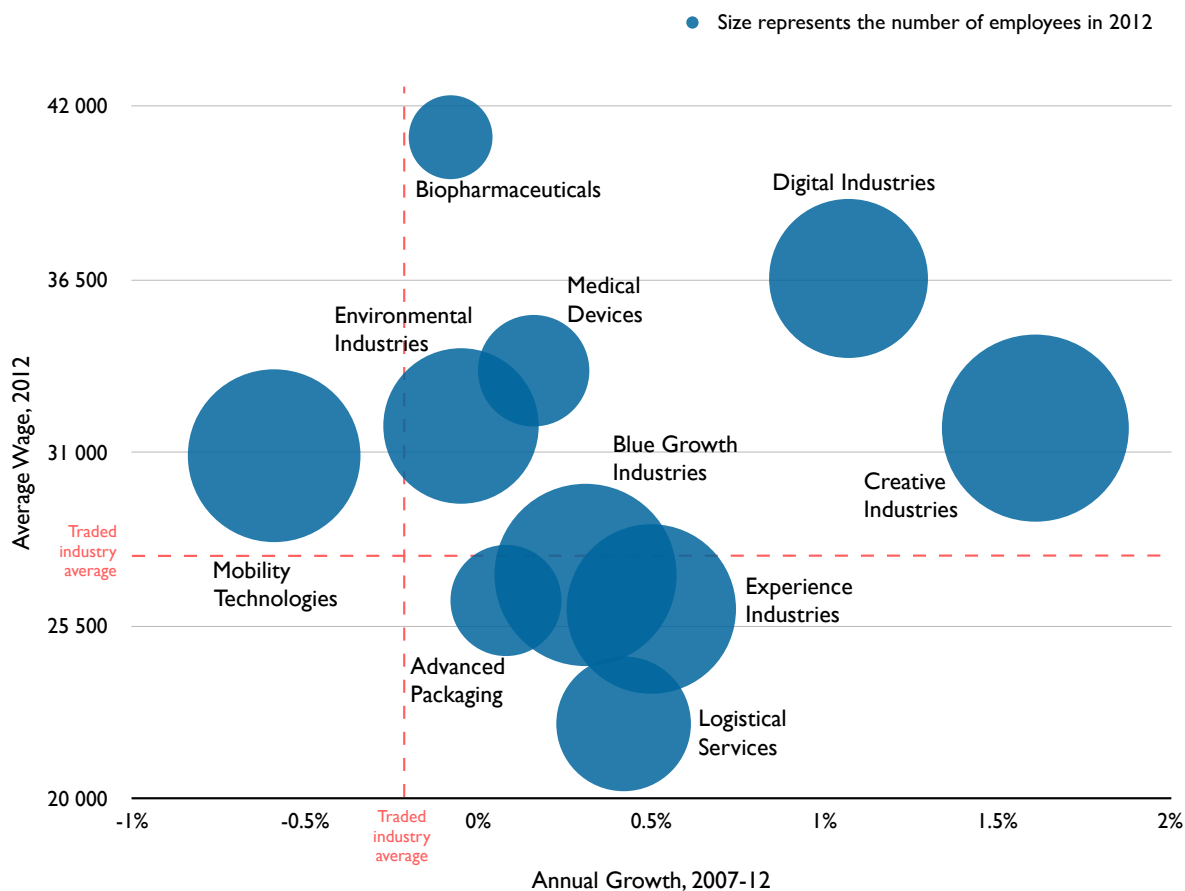
Overall, the regions that are strong (3 or 4 stars) in a specific emerging industry perform generally better in competitiveness indicators than regions in general. Table 6 presents median levels of the key competitiveness variables across all emerging industries. The majority of indicators are higher in strong regions, exceptions being 'Heavy environmental land use', where all strong regions score lower, and 'Sale of new innovations', where there is no obvious pattern. The performance of specific industries is discussed in more detail in respective subsections.

The remainder of this section reports for each of the ten emerging industries some overall performance indicators, a discussion of the industry's composition, and some of the key trends the industry is currently exposed to. The more granular cross-regional data available from the European Cluster Observatory is then used to identify the leading European regions for the industry. This data reflects the presence of economic activity in the narrow industries included; it does in itself not represent collaboration or linkages between them in each specific region.

Table 6: Profiles of strong regions in emerging industries

Indicator	Overall	Advanced Packaging	Biopharmaceuticals	Blue Growth Industries	Creative Industries	Digital Industries	Environmental Industries	Experience Industries	Logistical Services	Medical Devices	Mobility Technologies
GDP per capita	22 600	28 600	31 850	36 300	36 200	32 200	30 900	27 200	33 900	31 100	28 750
Dispos. income	14 900	18 800	17 900	18 000	17 950	18 200	19 100	17 400	17 400	18 850	18 650
Labour.Force Part	0.58	0.60	0.59	0.64	0.63	0.63	0.62	0.63	0.63	0.60	0.60
Youth Labour Force Particip.	0.41	0.51	0.49	0.55	0.52	0.54	0.53	0.55	0.55	0.52	0.53
Labour cost	33 560	35 100	39 700	42 670	41 750	41 690	37 600	37 950	48 700	37 340	35 420
Labour cost manu	38 930	44 410	49 580	53 785	50 240	50 180	50 240	48 185	51 020	48 525	45 580
Productivity	54 513	56 710	64 154	74 686	69 710	68 096	61 528	56 642	74 686	58 961	57 344
Employm growth	-0.48	-0.15	0.24	0.03	0.08	-0.17	0.56	-0.65	0.43	0.46	0.91
Exports over GDP	0.20	0.58	0.23	0.13	0.23	0.23	0.24	0.09	0.35	0.36	0.46
Patent per inhab.	54	164	194	138	154	212	228	126	114	241	242
Patent per empl	125	331	399	285	325	405	470	256	253	497	483
Patent per empl in Science & Techn	686	2 820	1 656	1 142	1 243	1 891	2 632	960	782	2 730	2 890
Sale of new innov	0.5	0.38	0.51	0.45	0.47	0.54	0.4	0.55	0.52	0.47	0.38
SME market innov	0.34	0.14	0.49	0.38	0.4	0.4	0.46	0.42	0.38	0.41	0.43
SME prod innov	0.37	0.15	0.56	0.6	0.59	0.66	0.57	0.7	0.53	0.64	0.57
At risk of poverty	15.5	12.2	14.75	11.6	13.2	12.8	12.2	17.79	10.6	13	12.45
Long term unempl	3	2.3	2.55	1.7	2	1.7	1.8	1.9	1.3	2.15	1.95
Unemployment	8.41	5.98	7.14	5.78	6.73	5.79	5.5	7.21	4.37	6.07	5.44
Youth unempl	21.03	10.28	15.53	10.19	16.53	13.96	10.49	21.07	10.49	9.02	9.1
Life satisfaction	6.81	6.83	7.2	7.75	7.73	7.74	7.85	7.68	7.73	7.81	7.78
Heavy land use	3.83	4.44	6.22	10.92	6.64	6.23	4.94	5.96	10.92	5.78	4.71

The numbers represent median values of each indicator overall and in regions strong in each respective emerging industry. Shaded cells indicate that smaller medians imply good performance.

The presence of cluster organisations, i.e. organized efforts to enhance the competitiveness of a group of related industries,[23] provides an indication that such linkages are indeed present. The Panorama draws on the organisational database of the European Cluster Observatory and the European Cluster Collaboration Platform to report on the presence of relevant organisations by emerging industry. As 'relevant' the Panorama identifies cluster organisations that are focused on any of the clusters that are fully included in the definition of the respective emerging industry.

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[23] *See Örjan Sölvell, Christian Ketels, and Göran Linqvist (2003), The Cluster Initiative Greenbook, Ivory Tower: Stockholm.*

3.1   Advanced Packaging

Basic Facts	Advanced Packaging	Share of all traded clusters	Share of overall economy
Number of employees	4 353 336	6.33%	2.52%
Number of enterprises	250 003	2.57%	0.94%
Turnover (million EUR)	838 270	4.79%	2.42%
Value added per employee (EUR)	60 010	85.0%	96.9%
Average wage (EUR)	26 302	97.1%	116.0%

Advanced packaging is the industry with Paper and Packaging cluster at its core. It employs more than 4.3 million people in Europe and constitutes a large share of traded cluster employment at 6.3%. It is relatively weak in terms of productivity, especially as measured by value added per employee, though the wages are approximately on par with traded industries in general. Advanced Packaging has been stable over time and now employs nearly the same number of people as it did in 1996. It appears to have been more affected by the recent downturn than the economy at large, though the recent signs seem to indicate a stronger bounce back.

Figure 10: Evolution of Advanced Packaging industry (Employment in 1996 = 100)
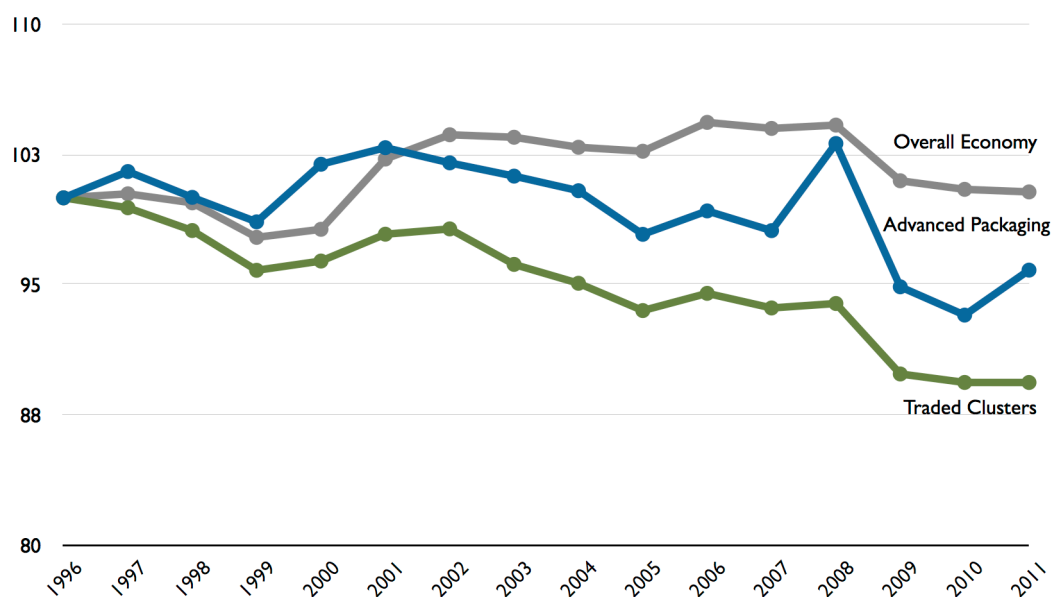
3.1.1 Industry at a Glance

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 (Figure 11). Packaging of any goods, from early steps in manufacturing, any distribution actions (transport packaging) until the end product having arrived at the final user (the consumer package) fulfils several basic functions:

- The packaging physically protects any enclosed objects against any external, for example mechanical, electrical, magnetic, optical, electrical, etc. impact.

- The packaging builds a barrier against elements, like water, oxygen or other gases, and against any contamination in general.

- The packaging defines the handling sizes of the goods, in pieces, weight, volume, etc. and thus can as well define portions or doses for specific cases of use.

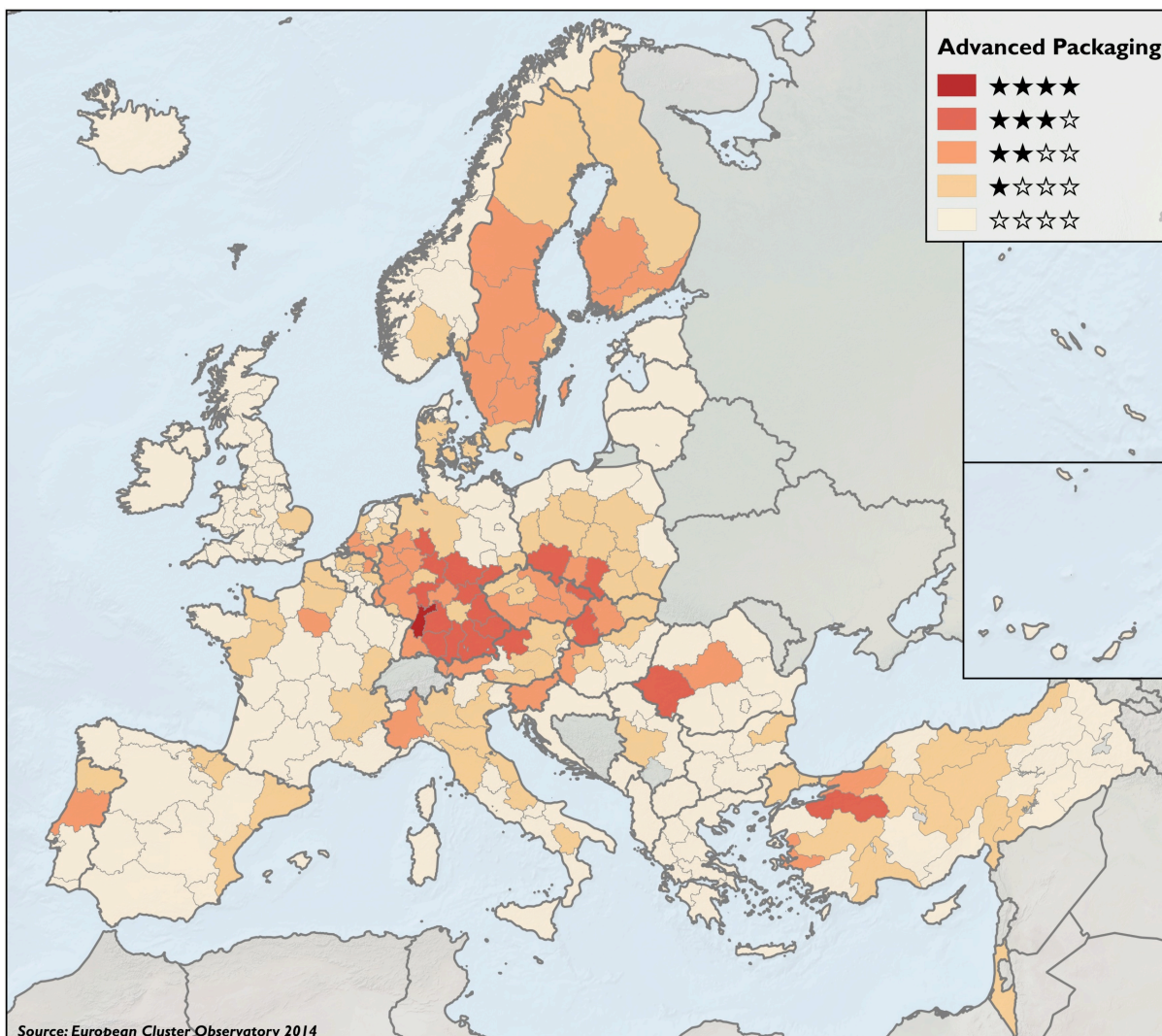**Figure 11: Advanced Packaging industry composition (area corresponds to payroll share)**
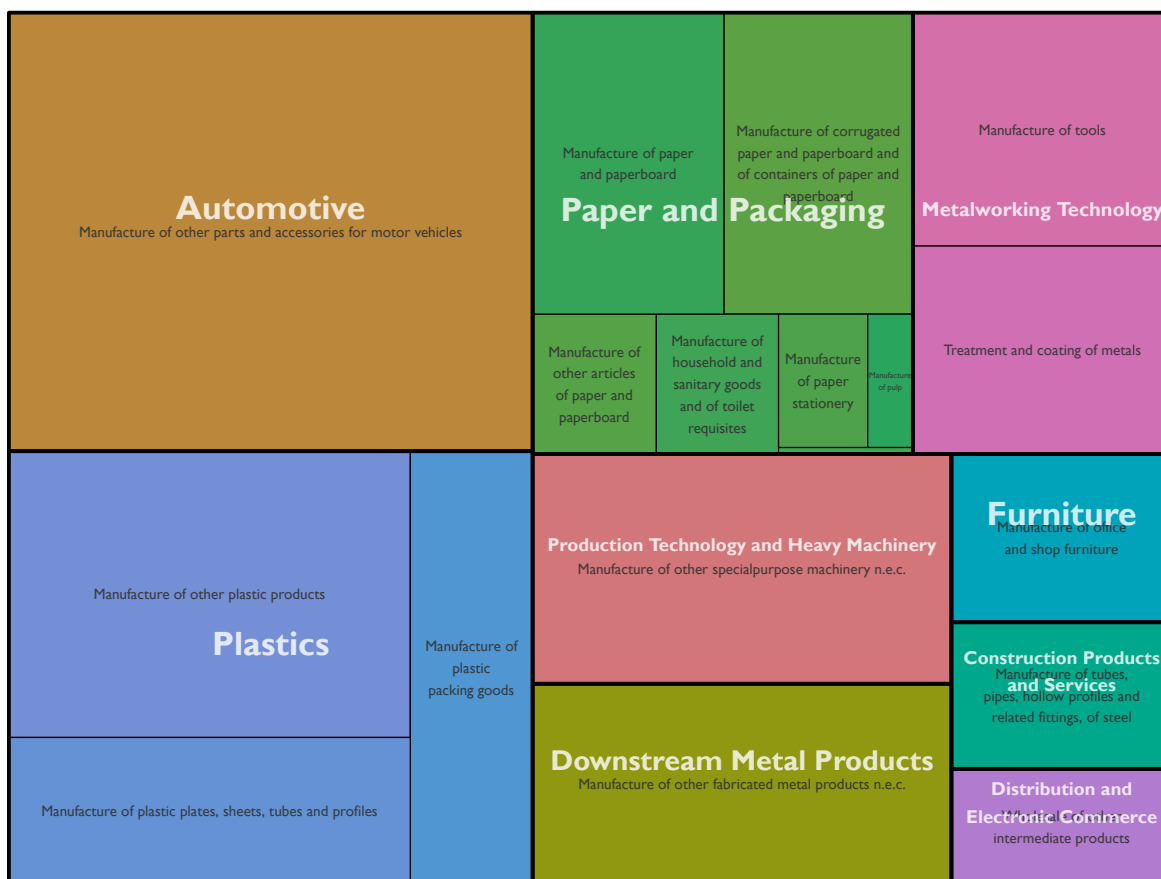
Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

Further functions are continuously being integrated into the packaging process:

- To contain information regarding the packaged goods themselves, as well as regarding re-strictions in storage and handling, or any other information related to the enclosed goods or their purpose of use.

- To use the packaging and its materials and design for marketing purposes, to display identity and brands or to attract potential buyers.

- To support any issues of security, reducing or hindering risks of theft, misuse, copying, or any other non-foreseen action.

- To include features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use and reuse, recycling and disposal, etc.

Figure 12: Leading regions in Advanced Packaging

Source: European Cluster Observatory 2014

The Advanced Packaging emerging industry comprises conventional packaging industry complement-ed by stakeholders creating and providing additional added-value products and services to fulfil or expand the scope of the core functions of the packaging. In particular, Advanced Packaging is setting and following trends for:

- Sustainable Packaging: Less use of material and manufacturing with a smaller carbon foot-print, increased focus on reuse, recyclability and packaging using biodegradable materials.

- Lightweight packaging.

- Emphasizing product safety and consumer information in the packaging (for example by packaging integrated and easy accessible data storage medium).

- Integration of packaging and functionalities of the product (for example coffee packed in cap-sules fulfilling the coffee filter function to be directly inserted into the respective coffee ma-chine).

Packaging is applied in nearly every industry sector, thus an entire value for this sector is complicated to estimate. Packaging is estimated to be a global business of over 500 billion US$ in 2012, with a yearly growth rate of 4%.[24] Growth in particular is seen in the less developed countries. For example the BRIC markets (Brazil, Russia, India, China) comprise approximately 30% of the global demand[25], with increasing tendency as their growth is linked to increased consumption of all types of consumer goods.

Table 7: Europe's top clusters in Advanced Packaging

#	Region	Name	Largest city	Employees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	DE12	Karlsruhe	Karlsruhe	66 505	2.14	39 431	5.34%	4
2	DE11	Stuttgart	Stuttgart	100 056	1.98	41 984	1.79%	3
3	PL22	Slaskie	Katowice	59 958	1.70	10 334	4.94%	3
4	DE71	Darmstadt	Frankfurt am Main	48 318	1.16	40 863	6.21%	3
5	TR41	Bursa	Bursa	46 633	1.92	8 272	5.35%	3
6	DE21	Oberbayern	München	46 319	0.91	42 054	7.45%	3
7	DEA4	Detmold	Detmold	42 276	2.06	35 586	3.88%	3
8	DE27	Schwaben	Augsburg	40 832	2.32	37 675	6.01%	3
9	PL51	Dolnoslaskie	Wroclaw	38 823	2.26	10 672	6.49%	3
10	DEG0	Thüringen	Erfurt	37 012	2.07	25 105	3.70%	3
11	DE14	Tübingen	Tübingen	35 760	1.79	38 432	3.13%	3
12	SK02	Zapadne Slovensko	Nitra	35 519	1.91	8 601	8.77%	3
13	DE24	Oberfranken	Bayreuth	33 193	2.88	31 342	4.48%	3
14	DED1	Chemnitz	Chemnitz	29 664	2.32	24 894	6.71%	3
15	DE22	Niederbayern	Landshut	29 106	2.72	36 487	4.84%	3
16	CZ08	Moravskoslezsko	Ostrava	27 639	1.78	11 098	8.15%	3
17	DE73	Kassel	Kassel	26 746	2.53	35 170	19.81%	3
18	DE23	Oberpfalz	Regensburg	25 114	2.26	35 526	9.29%	3
19	AT31	Oberösterreich	Linz	24 875	1.67	42 228	0.89%	3
20	RO42	Vest	Timisoara	23 756	1.63	5 375	8.79%	3

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[24] *Unwrapping the packaging industry: Seven factors for success, Ernst & Young (2013).*

[25] *ibid.*

3.1.2 Leading Clusters

Advanced Packaging is concentrated in Southern and Central Germany and some of the neighbouring countries: Poland, Slovakia, Czech Republic, Austria, and Slovenia. This area is home to 18 out of 20 strong clusters, including the only 4-star cluster in Karlsruhe and the largest one in Stuttgart.

Some of the other strong areas include Western Turkey and Western Romania, which both exhibit good performance in all areas, apart from productivity. Further, most of the territory of Sweden and Finland is also covered by the strong Advanced Packaging clusters reflecting their strong tradition in paper-related products, though these areas suffer from relatively low growth. The German and Eastern European regions are strong in Plastics, Production Technology and Automotive, while the Nordic and Austrian regions have stronger Paper-related industries.

The regions strong in Advanced Packaging are characterised by very high exports and research rates. The share of exports in GDP is 58% compared to 20% in Europe overall, while the number of patents per million people in Science & Technology is 2 820 compared to 686 overall. However, the commercialisation of new technology lags Europe at large as sale of new-to-market innovations is 25% lower and SME innovations lower by close to 60%. The strong Advanced Packaging regions are socially inclusive, manifested best by youth unemployment rate of 10% compared to 21%, though the land use indicators are lower than average.

Table 8: Cluster initiatives in Advanced Packaging

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
SE21	Småland med öarna	Jönköping	5	290
FR71	Rhône-Alpes	Lyon	4	82
ITD3	Veneto	Venice	4	55
ITC4	Lombardia	Milan	4	27
SE31	Norra Mellansverige	Gävle	3	156
ES51	Cataluña	Barcelona	3	49

When it comes to cluster initiatives, there are 103 of them in Advanced Packaging in the database[26] making it approximately average among the emerging industries. The leading region by organisation count, Småland med öarna in Sweden, contains five (Table 8). This corresponds to 290 organisations per million employees in Advanced Packaging, or one organisation per every 3 500 workers. The relationship between the strength of clusters and the amount of organisational efforts is rather vague as the organisations usually belong to weaker-performing regions.

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[26] *The cluster initiative database represents a merger of the European Cluster Observatory and the European Cluster Collaboration Platform databases and covers organisations for which both regional and sectoral dimensions were available.*

3.2 Biopharmaceuticals

Basic Facts	Biopharmaceuticals	Share of all traded clusters	Share of overall economy
Number of employees	2 507 906	3.65%	1.45%
Number of enterprises	110 849	1.14%	0.42%
Turnover (million EUR)	869 958	4.97%	2.51%
Value added per employee (EUR)	109 825	155.5%	177.4%
Average wage (EUR)	41 003	151.3%	180.9%

The Biopharmaceutical emerging industry is an expansion of a 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). Europe's employment is at 2.5 million people corresponding to a substantial share (1.45%) of its overall employment. Both wages and value added are significantly higher than in traded industries (by 50%) and than in the overall economy (by 80%) suggesting very high levels of productivity in this industry. Its growth has been rather low in the last decade corresponding roughly to the growth of the overall employment, though it significantly outperforms traded industries as a whole.

Figure 13: Evolution of Biopharmaceuticals industry (Employment in 1996 = 100)
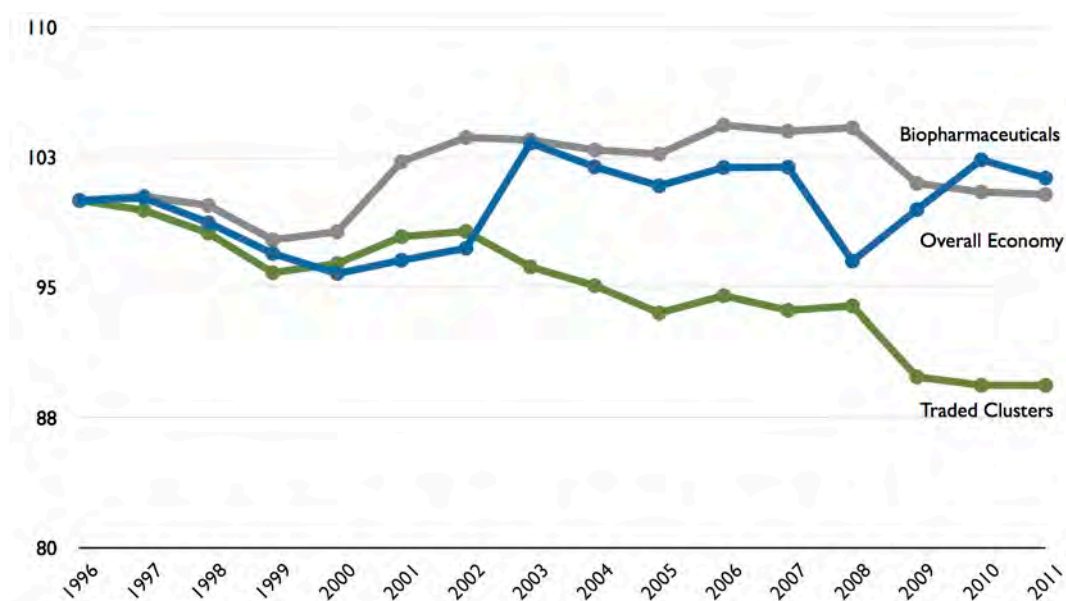

3.2.1 Industry at a Glance

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. [27] An impressive example for a substance produced in a biopharmaceutical process and approved for a therapeutic use was recombinant human insulin.

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 payroll 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.

Figure 14: Biopharmaceuticals industry composition (area corresponds to payroll share)
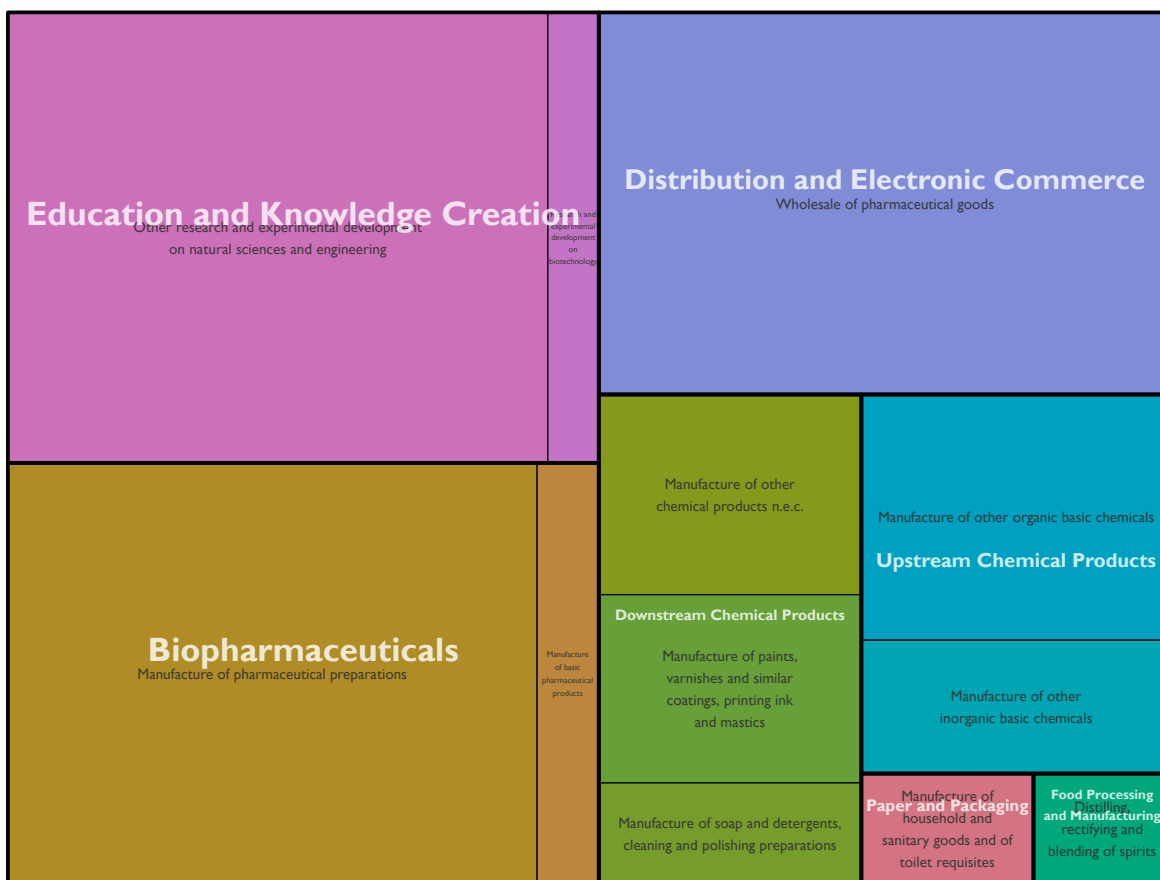
Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

The biopharmaceuticals sector is subject to a number of core trends. On the market, price pressure has led to an increasing shift towards pharmaceuticals that have moved out of patent protection and on-going attempts to enhance the efficiency of corporate R&D efforts. For emerging biopharmaceutical markets the availability of low-cost manufacturing facilities isn't as important as local presence to get

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[27] *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.*

access to the local market. Therefore, big pharmaceutical companies invest in new facilities in these regions and outsource several services and supply activities.

In the research system, the move from research conducted by and within large pharmaceutical companies to an innovation system driven increasingly by research institutions, universities, and research-focused start-ups continues. Within research, topics like personalised medicine and the use of new technologies like nanotechnology feature strongly.

Table 9: Europe's top clusters in Biopharmaceuticals

#	Region	Name	Largest city	Em-ployees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	DE71	Darmstadt	Frankfurt am Main	58 682	2.43	50 121	3.83%	4
2	DEB0	Rheinland-Pfalz	Mainz	49 916	2.79	60 698	13.91%	4
3	UKJ1	Berks, Bucks and Oxon	Oxford	30 476	1.82	57 702	3.69%	4
4	FR10	Île de France	Paris	97 198	1.39	57 144	0.64%	3
5	FR71	Rhône-Alpes	Lyon	46 003	1.72	49 094	1.59%	3
6	DEA2	Köln	Köln	41 909	1.91	49 536	0.93%	3
7	DEA1	Düsseldorf	Düsseldorf	39 756	1.45	53 582	-3.98%	3
8	DE12	Karlsruhe	Karlsruhe	36 953	2.06	45 732	3.40%	3
9	DK01	Hovedstaden	Copenhagen	33 475	2.90	86 855	1.29%	3
10	IE00	Ireland	Dublin	31 041	2.08	57 950	0.64%	3
11	ITE4	Lazio	Rome	28 011	1.32	50 861	-1.20%	3
12	DE30	Berlin	Berlin	27 242	1.87	47 252	6.96%	3
13	BE21	Antwerpen	Antwerpen	25 011	3.23	63 669	-0.83%	3
14	AT13	Wien	Wien	20 498	1.90	56 712	1.50%	3
15	DE13	Freiburg	Freiburg	18 486	1.45	49 488	-0.03%	3
16	SE11	Stockholm	Stockholm	17 899	1.49	70 121	-3.06%	3
17	UKH2	Beds and Herts	Luton	16 989	1.84	57 974	-2.06%	3
18	CZ01	Praha	Praha	15 967	1.78	22 224	5.61%	3
19	DEA3	Münster	Münster	15 428	1.41	48 942	-3.38%	3
20	DEE0	Sachsen-Anhalt	Magdeburg	15 237	1.61	38 196	6.27%	3
21	FR23	Haute-Normandie	Le Havre	15 183	2.22	48 440	-1.13%	3
22	BE10	Brussels	Brussels	12 586	1.89	62 642	-0.63%	3
23	FI1B	Helsinki-Uusimaa	Helsinki	11 973	1.39	57 127	-0.22%	3
24	BE31	Brabant Wallon	Wavre	10 018	7.58	66 153	5.07%	3
25	DE72	Gießen	Gießen	8 627	1.68	48 856	6.12%	3
26	NO06	Trøndelag	Trondheim	3 397	2.21	101 209	5.54%	3

3.2.2   Leading Clusters

The core of the Biopharmaceutical industry lies in South and Western Germany with two out of three 4-star cluster coming from that area (Darmstadt and the Rheinland-Pfalz region) as well as five of the top ten clusters (Köln and Düsseldorf and Karlsruhe, all 3-star clusters). These regions are particularly strong in pharmaceutical preparations and chemical industries.

Other regions strong in Biopharmaceuticals are those with strong universities, such as Oxford, Paris, Lyon, Copenhagen, Dublin and more. These regions exhibit high levels of research and development personnel, and the more urban ones also have a large presence of pharmaceutical wholesale.

Figure 15: Leading regions in Biopharmaceuticals
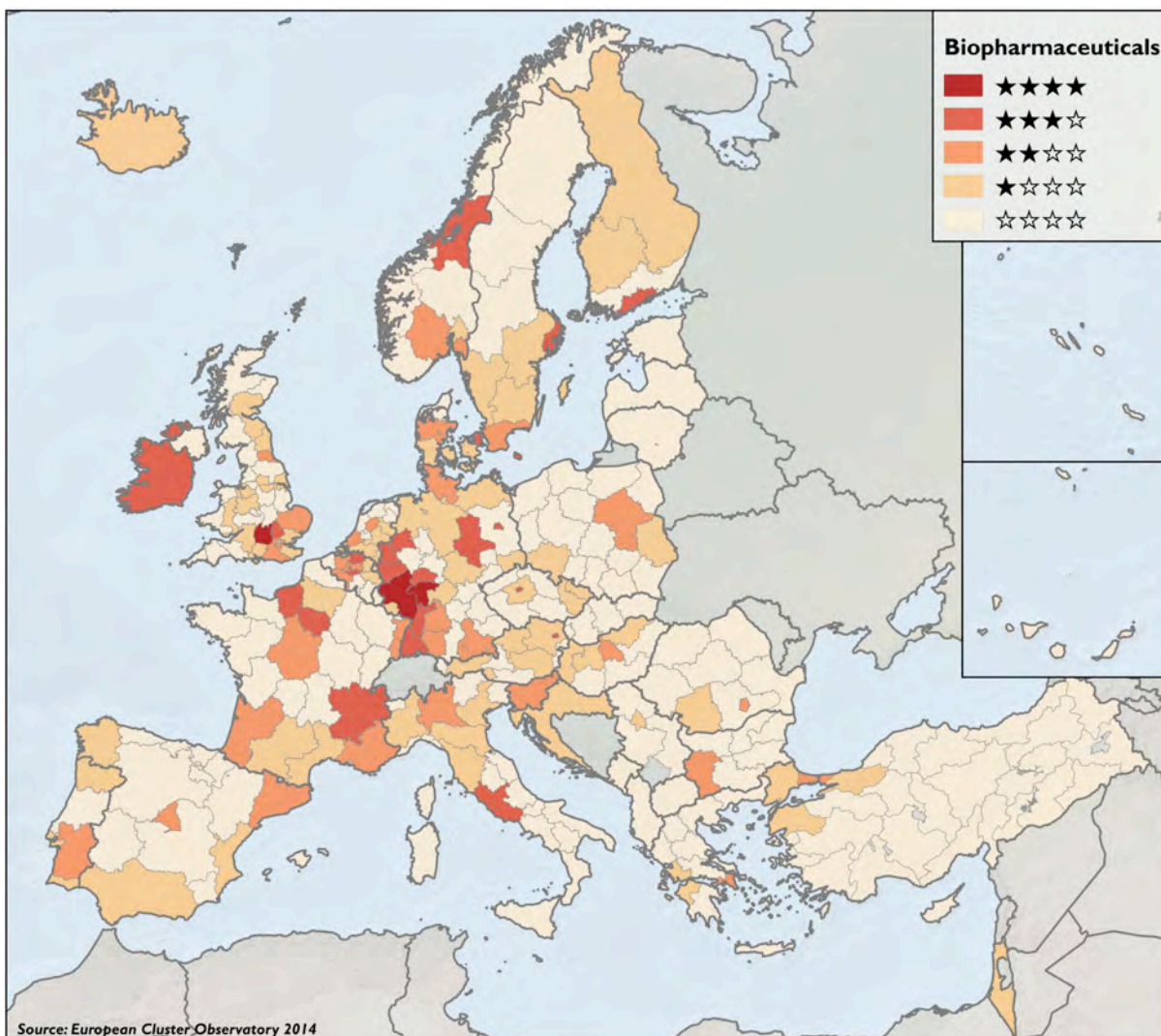
The Paris region with nearly 100 000 employees is quantitatively the largest Biopharmaceutical cluster in Europe. But since Île de France is a large region, the specialisation is rather low. Conversely, the clusters in Germany and, especially, Belgium have very high specialisation scores with Brabant Wallon employing 7.5 times more employees than an average European region.

In terms of the key competitiveness indicators, the regions strong in Biopharmaceuticals are in general richer (by 37%) and more productive (by 17%). However, unlike many rich regions, the Biopharmaceu-

tical hubs are also more dynamic and innovative, particularly when it comes to SME commercialisation of innovation (the scores are 50% higher on both SME-related metrics). This partially reflects the urban nature of these regions; however it also has a downside with suffering environmental indicators due to intensive land use.

Table 10: Cluster initiatives in Biopharmaceuticals

Region	Name	City	Organisations	Organisations per Million Employees
ES70	Canarias	Tenerife	5	2 280
FR71	Rhône-Alpes	Lyon	5	109
SE12	Östra Mellansverige	Uppsala	4	583
SE11	Stockholm	Stockholm	4	223
DK01	Hovedstaden	Copenhagen	4	119
HU21	Kozep-Dunantul	Székesfehérvár	3	1 221
DED3	Leipzig	Leipzig	3	646
FR52	Bretagne	Rennes	3	442
SE23	Västsverige	Göteborg	3	320
FR42	Alsace	Strasbourg	3	243
FR24	Centre	Orléans	3	195
FR82	Provence-Alpes-Côte d'Azur	Marseille	3	134
DE90	Niedersachsen	Hannover	3	83
DE12	Karlsruhe	Karlsruhe	3	81
ES51	Cataluña	Barcelona	3	61
DE21	Oberbayern	München	3	60
FR10	Île de France	Paris	3	31

Biopharmaceuticals is among the largest sectors targeted by organised cluster efforts. There are 171 cluster initiatives related to Biopharmaceuticals in the European Cluster Observatory database, including three GOLD-labelled ones[28]: BioM Biotech Cluster and BioRN Network in Germany, as well as Biopeople in Denmark. The highest concentrations of biotechnology clusters are in Canary Islands, Lyon and the core Nordic biotechnology regions: Uppsala, Stockholm and Copenhagen. The rate in Canaries, even if perhaps slightly inflated due to two of the organisation being multi-sectoral ones, corresponds to one organisation per 430 employees in Biopharmaceuticals.

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[28] *As awarded by European Cluster Excellence Initiative, more information available at http://www.cluster-analysis.org/gold-label-new.*

3.3   Blue Growth Industries

Basic Facts	Blue Growth Industries	Share of all traded clusters	Share of overall economy
Number of employees	11 825 652	17.20%	6.84%
Number of enterprises	1 849 496	18.99%	6.96%
Turnover (million EUR)	2 204 553	12.59%	6.36%
Value added per employee (EUR)	88 636	125.5%	143.2%
Average wage (EUR)	27 098	100.0%	119.5%

With 11.8 million employees and more than €2 trillion in turnover Blue Growth Industries is one of the largest among emerging industries and corresponds to between 6% and 7% of Europe's economy depending on the measure. It has also been consistently growing faster than the overall economy, though it has been hit rather strongly by the recession and has been declining in employment since 2008. Blue Growth is defined as water transpiration (sea, coastal and inland) together with related activities in logistics, production technology and engineering. While the wage levels are exactly the same as in traded industries as a whole, value added is substantially higher suggesting a productivity advantage of this industry.

Figure 16: Evolution of Blue Growth industries (Employment in 1996 = 100)
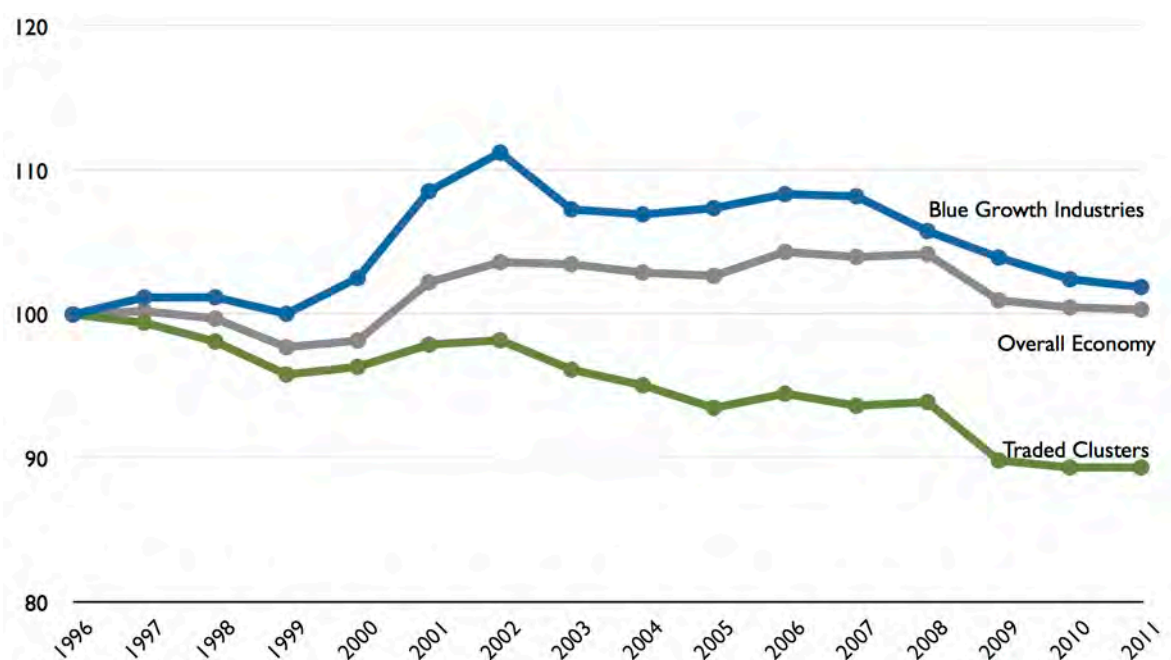
3.3.1   Industry at a Glance

Water resources in many parts of the world are pushed to their natural limits due to population growth and economic development. In turn, the ability of cities and countries to grow, attract investment, meet

the fundamental needs of populations, and ensure environmental protection will be increasingly threatened if water resources are not smartly managed.

Water is a finite resource that enables life and fuels all human activities. Therefore, the societal challenge and the industry's opportunity is that available and new solutions and models need to be put in place to ensure the viability and sustainable development of society, along with the preservation of a healthy environment. [29]

Figure 17: Blue Growth industries composition (area corresponds to payroll share)

Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

A specific water-related source are the oceans: they are an inexhaustible source of life with a tremendous biodiversity, they are food source for animals and as well directly for humans, and they are platform for global traffic and goods exchange. Whereas land-based mining activities are approaching their limits, sub-marine mining – so far only common for oil and gas – can be expected to be a promising solution to overcome upcoming shortages of some raw and rare materials.

"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:

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[29] *See http://growingblue.com/implications-of-growth/, accessed Aug 28, 2014.*

- Exploitation of water resources as an environment for fish and other water-based resources (fishery and aquaculture)

- Water-based energy production (water power and off-shore wind energy)

- Off-shore mining

- Marine biotechnology

- Tourism

- Water transport (ocean and in-land) and related civil engineering and infrastructures

- Water management

3.3.2   Leading clusters

Blue Growth Industries are predictably concentrated to the coastal areas, though, since the cluster also includes related and support industries, there are some inland clusters too. The largest of these is Darmstadt with a strong component of Logistics and Engineering.

Table 11: Europe's top clusters in Blue Growth industries

#	Re-gion	Name	Largest city	Employ ploy-ees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	NL33	Zuid-Holland	Rotterdam	102 615	1.52	41 392	3.89%	4
2	NO01	Oslo og Akershus	Oslo	62 975	1.48	91 320	7.05%	4
3	NO04	Agder og Ro-galand	Kristiansand	58 234	2.45	99 325	6.87%	4
4	DE71	Darmstadt	Frankfurt am Main	138 051	1.21	40 363	1.68%	3
5	UKI1	Inner London	Inner London	110 007	0.58	55 675	4.24%	3
6	DE60	Hamburg	Hamburg	99 796	1.56	38 816	0.55%	3
7	FR82	Provence-Alpes-Côte d'Azur	Marseille	94 742	1.43	38 039	0.29%	3
8	UKI2	Outer London	Outer London	83 493	0.94	38 951	2.93%	3
9	NL32	Noord-Holland	Amsterdam	65 083	1.08	36 350	5.80%	3
10	SE23	Västsverige	Göteborg	62 741	1.34	45 480	0.02%	3
11	NL34	Zeeland	Middelburg	15 595	1.85	38 126	14.80%	3

The strongest clusters in this sector all have Water Transportation at their core: Rotterdam and Hamburg are Europe's two busiest ports and predictably occupy top positions. On the other hand, the two Norwegian regions, Oslo and Kristiansand, have generally better productivity and dynamism scores and have substantial share of shipbuilding in addition to logistics-related industries.

The regions with strong Blue Growth clusters have very high apparent labour productivity (€75 000 vs €55 000 overall), partially due to the presence of rich Norwegian and Dutch regions. On the other hand, strong focus of some of these regions, particularly in the Netherlands, on large port- and logistics-related infrastructure mean that the heavy land use scores show poor environmental sustainability.

Figure 18: Leading regions in Blue Growth industries
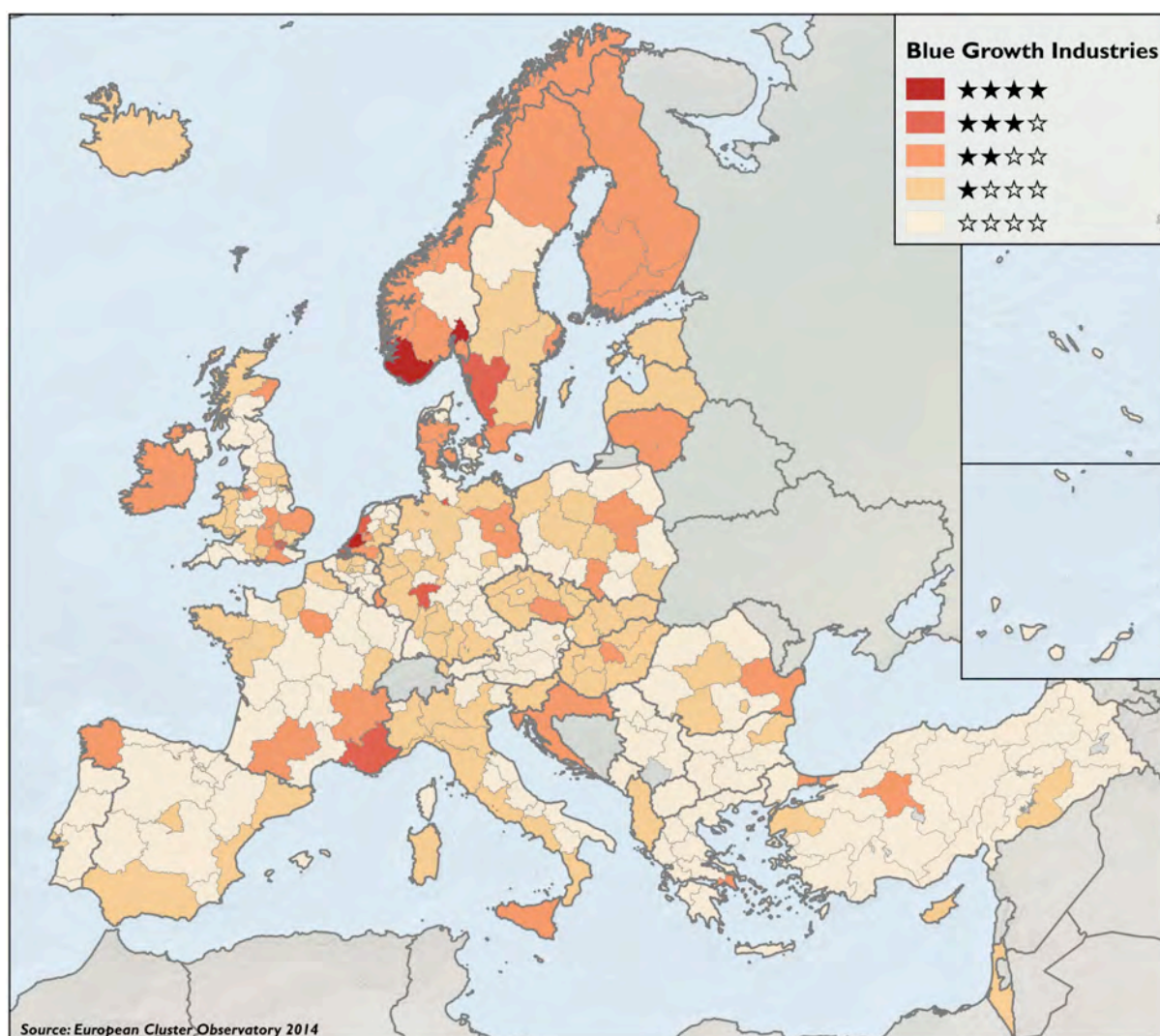
There are 79 cluster organisations in Blue Growth, many of which are located in the regions with strong Blue Growth clusters, like Bergen and Kristiansand. Overall, the cluster efforts in Blue Growth are strongest in Scandinavia and Italy.

Table 12: Cluster initiatives in Blue Growth industries

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
DK01	Hovedstaden	Copenhagen	5	84
NO05	Vestlandet	Bergen	4	84
ITC3	Liguria	Genoa	3	54
NO04	Agder og Rogaland	Kristiansand	3	52
ITD3	Veneto	Venice	3	25

3.4 Creative Industries

| Basic Facts	Creative Industries	Share of all traded clusters	Share of overall economy
Number of employees	12 175 055	17.71%	7.04%
Number of enterprises	3 316 477	34.06%	12.48%
Turnover (million EUR)	1 648 326	9.41%	4.75%
Value added per employee (EUR)	71 792	101.6%	116.0%
Average wage (EUR)	31 789	117.3%	140.2%

Creative Industries is the largest of the emerging industries in terms of employment, but perhaps more importantly, it is also the largest by the number of enterprises by a large margin. It has, for example, 15% more employees than Mobility Technologies, but almost six times as many enterprises. In this way it is structurally rather different from the rest of the industries (an average firm employs 3.7 people versus 6.7 overall) and has the strongest focus on SMEs. Creative industries comprises, amongst others, firms in Business Services, Design, Video, and Music clusters and enjoys rather high levels of productivity. However, the outstanding feature of Creative Industries is the sector's rapid growth, especially during the first half of the past decade. The number of employees in 2011 is almost 40% above the 1996 level making it by far the fastest growing of the emerging industries.

Figure 19: Evolution of Creative Industries (Employment in 1996 = 100)
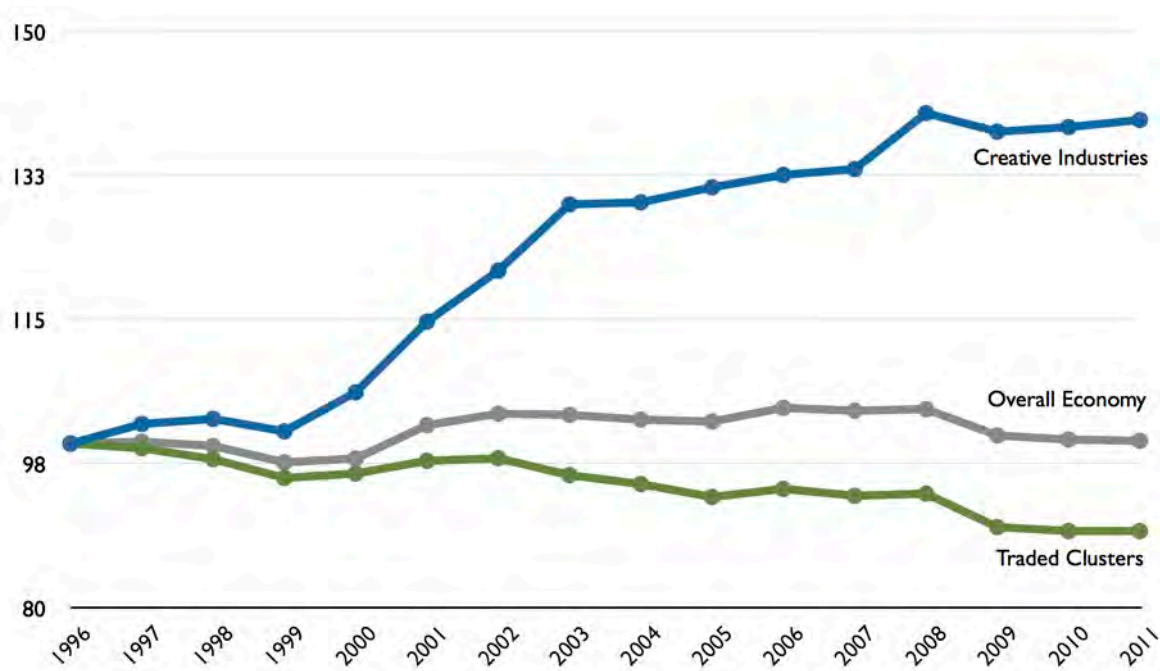
The employment of over 12 million for creative industries captured through the present analysis is considerably higher than the figures of 6.4 million identified in the 2011 priority sector report for creative and cultural industries of the European Cluster Observatory[30] and of 6.7 million identified in the 2010 European Competitiveness Report[31]. The considerably larger employment figure for the wider grouping of related sectors indicates that the narrowly defined creative industries play an important transversal role for providing positive spill-over effects into many other related industries.

Figure 20: Creative Industries composition (area corresponds to payroll share)
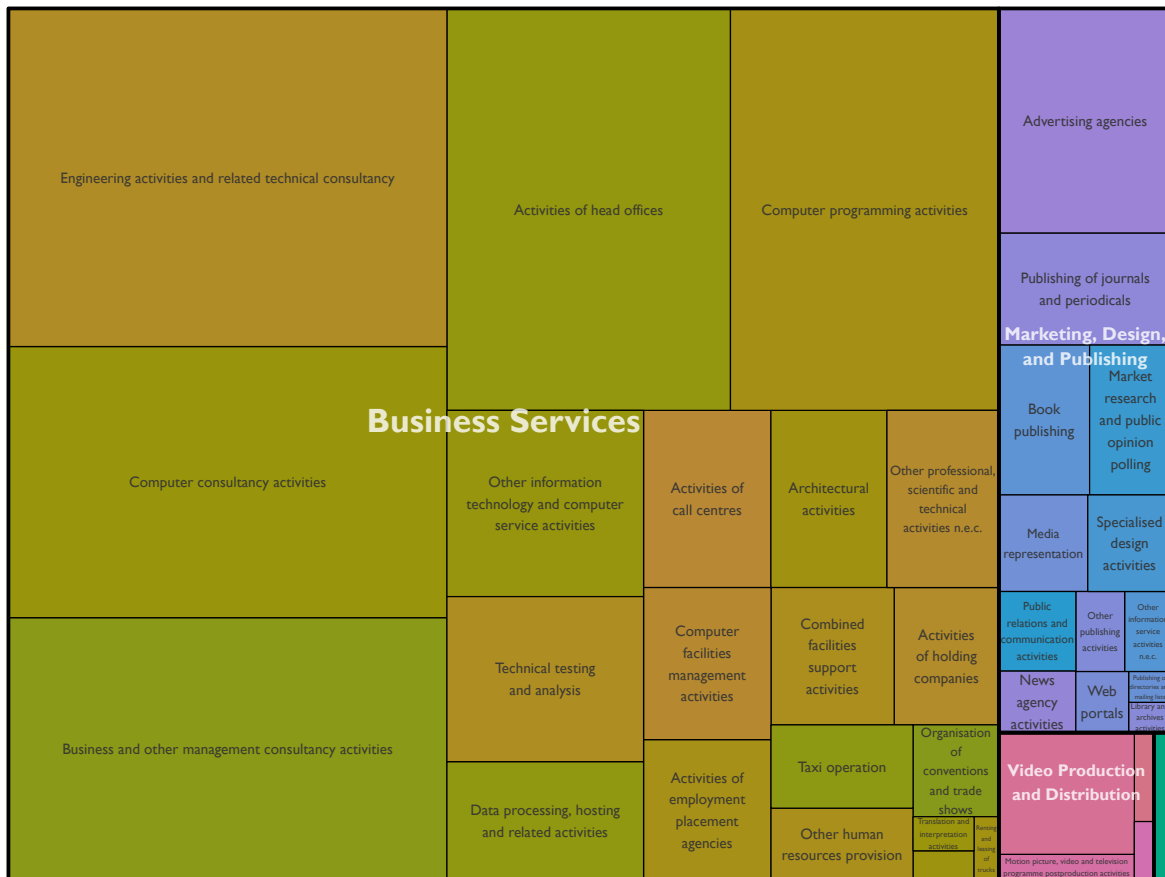
Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

3.4.1 Industry at a Glance

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

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[30] *Available at http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=7070.*

[31] *Available at http://bookshop.europa.eu/en/european-competitiveness-report-2010-pbNBAK10001/downloads/NB-AK-10-001-EN-C/NBAK10001ENC_002.pdf?FileName=NBAK10001ENC_002.pdf&SKU=NBAK10001ENC_PDF&CatalogueNumber=NB-AK-10-001-EN-C.*

subsectors such as graphic design, fashion design or advertising."[32] According to a definition of the Conference of German Ministers of Economic Affairs "culture and creative industries comprise of all cultural and creative enterprises that are mainly market oriented and deal with the creation, production, distribution and/or dissemination through the media of cultural/creative goods and services."[33]

The 2012 final report of the ESSnet-CULTURE project (European Statistical System Network on Culture) co-financed by Eurostat[34] provides a list of the following ten domains of cultural and creative activities that are viewed as part of creative industries: heritage (including museums, historical monuments and archaeological sites), archives, libraries, books & press, visual arts (including photography and design), performing arts, audio-visual & multimedia (including film, radio, television, and videogames), architecture, advertising, and art crafts.[35]

In the context of this report any further activities which are driven by intellectual inputs and which are delivering intellectual outputs only (not being complemented with delivery of any hardware or product), should also be considered as part of this industry. Such activities include market research, opinion polling, translation, business and management consulting. To be differentiated from this are cultural industries including industries that are "producing and distributing goods or services which at the time they are developed are considered to have a specific attribute, use or purpose which embodies or conveys cultural expressions, irrespective of the commercial value they may have".

Common to all definitions is that cultural and creative industries are considered market-oriented and that they are an integral part of the economy. Like any other industry the creative sector has its specific characteristics, but in terms of economic logic it functions the same way. This provides the opportunity to collaborate along similar value chains supporting cross-innovation.

Research has shown that creative industries differ to large extent from traditional industrial sectors. There is no one size-fits-all picture of the creative industries as its individual branches are very heterogeneous in terms of company structures, turnover, employment, markets, distribution channels and business models.[36]

Common to creative industries is that the economic relevance of micro enterprises is much higher than in other industry sectors. The vast majority of European creative industries enterprises (95%) are microenterprises (with fewer than 10 employees), which however only account for 35% of employment.[37]

Another difference from traditional industrial sectors is to be seen in the low capital intensity which in conjunction with the heterogeneity of markets results in low market entry barriers and high start-up dynamism. However, this effect is countered by an insufficient availability of capital that inhibits growth

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

[33] *Söndermann, Michael/Backes, Christoph/Arndt, Olaf/Brünink, 2009: Cultural and creative industries in Germany – defining the common characteristics of the heterogenous core branches of the "cultural industries" from a macro-economic perspective, study commissioned by the Federal Ministry of Economy and Technology, p. 20.*

[34] *http://ec.europa.eu/culture/library/reports/ess-net-report_en.pdf.*

[35] *It should be noted that recent reports also make close connections with fashion (linked to design) and experience-related sectors such as tourism, sport and recreation.*

[36] *Prognos/Fraunhofer ISI, 2012: Die Kultur- und Kreativwirtschaft in der gesamtwirtschaftlichen Wertschöpfungskette – Wirkungsketten, Innovationskraft, Potenziale, study commissioned by the German Federal Ministry of Economy and Technology, p. 10.*

[37] *European Competitiveness Report (2010).*

of enterprises because investments in market development and research and development cannot be made. As a consequence human capital is of prime importance to economic success.[38]

Table 13: Europe's top Clusters in Creative Industries

#	Region	Name	Largest city	Employ-ees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	NO01	Oslo og Akershus	Oslo	86 079	1.93	92 821	7.72%	4
2	FR10	Île de France	Paris	677 815	1.97	54 298	0.39%	3
3	UKI1	Inner London	Inner London	526 964	2.68	53 394	2.54%	3
4	DE21	Oberbayern	München	195 925	1.35	46 679	4.12%	3
5	UKJ1	Berks, Bucks and Oxon	Oxford	177 116	2.15	45 342	0.67%	3
6	UKI2	Outer London	Outer London	169 751	1.83	45 417	-0.07%	3
7	DE71	Darmstadt	Frankfurt am Main	161 183	1.36	46 885	1.03%	3
8	HU10	Kozep-Magyarors.	Budapest	160 493	1.92	10 074	17.98%	3
9	SE11	Stockholm	Stockholm	143 098	2.43	51 342	4.33%	3
10	UKJ2	Surrey, E and W Sussex	Brighton	142 836	1.97	39 059	0.16%	3
11	DEA2	Köln	Köln	138 288	1.28	43 280	2.02%	3
12	RO32	Bucuresti - Ilfov	Bucuresti - Ilfov	123 717	1.72	7 724	7.46%	3
13	DE60	Hamburg	Hamburg	107 275	1.61	37 458	1.53%	3
14	IE00	Ireland	Dublin	102 877	1.40	50 223	-0.50%	3
15	AT13	Wien	Wien	101 582	1.92	40 520	2.12%	3
16	NL33	Zuid-Holland	Rotterdam	97 679	1.39	38 931	-1.87%	3
17	DK01	Hovedstaden	Copenhagen	90 559	1.60	80 106	-0.34%	3
18	UKJ3	Hants and Isle of Wight	Southampton	89 735	1.76	42 410	0.20%	3
19	UKH2	Beds and Herts	Luton	82 031	1.81	36 345	0.96%	3
20	FI1B	Helsinki-Uusimaa	Helsinki	81 831	1.94	46 811	1.44%	3
21	BE10	Brussels	Brussels	64 791	1.98	53 338	2.98%	3
22	SK01	Bratislavsky kraj	Bratislava	63 792	1.89	13 525	9.19%	3
23	DE25	Mittelfranken	Nürnberg	61 733	1.06	39 101	4.78%	3
24	FR62	Midi-Pyrénées	Toulouse	61 460	1.21	37 804	2.52%	3
25	SE23	Västsverige	Göteborg	59 624	1.22	46 621	3.98%	3
26	NL31	Utrecht	Utrecht	56 656	1.96	39 404	9.37%	3

Creative Industries are very much open to collaboration along the entire value chain. They are also very much customer- and service-oriented which helps to access internal innovation processes of suppliers and clients. This contributes to spillovers to and cross-innovation between other branches within the creative industries and to other industrial sectors.[39] This catalytic innovation role and poten-

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[38] *Prognos/Fraunhofer ISI, 2012, pp. 10 and European Competitiveness Report (2010).*

[39] *Prognos/Fraunhofer ISI, 2012, pp. 12-13.*

tial for reinforcing cross-sectoral fertilisation was also stressed more recently by the European Commission Communication.[40]

3.4.2   Leading Clusters

Creative Industries are strongest in national capitals and large urban regions, as observed by earlier analysis.[41] In particular, Paris and London employ more than half-a-million creative workers each, Inner London remarkably also being the most specialised region. The only exceptions from this rule are several regions in the South of the United Kingdom, which overall can be considered the strongest area in Creative Industries.

Figure 21: Leading regions in Creative Industries
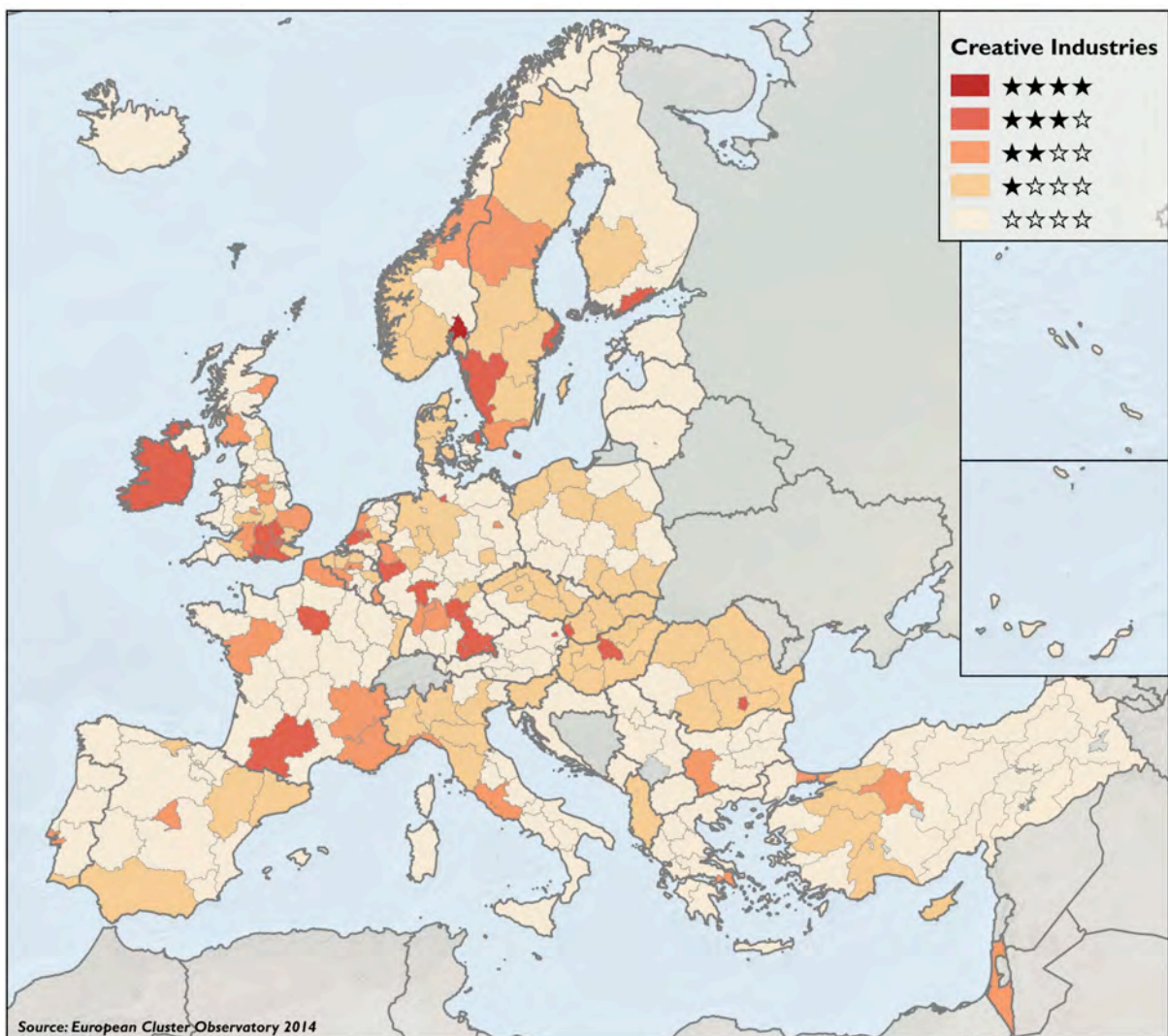
There also are some places that have extremely high growth in Creative industries employment, particularly in Eastern Europe where Bucharest grows by 7.5%, Bratislava by 9% and Budapest by 18%

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[40] *European Commission (2012) Promoting cultural and creative sectors for growth and jobs in the EU, COM(2012)537,available at http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52012DC0537.*

[41] *European Cluster Observatory (2011) Priority sector report: Creative and cultural industries.*

per year according to the European Cluster Observatory dataset.

In terms of subsectors, the employment in Creative Industries is dominated by Business Services and Marketing/Design activities, which occupy the first and second spots in every single one of the strongest regions. Music and Video are much smaller industries and are harder to register, but again this is the area where United Kingdom in general and London in particular shine with location quotients close to ten.

Overall, strong regions in Creative Industries are substantially richer (GDP per capita of 36 200 vs 22 600) and more productive (69 700 vs 54 500). This reflects that the strong regions are usually urban, particularly the capitals of respective countries, and include such large centres as London and Paris. Other competitiveness indicators are generally higher than the regions in general, but similar to other emerging industries.

Table 14: Cluster initiatives in Creative Industries

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
HU10	Kozep-Magyarorszag	Budapest	4	25
ES43	Extremadura	Mérida	3	467
ES11	Galicia	A Coruña	3	78
PL12	Mazowieckie	Warszawa	3	24
ES51	Cataluña	Barcelona	3	17

When it comes to organised cluster effort, there are 79 Creative Industries cluster initiatives in the database, though interestingly most of them are located in Eastern and Southern Europe. Budapest, Warsaw and several Spanish regions are the most represented. However, the strongest organisations are found in regions with generally stronger Creative Industries clusters. The GOLD-labelled ones are: Cap Digital in France, Innovation Network Lifestyle in Denmark, and VDC Fellbach in Germany.

3.5 Digital Industries

Basic Facts	Digital Industries	Share of all traded clusters	Share of overall economy
Number of employees	8 775 778	12.76%	5.08%
Number of enterprises	1 041 176	10.69%	3.92%
Turnover (million EUR)	2 139 659	12.22%	6.17%
Value added per employee (EUR)	80 092	113.4%	129.4%
Average wage (EUR)	36 532	134.8%	161.1%

Digital Industries comprise computer hardware, software, telecommunications and many supporting activities to these sectors. The industry grew very fast in the past decade and employs 8.7 million people in 2011 compared to 7.3 million in 1996. Despite some overlap with Creative Industries, Digital industries exhibit a very different enterprise structure with firms generally being larger – compared to the other emerging industries – with an average of 8.7 employees per enterprise. The industry mostly employs skilled workers, which is reflected in high productivity numbers: the average wage is more than 60% higher than in economy at large.

Figure 22: Evolution of Digital Industries (Employment in 1996 = 100)
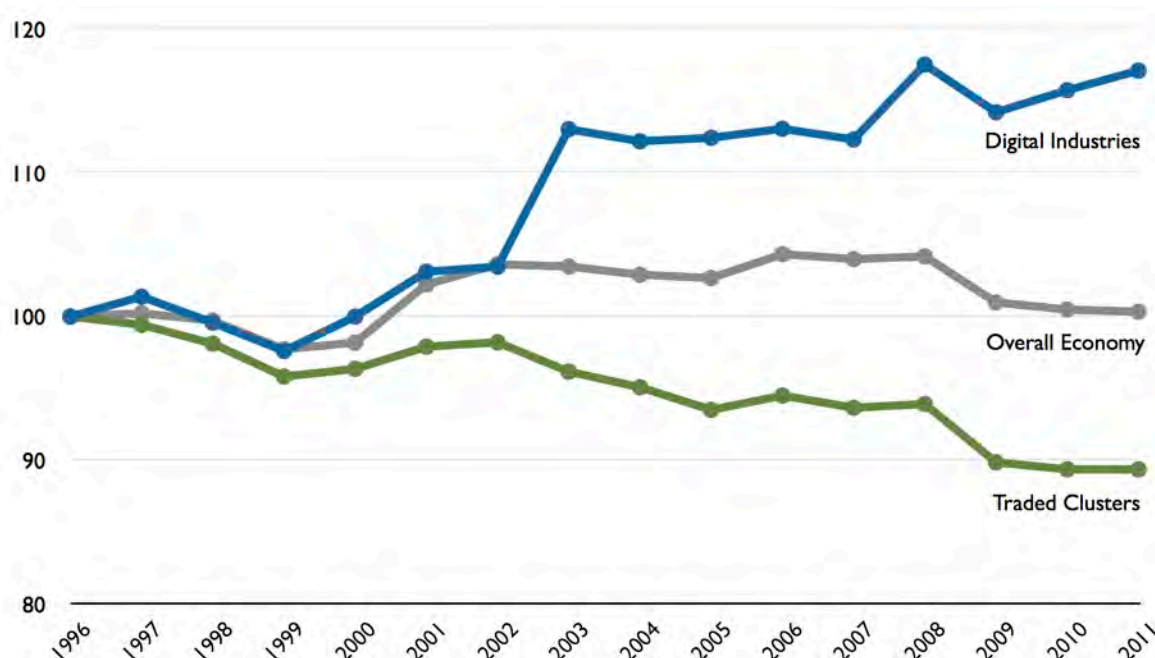
3.5.1 Industry at a Glance

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.

One of the dominant trends in the digital sector is the shift from hardware to software, and within the software area from product to service. Another key element has been the rapid move from stationary systems like PCs to multiplatform, wireless user interaction.

Figure 23: Digital Industries composition (area corresponds to payroll share)

Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

3.5.2   Leading Clusters

Digital Industries have the largest number of 4-star clusters suggesting that this is the sector where the largest and most productive regions are also the most dynamic. The top region is Stockholm with 100 000 employees and the highest specialisation, though it is closely followed by German and Dutch clusters. The industry is also characterised by uneven growth rates as many regions in France, United Kingdom, Ireland and Finland register negative growth.

Table 15: Europe's top clusters in Digital Industries

#	Re-gion	Name	Largest city	Employees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	SE11	Stockholm	Stockholm	100 358	2.38	57 404	4.62%	4
2	DEA2	Köln	Köln	92 890	1.20	44 013	4.69%	4
3	DE25	Mittelfranken	Nürnberg	83 640	2.01	46 978	11.83%	4
4	NL33	Zuid-Holland	Rotterdam	69 110	1.37	42 921	5.15%	4
5	NL32	Noord-Holland	Amsterdam	62 615	1.39	43 359	9.08%	4
6	NL41	Noord-Brabant	Eindhoven	61 180	1.58	45 389	4.67%	4
7	NO01	Oslo og Akershus	Oslo	53 413	1.68	97 490	6.45%	4
8	FR10	Île de France	Paris	365 953	1.48	53 171	-0.62%	3
9	DE11	Stuttgart	Stuttgart	163 585	1.59	47 902	1.51%	3
10	DE21	Oberbayern	München	156 399	1.50	53 381	2.55%	3
11	UKJ1	Berks, Bucks and Oxon	Oxford	129 294	2.19	64 311	-0.31%	3
12	DE12	Karlsruhe	Karlsruhe	111 892	1.77	50 362	1.69%	3
13	DE71	Darmstadt	Frankfurt am Main	108 879	1.28	50 816	0.83%	3
14	IE00	Ireland	Dublin	90 275	1.72	51 169	-1.35%	3
15	HU10	Kozep-Magyarorszag	Budapest	89 794	1.50	13 755	5.51%	3
16	UKI2	Outer London	Outer London	80 595	1.22	52 739	-1.08%	3
17	UKJ2	Surrey, E and W Sussex	Brighton	70 136	1.35	52 497	0.11%	3
18	DK01	Hovedstaden	Copenhagen	68 493	1.69	79 502	-0.22%	3
19	DE30	Berlin	Berlin	67 376	1.31	41 090	5.61%	3
20	UKJ3	Hants and Isle of Wight	Southamp-ton	66 137	1.81	54 357	0.67%	3
21	UKK1	Gloucs, Wilts and N Som	Bristol	60 182	1.31	42 026	-0.26%	3
22	AT13	Wien	Wien	59 981	1.58	50 783	1.77%	3
23	FI1B	Helsinki-Uusimaa	Helsinki	54 977	1.82	57 875	-1.45%	3
24	UKH2	Beds and Herts	Luton	50 409	1.55	46 091	-1.40%	3
25	DE23	Oberpfalz	Regensburg	47 203	2.09	40 478	6.78%	3
26	SE23	Västsverige	Göteborg	46 528	1.33	52 059	3.59%	3
27	NL31	Utrecht	Utrecht	37 907	1.84	47 137	9.37%	3
28	LU00	Luxembourg	Luxembourg	16 649	1.33	56 240	7.26%	3

The Digital Industries are a very diverse sector and it is also reflected in the sectoral composition of the strongest clusters. Some of the German regions specialise in hardware, Ireland has a strong Analytical Instruments sector and in Netherlands there are telecommunications-related strengths. Still, the largest pat of Digital Industries is software, computer-related business services, and e-commerce, which together constitute almost one half of the overall employment and are most commonly seen as the strongest subsector.

Figure 24: Leading regions in Digital Industries

Source: European Cluster Observatory 2014
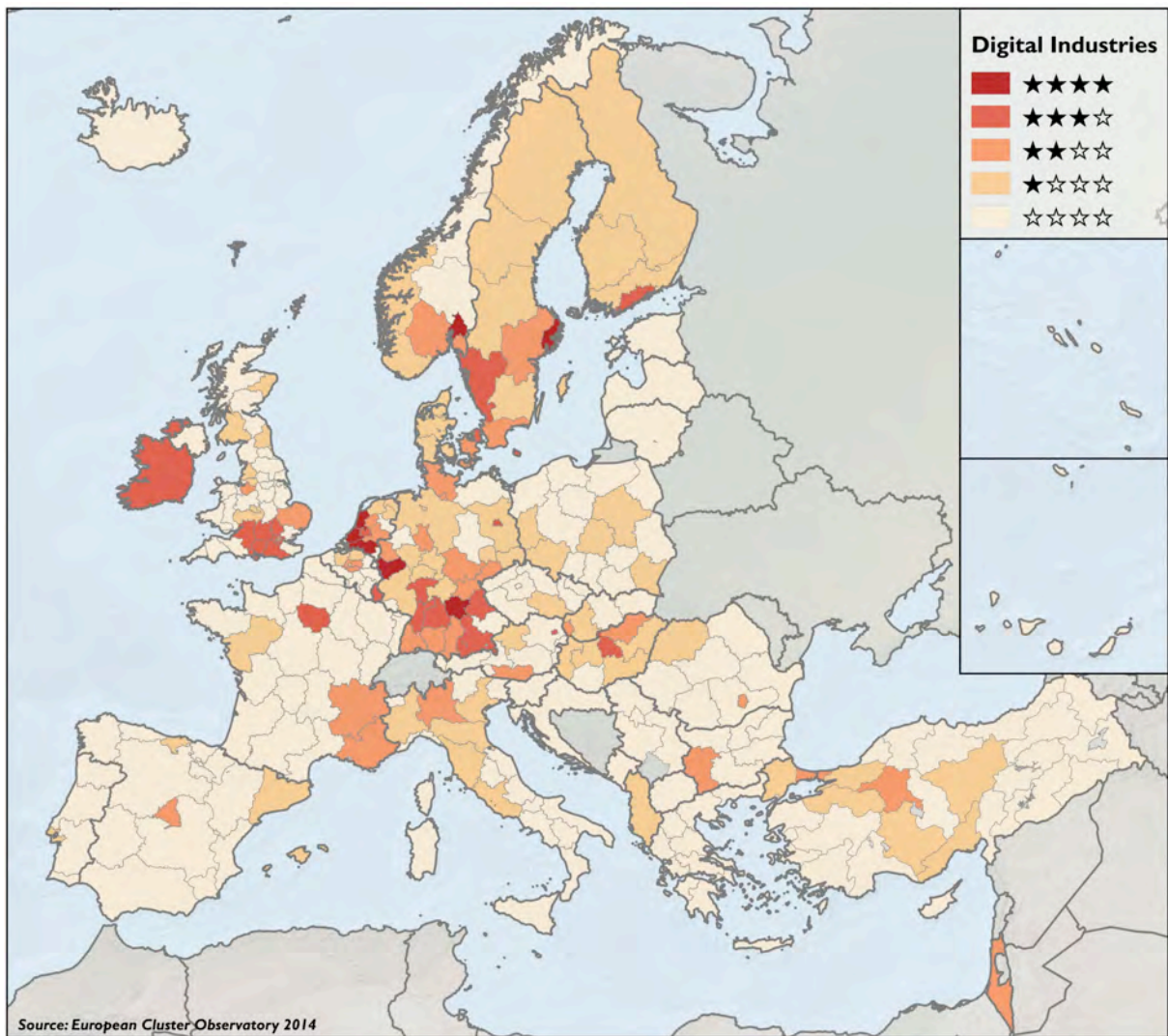
The regions strong in Digital industries are characterised with very high innovation levels, both in terms of research & development, and in terms of commercialisation of these inventions. The score for SME product and process innovations is 75% larger (0.66 compared to 0.37 overall) and the number of patents per million inhabitants is nearly four times larger 212 versus 54).

Digital Industries is by far the most common sector targeted by cluster initiatives. According to the European Cluster Observatory database, there are 261 cluster initiatives in Europe related to Digital Industries. Lyon with 9 organisations is the region with the most effort, while the second-place Aalborg follows with 6 organisations, but 18 times fewer employees. There are seven GOLD-labelled organisations in Digital Industries: BrainsBusiness in Denmark; Pole SCS and Systematic in France; CyberForum, Silicon Saxony and Software-Cluster in Germany; and Future Position X in Sweden.

Table 16: Cluster initiatives in Digital Industries

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
FR71	Rhône-Alpes	Lyon	9	75
DK05	Nordjylland	Aalborg	6	916
DE11	Stuttgart	Stuttgart	6	37
SE31	Norra Mellansverige	Gävle	5	335
SE22	Sydsverige	Malmö	5	148
GR30	Attiki	Athens	5	148
FR82	Provence-Alpes-Côte d'Azur	Marseille	5	105
ES51	Cataluña	Barcelona	5	44
FR10	Île de France	Paris	5	14
ES43	Extremadura	Mérida	4	1 263
ES70	Canarias	Tenerife	4	810
DE40	Brandenburg	Potsdam	4	162
HU21	Kozep-Dunantul	Székesfehérvár	4	160
FR52	Bretagne	Rennes	4	123
SE12	Östra Mellansverige	Uppsala	4	110
PL12	Mazowieckie	Warszawa	4	47
IE00	Ireland	Dublin	4	44
SE11	Stockholm	Stockholm	4	40

3.6   Environmental Industries

Basic Facts	Environmental Industries	Share of all traded clusters	Share of overall economy
Number of employees	8 597 431	12.50%	4.97%
Number of enterprises	961 055	9.87%	3.62%
Turnover (million EUR)	2 320 215	13.25%	6.69%
Value added per employee (EUR)	98 777	139.9%	159.6%
Average wage (EUR)	31 803	117.4%	140.3%

Environmental Industries are the most crosscutting of the ten selected industries, containing parts of 20 of the 51 cluster categories overall. Even if the size of its employment is average among the sectors, it is second in terms of both, turnover and value added, suggesting high capital intensity and productivity. The growth of the sector has seen both periods of increase and decrease and is now about 5% smaller than in 1996, though still ahead of the traded industries in general.

Figure 25: Evolution of Environmental Industries (Employment in 1996 = 100)
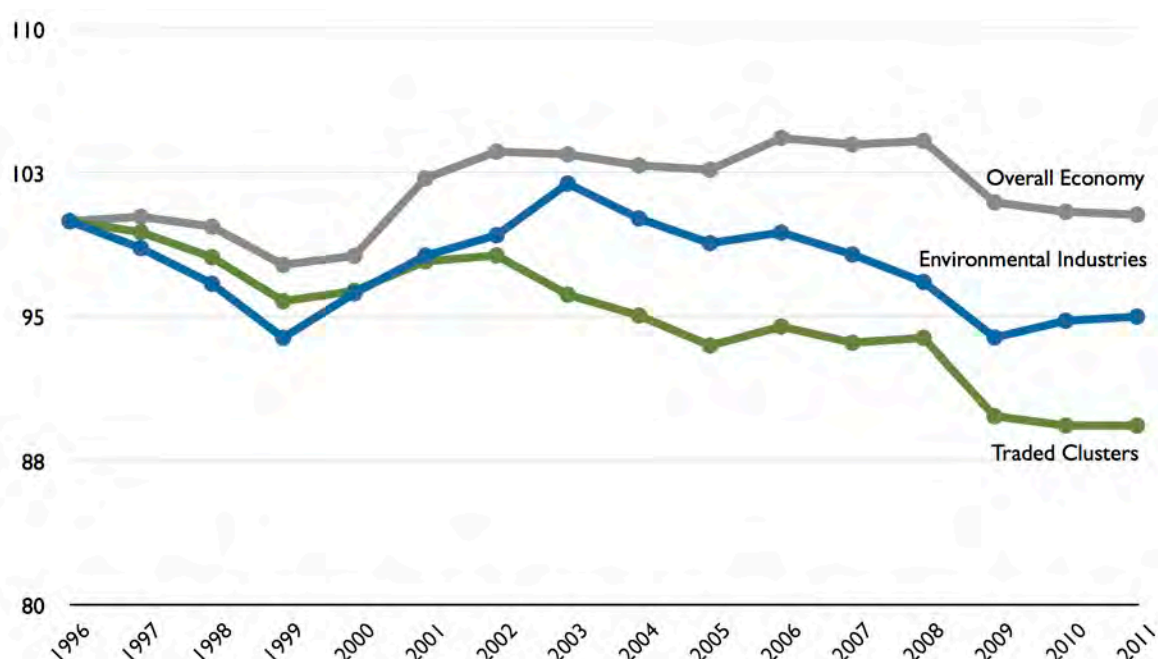
3.6.1   Industry at a Glance

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. This area is characterised by a high interdisciplinarity and high growth potential.

Figure 26: Environmental Industries composition (area corresponds to payroll share)

Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

The main sub-sectors are renewable energy; material and energy efficiency; waste management; reuse, recycling and remanufacturing; repair and maintenance; sharing economy, including renting and leasing; environmental services, including environmental engineering; water; and environmental protection On the one hand, elements of the green economy can be understood and approached as traditional vertical economic sectors (e.g. renewable energy production). On the other hand, the area includes the dimension of services, technologies or process that can serve - or create value for - any industrial sector (e.g. material and energy efficiency services can be applied in any manufacturing sector). The latter means that green economy by definition will include cross-sectoral collaboration.

3.6.2   Leading Clusters

Environmental technologies cut through many sectors and it is hard to pinpoint the single most important one. Most of the top regions are located in Germany (top 7 are all German) and the Nordic countries with Rheinland-Pfalz being the only one 4-star cluster. Most regions have 40 to 100 thou-

sand employees and other parameters are often quite similar as well, except for growth that varies more.

Figure 27: Leading regions in Environmental Industries

Source: European Cluster Observatory 2014
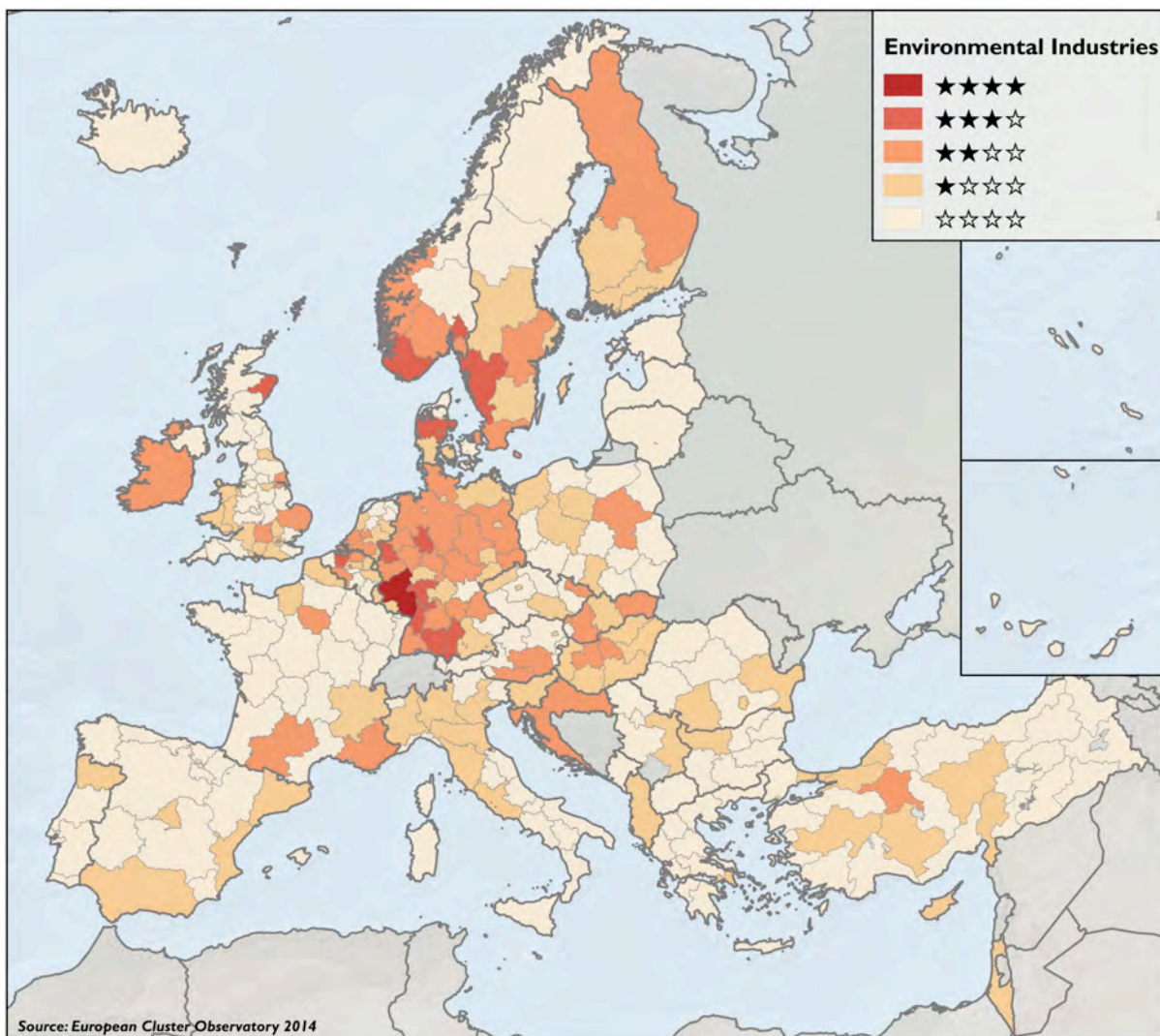
The profiles of the top regions are quite different and reflect their unique strengths. The German regions are strong in Production Technology, Metal and Chemical industries. The Nordic regions specialise more on Engineering and Transportation, while Kristiansand and Aberdeen even have Oil and Gas as their primary sector.

This set of strong regions significantly outperforms the regions in general in all metrics but for the heavy land use. Even if these regions perform the best among all emerging industries in terms of their environmental impact, the fact that this indicator is still worse than average suggests that having strong clusters in Environmental Industries does not necessarily imply strong sustainability, at least the way it can be measured right now.

Table 17: Europe's top clusters in Environmental Industries

#	Region	Name	Largest city	Employees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	DEB0	Rheinland-Pfalz	Mainz	105 874	1.73	43 322	5.85%	4
2	DEA1	Düsseldorf	Düsseldorf	160 259	1.70	44 559	-0.27%	3
3	DE71	Darmstadt	Frankfurt am Main	117 001	1.41	42 526	1.41%	3
4	DE12	Karlsruhe	Karlsruhe	101 544	1.65	38 446	2.74%	3
5	DE27	Schwaben	Augsburg	57 003	1.63	36 884	5.35%	3
6	DE14	Tübingen	Tübingen	56 501	1.43	38 866	2.24%	3
7	DEA4	Detmold	Detmold	54 093	1.33	35 950	2.50%	3
8	SE23	Västsverige	Göteborg	43 478	1.28	49 767	0.83%	3
9	UKM5	NE Scotland	Aberdeen	42 732	2.90	69 714	-0.66%	3
10	NO01	Oslo og Akershus	Oslo	40 026	1.29	100 364	9.58%	3
11	NO04	Agder og Rogaland	Kristiansand	39 273	2.26	112 337	16.33%	3
12	DK04	Midtjylland	Aarhus	30 672	1.46	68 178	2.91%	3
13	BE23	Oost-Vlaanderen	Gent	20 823	1.35	48 503	9.62%	3

Environmental industries have also been a target of substantial organised efforts with 180 organisations in the European Cluster Observatory database. They are spread all over Europe similarly to the clusters themselves, though Copenhagen is a clear leader with 9 organisations. Denmark is also home to two of five GOLD-labelled cluster organisations: Offshore Center Danmark and CLEAN. Additionally, Eco World Styria is in Austria while NCE Subsea and NCE NODE are both in Norway.

Table 18: Cluster initiatives in Environmental Industries

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
DK01	Hovedstaden	Copenhagen	9	195
HU31	Eszak-Magyarorszag	Miskolc	4	226
ES52	Valencia	Valencia	4	89
DE12	Karlsruhe	Karlsruhe	4	39
FR71	Rhône-Alpes	Lyon	4	38
HU32	Eszak-Alfold	Debrecen	3	188
HU22	Nyugat-Dunantul	Györ	3	160
RO11	Nord-Vest	Cluj	3	121
FR41	Lorraine	Metz	3	104
ES11	Galicia	A Coruña	3	99
ITG1	Sicilia	Palermo	3	99
RO12	Centru	Brasov	3	73
IE00	Ireland	Dublin	3	71
DEG0	Thüringen	Erfurt	3	58
UKH1	E Anglia	Ipswich	3	56
ITC1	Piemonte	Turin	3	41
ES30	Madrid	Madrid	3	36

3.7 Experience Industries

Basic Facts	Experience Industries	Share of all traded clusters	Share of overall economy
Number of employees	10 043 510	14.61%	5.81%
Number of enterprises	2 362 225	24.26%	8.89%
Turnover (million EUR)	1 414 926	8.08%	4.08%
Value added per employee (EUR)	62 809	88.9%	101.5%
Average wage (EUR)	26 045	96.1%	114.9%

Experience Industries combine creation and consumption of cultural products and services and employs more than 10 million people. Similarly to Creative Industries, the average size of a firm is rather small at 4.3 employees suggesting a structure based predominantly on SMEs. The productivity levels are generally in line with the traded and overall economy, though second lowest among the emerging industries. The growth of the sectors exhibits strong patterns, but it is possible that they are a result of data irregularities.

Figure 28: Evolution of Experience Industries (Employment in 1996 = 100)
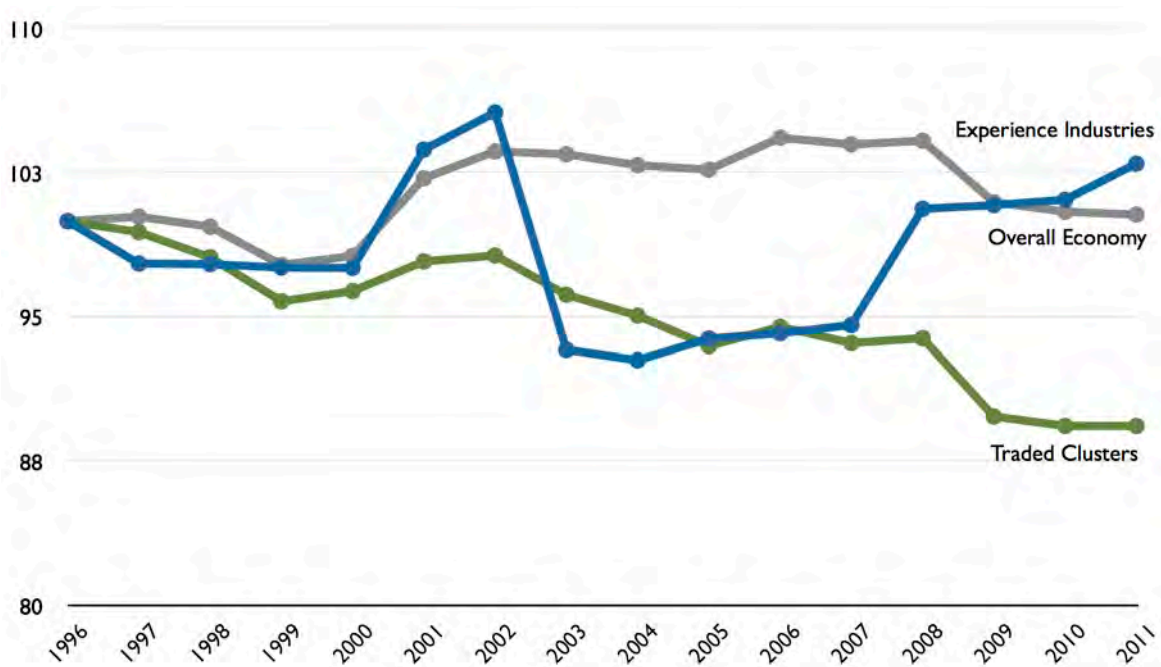
3.7.1   Industry at a Glance

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"[42]. 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".[43] The underlying two key aspects of the experience economy are thus activities associated with creation and consumption of such experiences.

Figure 29: Experience Industries composition (area corresponds to payroll share)
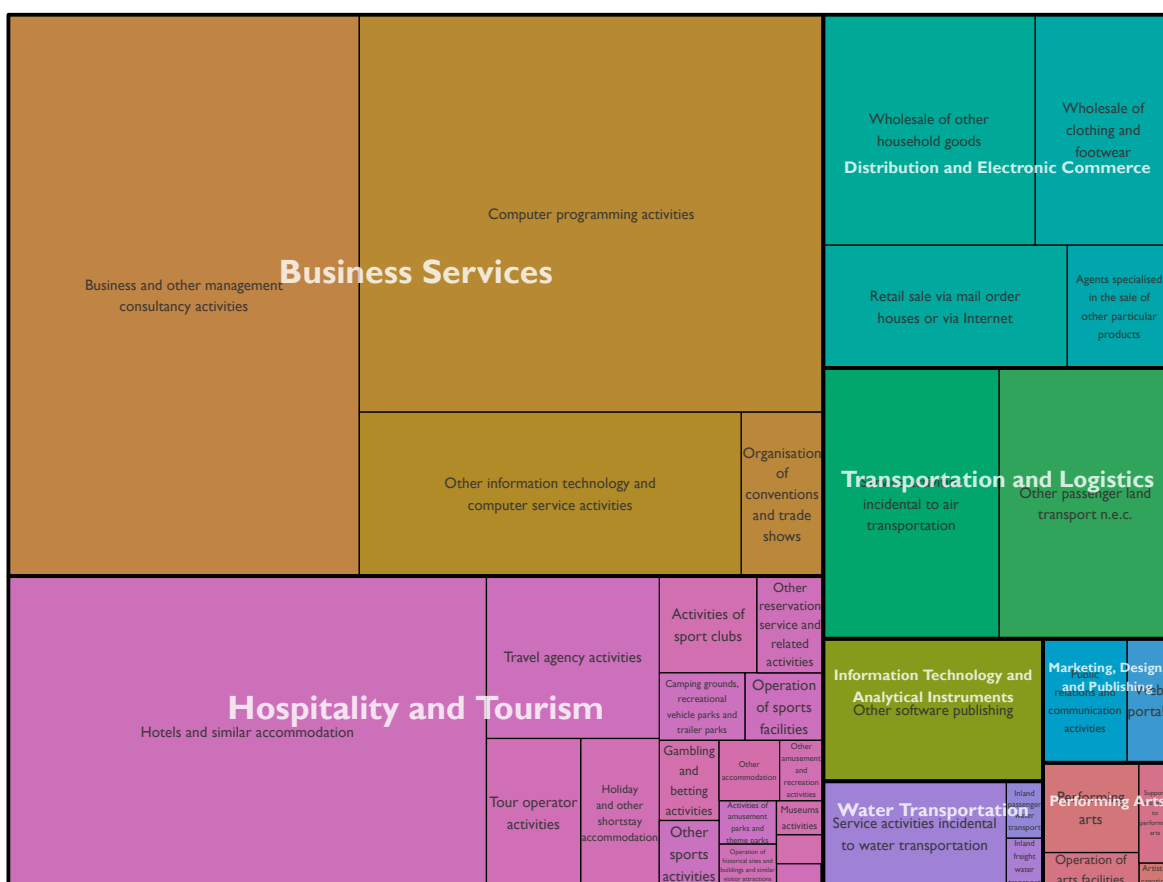
Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

The *consumption* part is closely related to hospitality, tourism and performing arts, and in particular refers to activities that can be performed 'on the spot', such as visiting sport events, theme parks, museums, theatres and galleries. This aspect also relies substantially on support industries, particularly on retail trade and passenger transportation. In fact, water transport could often serve both the main and the support functions, exemplified by the leisure boats. Business and cultural activities are con-

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[42] *'European Cluster Observatory (2012) "Emerging industries": report on the methodology for their classification and on the most active, significant and relevant new emerging industrial sectors.'*

43 European Cluster Observatory (2011) Priority Sector Report: Experience Industries" The report identified a similar figure of about 9.8 million people being employed in experience industries in the EU-27 and EFTA.

verging to some degree as well as organisation of conventions and trade shows became one of the largest employers.

The *creation* aspect of the experience economy is related to creative and cultural industries and comprises activities resulting in creation of cultural artefacts. This area is traditionally based on design and artistic creation, however in recent years the role of software and web sites has become increasingly more prominent. Creation also relies on its own set of support industries, including e-commerce, software publishing and management consultancy, further suggesting that Experience Industries lie at the intersection of art and business.

3.7.2   Leading Clusters

Given the overall dichotomy between creation and consumption of the experiences, it is only reasonable that the top two regions in Experience Industries are the ones that are strong in both: London and Amsterdam. In fact, most of the strong clusters in Northern Europe, particularly in United Kingdom, rely on computer-related services and performing arts to claim their high positions.

Table 19: Europe's top clusters in Experience Industries

#	Region	Name	Largest city	Employ-ees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	UKI1	Inner London	Inner London	315 106	1.96	52 094	3.40%	4
2	NL32	Noord-Holland	Amsterdam	83 970	1.63	35 828	6.92%	4
3	UKI2	Outer London	Outer London	132 259	1.75	45 592	1.88%	3
4	ES70	Canarias	Tenerife	121 471	3.88	20 463	3.33%	3
5	UKJ2	Surrey, E and W Sussex	Brighton	116 816	1.97	39 365	1.07%	3
6	TR61	Antalya	Antalya	110 397	3.28	5 961	21.82%	3
7	UKJ1	Berks, Bucks and Oxon	Oxford	104 082	1.55	48 392	-0.24%	3
8	HU10	Kozep-Magyarorszag	Budapest	98 739	1.45	11 059	10.63%	3
9	SE11	Stockholm	Stockholm	86 300	1.79	50 394	0.59%	3
10	FR82	Provence-Alpes-Côte d'Azur	Marseille	81 806	1.44	32 344	0.87%	3
11	UKJ3	Hants and Isle of Wight	Southampton	75 620	1.81	39 877	0.95%	3
12	UKH2	Beds and Herts	Luton	59 644	1.61	40 007	1.21%	3
13	UKL1	W Wales and The Valleys	Gwynedd	50 058	1.85	17 635	2.86%	3
14	TR32	Aydin	Aydin	49 703	1.63	4 791	9.83%	3
15	NL31	Utrecht	Utrecht	39 685	1.68	39 113	9.39%	3

Conversely, the regions in the South and East have a stronger component of tourism and leisure transportation. They are usually also more specialised: both Canary Islands and Antalya in Turkey have very high location quotients largely due to a strong tourism sector. These regions are in general rather close to the average and are perhaps a bit poorer than strong regions in other industries. However, they score very high on both SME-related indicators, especially on product and process innovations, and have considerably higher life satisfaction rates.

Figure 30: Leading regions in Experience Industries
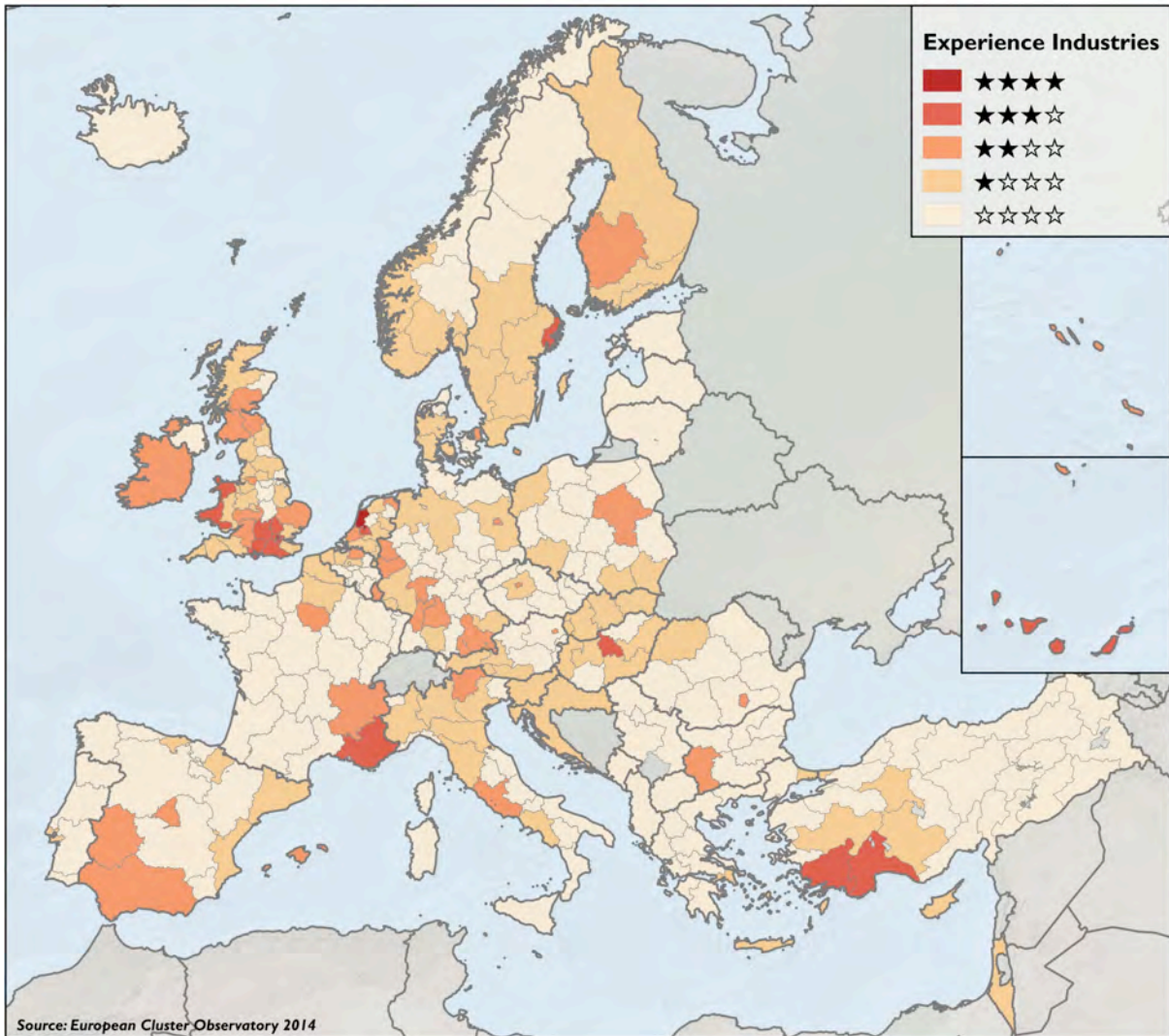
Experience Industries are also attracting substantial organisational action with 90 organisations in Europe. They are spread all across Europe with Zilina in Slovakia and Venice in Italy each having 5 organisations, though the relative effort per employee is much higher in the former region.

Table 20: Cluster initiatives in Experience Industries

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
SK03	Stredne Slovensko	Zilina	5	292
ITD3	Veneto	Venice	5	58
DK05	Nordjylland	Aalborg	4	586
BG41	Yugozapaden	Sofia	4	59
ES30	Madrid	Madrid	4	19
HU31	Eszak-Magyarorszag	Miskolc	3	346
DE40	Brandenburg	Potsdam	3	99

3.8   Logistical Services

Basic Facts	Logistical Services	Share of all traded clusters	Share of overall economy
Number of employees	6 344 855	9.23%	3.67%
Number of enterprises	1 206 532	12.39%	4.54%
Turnover (million EUR)	837 937	4.78%	2.42%
Value added per employee (EUR)	62 688	88.8%	101.3%
Average wage (EUR)	22 390	82.6%	98.8%

Logistical Services is an industry based on Transportation and Logistics cluster with addition of several supporting industries. It has grown by more than 15% since 1996, though most of the growth occurred in the beginning of the previous decade and the employment level has been rather constant ever since at about 6.5 million. Logistical Services have the lowest productivity among the emerging industries and is the only industry to have average wage below the level of the economy at large.

Figure 31: Evolution of Logistical Services industry (Employment in 1996 = 100)
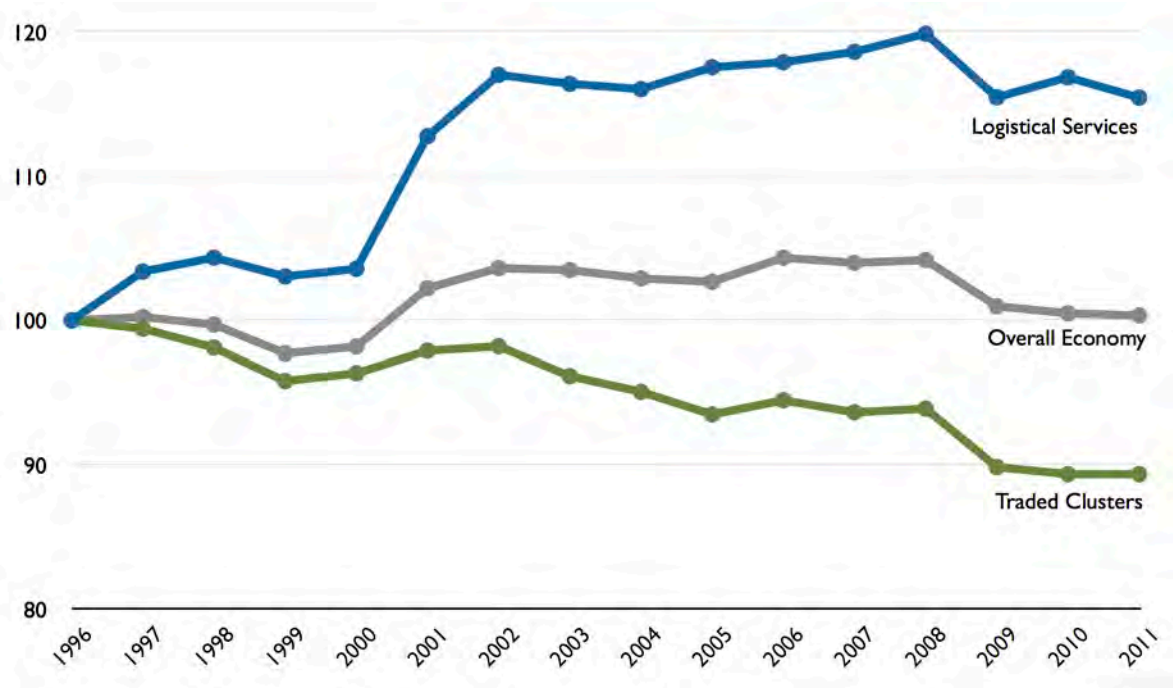
3.8.1   Industry at a Glance

Logistics is the management of the flow of goods or people and the actual process of transport be-tween a starting point and a specific destination land-, air-based or space-based. Furthermore all aux-iliary 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 provi-sion of IT-systems for the logistics planning, organisation, and management.

Figure 32: Logistical Services industry composition (area corresponds to payroll share)
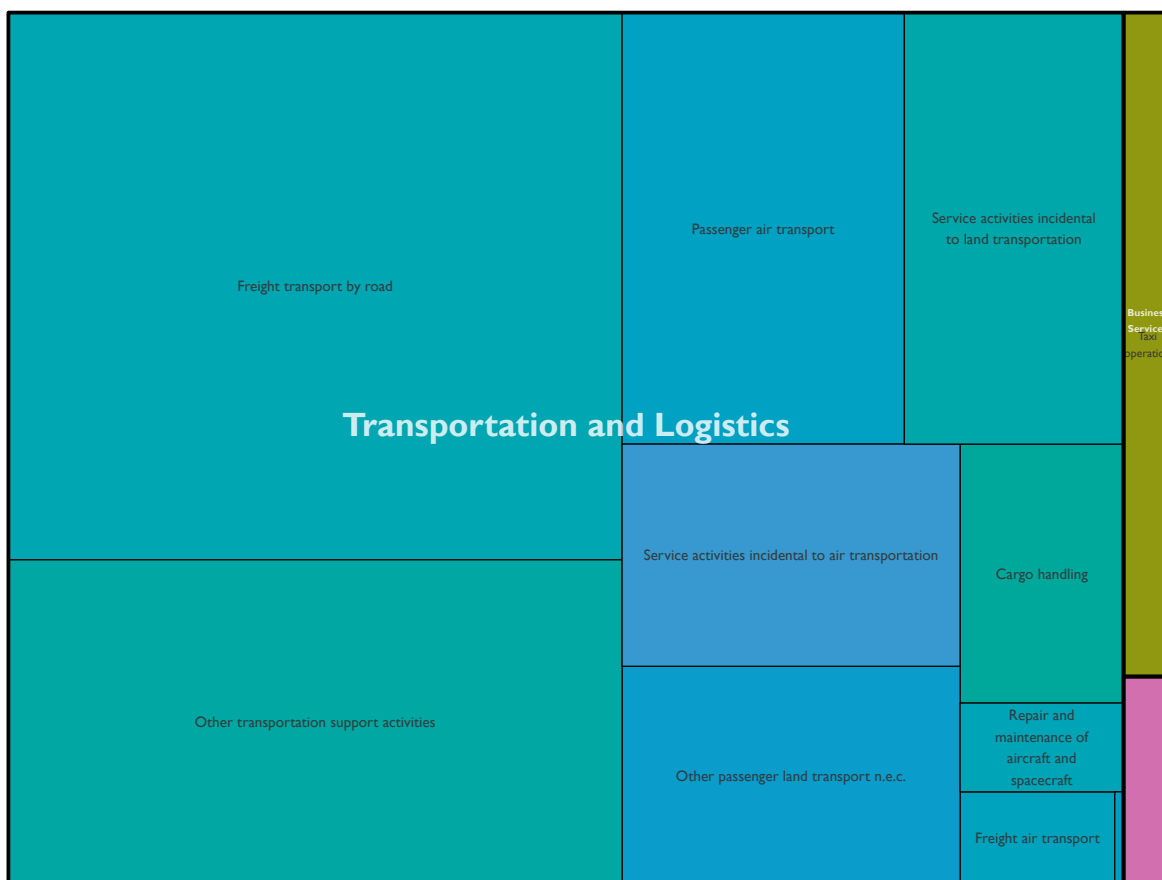
Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

The development and manufacturing of vehicles and logistical equipment including all earlier process-es for the value chain will not be considered as part of this industry. Vehicle manufacturing is consid-ered to be the core of the Mobility Technologies. Intra-logistics, meaning logistics within one organisa-tion or facility, complementing for example a production process, as well should not be considered here.

3.8.2   Leading Clusters

The leading Logistical Services clusters are located in the areas with large airports and seaports, such as Amsterdam, Outer London, Oslo and Rotterdam. The traditional logistical hubs in Benelux and

around Vienna are both represented by multiple regions, though overall the size of the largest clusters is modest relative to other emerging industries.

Figure 33: Leading regions in Logistical Services

Source: European Cluster Observatory 2014
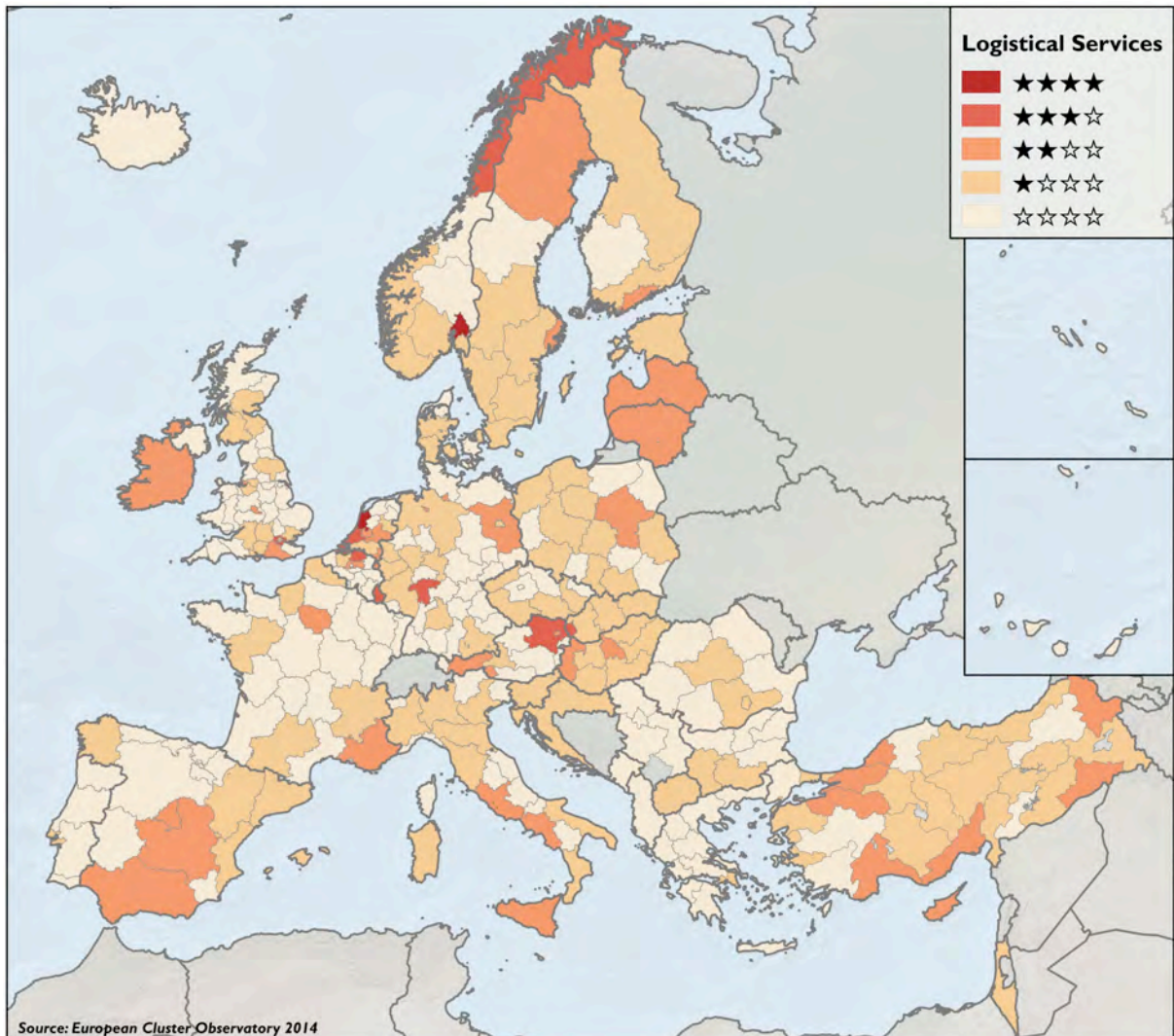
These regions score the lowest on environmental sustainability; at least in part due to the effect logistical infrastructure has on land use. On the other hand, the labour force participation rates are high and unemployment is low in all brackets suggesting relatively high levels of social inclusion.

Table 21: Europe's top clusters in Logistical Services

#	Region	Name	Largest city	Em-ployees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	NL32	Noord-Holland	Amsterdam	44 490	1.37	42 541	7.01%	4
2	NO01	Oslo og Akershus	Oslo	33 278	1.45	70 941	8.25%	4
3	DE71	Darmstadt	Frankfurt am Main	93 257	1.52	46 570	1.90%	3
4	UKI2	Outer London	Outer London	82 867	1.74	45 680	1.28%	3
5	NL33	Zuid-Holland	Rotterdam	48 841	1.34	39 543	1.26%	3
6	SK01	Bratislavsky kraj	Bratislava	31 626	1.82	9 351	25.35%	3
7	BE21	Antwerpen	Antwerpen	30 140	1.54	37 740	2.54%	3
8	AT12	Niederösterreich	St. Pölten	28 894	1.66	35 017	-0.60%	3
9	LU00	Luxembourg	Luxembourg	19 648	2.18	45 263	4.46%	3
10	NO07	Nord-Norge	Tromsø	9 077	2.61	53 021	4.44%	3
11	NL34	Zeeland	Middelburg	7 164	1.58	34 159	12.53%	3

In total there are 92 cluster initiatives in Logistical Services in Europe, Veneto being a clear leader with 9. Interestingly, there is little intersection between the regions with the highest effort and the regions with the strongest underlying clusters.

Table 22: Cluster initiatives in Logistical Services

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
ITD3	Veneto	Venice	9	132
HU22	Nyugat-Dunantul	Györ	4	203
FR71	Rhône-Alpes	Lyon	4	62
DK03	Syddanmark	Odense	3	218
ES21	País Vasco	Bilbao	3	159
SE23	Västsverige	Göteborg	3	113
DE90	Niedersachsen	Hannover	3	36

3.9 Medical Devices

Basic Facts	Medical Devices	Share of all traded clusters	Share of overall economy
Number of employees	4 373 575	6.36%	2.53%
Number of enterprises	260 031	2.67%	0.98%
Turnover (million EUR)	1 009 199	5.76%	2.91%
Value added per employee (EUR)	68 891	97.5%	111.3%
Average wage (EUR)	33 606	124.0%	148.2%

The Medical Devices emerging industry extends the cluster category of the same name to include precision instruments, machinery, and supporting services. It is characterized by relatively large enterprises (17 employees on average compared to 6.7 in emerging industries in general) and high wages, though value added figures are similar to the traded clusters as a whole. The Medical Devices industry has been growing at roughly the same pace as the traded industries, though recently it has outstripped them significantly.

Figure 34: Evolution of Medical Devices industry (Employment in 1996 = 100)
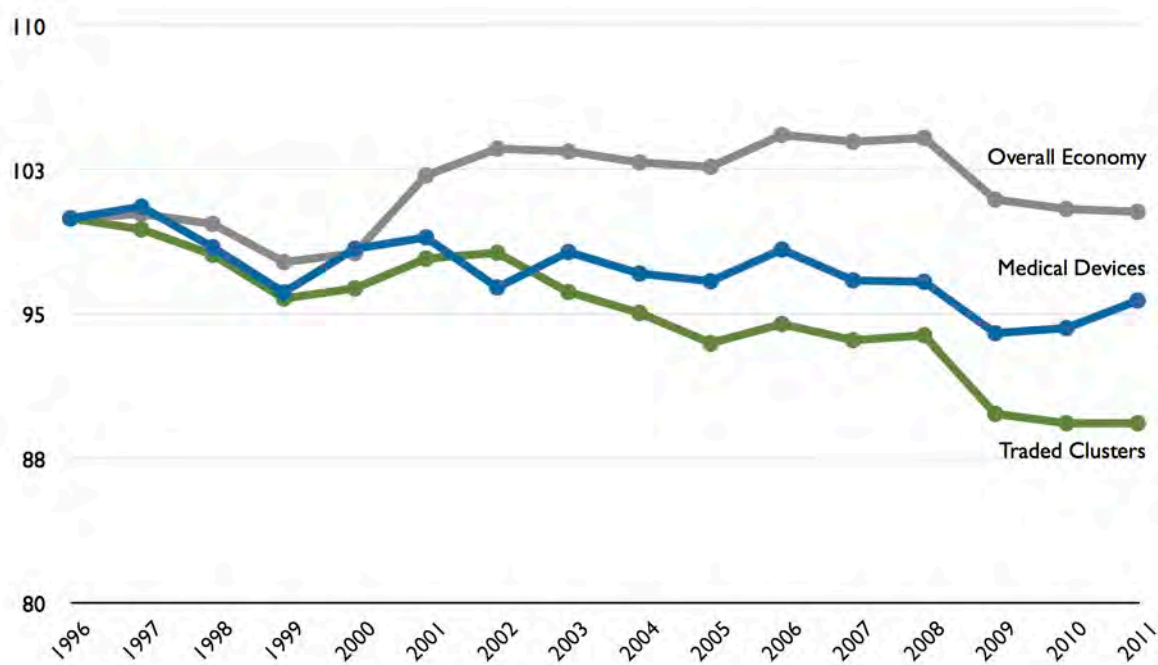
3.9.1 Industry at a Glance

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. This industry is characterized by a high interdisciplinarity with extremely high innovation dynamics.

Figure 35: Medical Devices industry composition (area corresponds to payroll share)

Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

A 'medical device' is an instrument, apparatus, implant, machine, appliance, in vitro reagent or calibrator, software, material, etc. that is intended by the manufacturer to be used, alone or in combination, for human beings, for one or more of the specific purpose(s) of…

- diagnosis, prevention, monitoring, treatment or alleviation of disease,

- diagnosis, monitoring, treatment, alleviation of or compensation for an injury,

- investigation, replacement, modification, or support, of the anatomy or of a physiological process,

- support or sustaining life,

- control of conception,

- disinfection of medical devices,

- providing information for medical or diagnostic purposes by means of in-vitro examination of specimens derived from the human body,

and which does not achieve its primary intended action in or on the human body by pharmaceutical, immunological or metabolic means, but which may be assisted in its intended function by such means.[44]

Following this approach Medical Devices includes manufacturers of electromedical and electrotherapeutic apparatus, such as magnetic resonance imaging equipment, medical ultrasound equipment, pacemakers, hearing aids, electrocardiographs, and electromedical endoscopic equipment. Also included are manufacturers of several irradiation apparatus and tubes for applications such as medical diagnostic, medical therapeutic, industrial, research and scientific evaluation.

Products in the Medical Device industry are generally based on interdisciplinary engineering, taking advantage of a wide cross-section of technologies, including mechanical, electrical, and materials-based engineering, as well as biotechnology and other sciences. The products often are designed and developed with clinicians, to perform certain functions based on a broad spectrum of physical means.[45]

Table 23: Europe's top clusters in Medical Devices

| #	Region	Name	Largest city	Em-ployees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	DE25	Mittelfranken	Nürnberg	55 138	2.67	49 620	10.97%	4
2	DE26	Unterfranken	Würzburg	27 137	1.99	42 542	4.03%	4
3	NL41	Noord-Brabant	Eindhoven	26 123	1.36	52 857	4.53%	4
4	DE11	Stuttgart	Stuttgart	116 618	2.29	46 990	2.50%	3
5	DE21	Oberbayern	München	75 633	1.46	51 095	0.11%	3
6	DE12	Karlsruhe	Karlsruhe	74 136	2.37	44 916	2.24%	3
7	DEA1	Düsseldorf	Düsseldorf	68 427	1.43	44 052	2.02%	3
8	DE14	Tübingen	Tübingen	58 129	2.89	44 531	2.03%	3
9	DE71	Darmstadt	Frankfurt am Main	56 199	1.33	48 361	1.13%	3
10	IE00	Ireland	Dublin	50 264	1.93	44 312	1.28%	3
11	DEA2	Köln	Köln	48 645	1.27	43 235	4.13%	3
12	DE27	Schwaben	Augsburg	42 746	2.41	41 533	4.34%	3
13	DEG0	Thüringen	Erfurt	41 383	2.29	30 587	4.70%	3
14	DE23	Oberpfalz	Regensburg	40 068	3.58	42 072	7.43%	3
15	DEF0	Schleswig-Holstein	Kiel	36 057	2.00	44 027	2.26%	3
16	DE30	Berlin	Berlin	34 326	1.35	41 062	8.53%	3
17	DEA3	Münster	Münster	28 404	1.49	38 808	5.47%	3
18	DE60	Hamburg	Hamburg	23 777	1.00	48 803	5.03%	3
19	DED1	Chemnitz	Chemnitz	23 733	1.84	25 591	8.15%	3
20	FI1B	Helsinki-Uusimaa	Helsinki	22 406	1.49	54 616	-0.41%	3
21	SE12	Östra Mellansv.	Uppsala	20 961	1.83	50 381	-0.67%	3
22	AT21	Kärnten	Klagenfurt	10 616	2.54	45 019	4.76%	3

[44] *Medical Technology: Key facts and figures 2013, Medical Technology Association of Australia Limited (MTAA), 2013, p. 5*

[45] *In contrast to prescription drugs, medical devices do not achieve their primary therapeutic or diagnostic purpose by way of a chemical reaction with a bodily process.*

Examples of medical devices are e.g. pacemakers, artificial heart valves, diagnostic and imaging equipment, in vitro diagnostics, equipment for dialysis, hip or knee implants, synthetic skin, surgical tools, infusion pumps, life support machines, exe-skeletons, catheters, bandages, plasters as well as applied information and communications technologies. The complexity of medical device products continues to increase with the inclusion of multiple technologies into a given product. Technologies such as advanced, tailored materials, microelectronics, biotechnology, and software and informatics are also important technologies featured in medical devices.

Worldwide, more than 27.000 companies are active in this area, when counting Original Equipment Manufacturers (OEMs) only and not considering the entire value chain of suppliers. These companies contribute with an extremely high value to their national economies. Currently, the United States and Europe have numerous well-performing companies. However, the industry is subject to several influential trends. The regional distribution of interesting markets varies, the sources of innovation are shifting and also the proven business concepts require revision.

Figure 36: Leading regions in Medical Devices
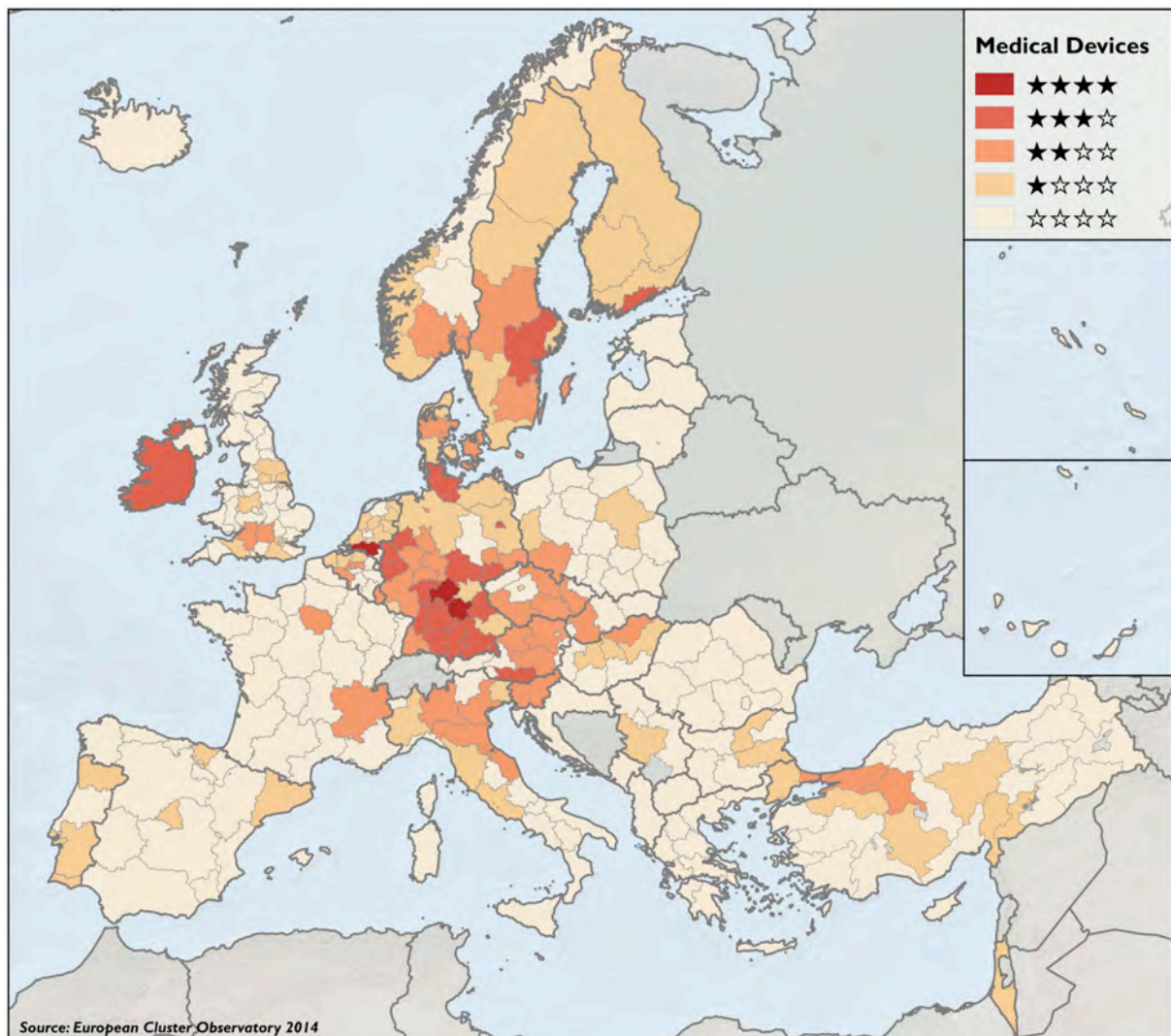
3.9.2 Leading Clusters

The Medical Devices industry is concentrated in Germany with 17 out of 22 strong clusters, particularly in its southern part - this despite traditionally strong regions, such as Freiburg, not even making the cut due to low growth and wages below the threshold. Mittelfranken is Europe's strongest Medical Devices cluster and despite its relatively large size at 55 000 employees it grows at an annualised rate of 10%. Other large clusters are in Stuttgart, Munich and Karlsruhe with more than 70 000 each, while the only two large clusters outside of Germany are Eindhoven and Dublin.

The clusters with the strongest core Medical Devices component are Dublin and Hamburg, while other regions have strong auxiliary industries, mostly related to Analytical Instruments and Machinery. The regions strong in Medical Devices are overall highly innovative and register very high patenting (2 730 per person in Science & Technology versus the average of 686) and commercialisation of products (0.64 versus 0.37). They are also socially inclusive with very low youth unemployment at just 9% (versus 21%) and happy with life satisfaction rate at 7.8 (versus 6.8).

The Medical Devices industry is served by 205 cluster initiatives in Europe – the second highest number among the emerging industries. The clear leader is Lyon with 13 organisations, though Odense in Denmark has a lot more relative effort based on the number of employees in Medical Devices. Odense is also home to the only GOLD-labelled cluster in the Health and medical science category: Welfare Tech. There are another three organisations in a related category of 'Micro, nano and optical technologies': Minalogic in France, as well as Photonics BW and MST BW Mikrosystemtechnik in Germany.

Table 24: Cluster initiatives in Medical Devices

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
FR71	Rhône-Alpes	Lyon	13	184
DK03	Syddanmark	Odense	7	757
DE30	Berlin	Berlin	6	175
DE12	Karlsruhe	Karlsruhe	6	80
DE80	Mecklenburg-Vorpommern	Rostock	5	543
SE12	Östra Mellansverige	Uppsala	5	239
DK01	Hovedstaden	Copenhagen	5	226
DEA5	Arnsberg	Dortmund	5	101
ES62	Murcia	Murcia	4	1 856
ES41	Castilla y León	Valladolid	4	853
FR72	Auvergne	Clermont-Ferrand	4	765
BE10	Brussels	Brussels	4	592
FR24	Centre	Orléans	4	221
FI1B	Helsinki-Uusimaa	Helsinki	4	179
ITC1	Piemonte	Turin	4	85
FR10	Île de France	Paris	4	43

3.10   Mobility Technologies

Basic Facts	Mobility Technologies	Share of all traded clusters	Share of overall economy
Number of employees	10 658 541	15.50%	6.17%
Number of enterprises	593 814	6.10%	2.23%
Turnover (million EUR)	2 565 817	14.65%	7.40%
Value added per employee (EUR)	66 159	93.7%	106.9%
Average wage (EUR)	30 907	114.0%	136.3%

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. It is characterised by large enterprises (18 employees on average) and high turnover, where Mobility Technology is the largest among all emerging industries in this report. It had a stable employment at 11-12 million for most of the past decades, but it was affected strongly by the recession that saw a 6% drop in 2008 alone.

Figure 37: Evolution of Mobility Technologies industry (Employment in 1996 = 100)
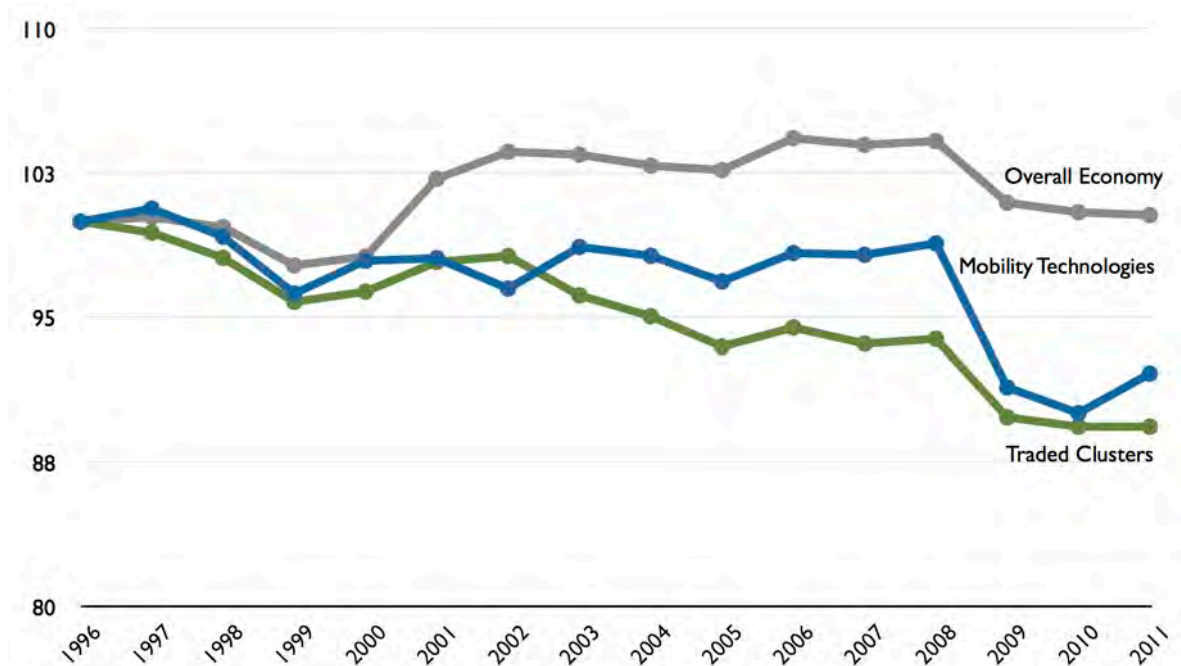
3.10.1   Industry at a Glance

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 38: Mobility Technologies industry composition (area corresponds to payroll share)

Distinct colours with white labels correspond to cluster categories, while colour shades and black labels depict the constituent narrow industries. Unlabelled cells correspond to marginal industries in terms of payroll share.

Examples of emerging mobility technologies are predominantly bundled under the so-called 'smart mobility' trends, which involve the development of cleaner energy fuelling and more energy efficient solutions. In the last decade, new forces have been reshaping the mobility industry, adding significant complexity to business models of stakeholders. For example, the automotive industry traditionally focussed on the design and production of cars, while having added complementary financial services for the purchase of cars. Nowadays, the automotive industry is facing and tackling the rise of climate change awareness, the emergence of new technologies and customer preferences, the demographic evolution and infrastructure limits, which leads to increased complexity and new players entering the market.. In light of those trends, already 73% of manufacturers have put emphasis on the expansion of their value chain or on diversification (KPMG, 2013).

Many governments are promoting cleaner transportation, by emphasizing on resources preservation and environmental compatibility (Ernst & Young, 2013). The design of hybrid, electrified or zero-emission vehicles illustrates the need for cross-sectoral linkages by the involvement, for instance, of energy and automotive industries as a means to meet objectives of governments and manufacturers.

For the analysis of the European Cluster Observatory, a focus was placed on the movement of people by the different modes such as road, rail and air transport[46]. The industries under Mobility Technologies include manufacturers of transport vehicles and their first and second tier suppliers of components and service providers of passenger transport.

Table 25: Europe's top clusters in Mobility Technologies

| #	Region	Name	Largest city	Employploy-ees 2012	Location Quotient 2012	Average Wage 2012	Annual Growth 2007-2012	Stars
1	DE14	Tübingen	Tübingen	121 030	2.49	42 678	2.50%	4
2	DE27	Schwaben	Augsburg	100 378	2.34	42 380	3.25%	4
3	DE23	Oberpfalz	Regensburg	79 187	2.92	42 009	9.98%	4
4	DE11	Stuttgart	Stuttgart	329 460	2.67	49 720	-0.15%	3
5	DE90	Niedersachsen	Hannover	261 991	1.70	41 848	-0.20%	3
6	DE21	Oberbayern	München	177 845	1.42	58 902	0.80%	3
7	DE12	Karlsruhe	Karlsruhe	144 026	1.90	42 276	0.53%	3
8	DE25	Mittelfranken	Nürnberg	99 585	1.99	44 142	-0.96%	3
9	TR41	Bursa	Bursa	95 385	1.61	11 215	4.27%	3
10	TR42	Kocaeli	Kocaeli	85 060	1.67	12 507	2.92%	3
11	SK02	Zapadne Slov-ensko	Nitra	82 336	1.82	9 039	2.91%	3
12	DEG0	Thüringen	Erfurt	79 518	1.82	27 138	3.07%	3
13	DE26	Unterfranken	Würzburg	77 553	2.35	43 204	-1.55%	3
14	AT31	Oberösterreich	Linz	71 024	1.95	45 102	0.04%	3
15	DE22	Niederbayern	Landshut	70 715	2.71	41 560	2.06%	3
16	RO42	Vest	Timisoara	70 394	1.98	5 442	4.84%	3
17	DED1	Chemnitz	Chemnitz	68 964	2.20	26 590	3.21%	3
18	SE23	Västsverige	Göteborg	65 351	1.56	47 858	-3.15%	3
19	DEC0	Saarland	Saarbrücken	60 265	2.64	41 582	-0.20%	3
20	SE12	Östra Mellans-verige	Uppsala	54 800	1.98	47 881	-2.40%	3
21	DE24	Oberfranken	Bayreuth	51 791	1.84	33 922	2.22%	3
22	BE23	Oost-Vlaanderen	Gent	30 439	1.60	44 600	4.96%	3

3.10.2 Leading Clusters

Not surprisingly, the strong Mobility Technology clusters are located in areas of traditional automotive strength, though regions that are also strong in related industries score higher. Stuttgart is the largest cluster followed by Niedersachsen, though they all have small negative growth and thus only received three stars. The three 4-star clusters, Tübingen, Schwaben and Oberpfalz, all have very similar scores, though benefitting from the tendency that the smaller a region the faster it grows.

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[46] *For the movement of goods see the description of: Logistics. For the maritime sector see the description of: Blue Growth*

The strong clusters outside Germany are in Turkey, Slovakia, Austria, Romania, Sweden and Belgium. All of these, aside from the Swedish ones, are growing quite rapidly.

The vast majority of all clusters have Automotive as the core category usually followed by Production Technology or Metalworking. Interestingly, Mittelfranken has a high score in Analytical Instruments, perhaps highlighting a potentially interesting cross-sectoral collaboration.

Figure 39: Leading regions in Mobility Technologies
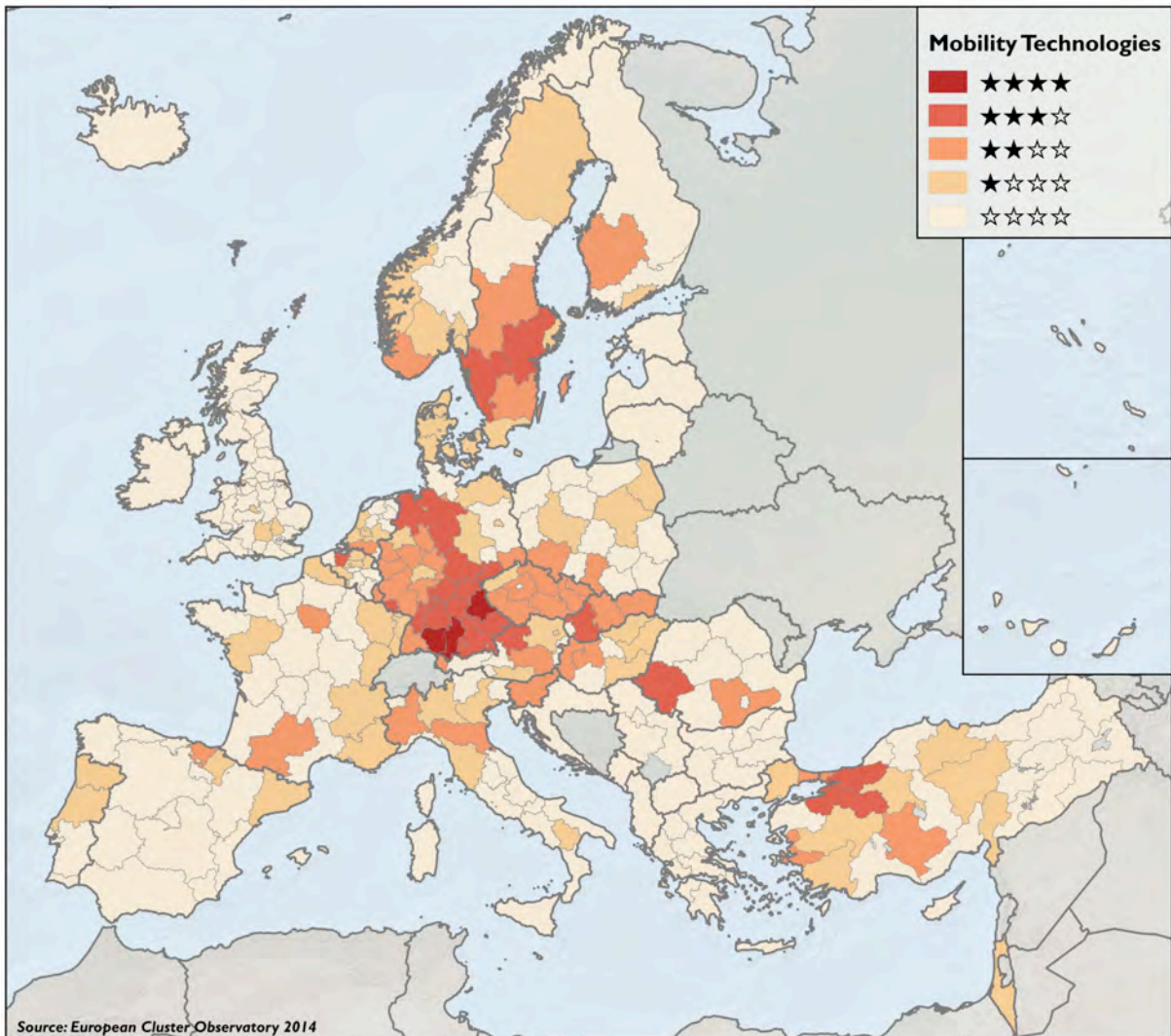
The regions strong in Mobility Technologies are relatively export-oriented (the share of GDP exported is 46% vs 20% overall) and innovative (the number of patents per million employees in Science & Technology is the highest at 2 900 compared to 686). These regions score high on social inclusion indicators like labour force participation and unemployment, though, as in all other emerging industries, the environmental performance is quite low.

Table 26: Cluster initiatives in Mobility Technologies

Region	Name	City	Number of Initiatives	Initiatives per Million Employees
ITD3	Veneto	Venice	10	61
SE23	Västsverige	Göteborg	7	107
DE12	Karlsruhe	Karlsruhe	7	49
SI00	Slovenija	Ljubljana	6	80
FR71	Rhône-Alpes	Lyon	6	38
DE90	Niedersachsen	Hannover	6	23
ITC4	Lombardia	Milan	6	17
DED1	Chemnitz	Chemnitz	5	73
FR10	Île de France	Paris	5	30
ES70	Canarias	Tenerife	4	3 189
BG41	Yugozapaden	Sofia	4	165
DE40	Brandenburg	Potsdam	4	107
AT31	Oberösterreich	Linz	4	56
ITD5	Emilia-Romagna	Bologna	4	23
ES61	Andalucía	Sevilla	3	106
ITE1	Toscana	Florence	3	52
FR51	Pays de la Loire	Nantes	3	44

Mobility Technologies has attracted substantial organisational effort with 199 initiatives in Europe choosing it as their focus. Here, many of the strong clusters also exhibit strong organisational action, for example Gothenburg, Karlsruhe, Hannover, Linz and others. Among the GOLD-labelled initiatives, four are in Mobility Technologies: LUTB Transport & Mobility System in France, CEAGA in Spain, as well as Cluster Elektromobilität Süd-West and Logistik-Initiative Hamburg in Germany.

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

http://ec.europa.eu/enterprise/initiatives/cluster/observatory/

Enterprise and
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