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"Emerging industries": report on the methodology for their classification and on the most active, significant and relevant new emerging industrial sectors

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Executive Summary

The objective of this study and the first task to be performed as part of the third phase of the European Cluster Observatory (ECO III) is to identify, determine the characteristics of and develop a **classification system for "emerging industries"**. These are industrial sectors, typically based on new products, services, technologies or ideas, which are in early stage development and are characterised by high-growth rates and market potential. The specific aims are to:

- Provide a sound and robust methodological underpinning for the identification, definition, composition and delimitation of those economic sectors that will be considered as "emerging industries";
- Propose a robust and consistent classification system for a limited number of key emerging industries.

Following a brief introduction which sets the context for ECO III, chapter 2 outlines our understanding of the development of new emerging industries. It introduces the key characteristics of emerging industries in the context of the industry life cycle. This chapter also discusses traditional industry classifications and their limitations for capturing the kinds of transformations in the market that characterise emerging industries. We propose **four approaches for identifying and determining the scope of emerging industries** based on underlying assumptions about the characteristics of emerging industries. Four types of data are considered for our classification methodology: firm capital raising data, cross-sector investment data, firm patenting data and sector growth potential.

The chapter then highlights the criteria that we used for selecting our classification methodology and describes the approach that was finally adopted. A **classification system based on firm capital raising data and on cross-sector combinations through mergers and acquisitions** (M&As) was chosen. This allowed for the capturing of data about firms that already have an impact on the markets as well as data on cross-sector spillovers that give rise to emerging industries. The approach was complemented by an analysis of patent and sector growth data.

Chapter 3 focuses on the application of our methodology for the classification of emerging industries and presents the findings of our approach. A database was constructed by compiling data coming from different sources to obtain **a diversified and complementary information set** for the analysis. We used two primary sources of information: Zephyr, a database of private equity, venture capital and M&A deals, and Europe Unlimited, a database with information on companies that are in the process of raising funds. We complemented our database with data on sector activities (turnover, added value, and employees) from EUROSTAT as well as data on patents from the European Patent Office (EPO).

We started the data analysis with an assessment of the distribution of M&A and equity deals in Europe and North America. We then proceeded to analyse the major relations or 'linkages' that exist between the NACE codes and to spot which codes have the highest activity in the market, meaning M&A and equity raising. This analysis served as the basis for **identifying a series of candidate emerging industries** and defining their perimeters. The perimeter refers to all the NACE codes which should be included into the different new emerging industries. We did a comparative analysis of these candidate emerging industries focusing on market signals, namely equity and M&A investments, as well as turnover, employment and value added.

The chapter concludes with the **selection of 7 key emerging industries** based on the level of activity, significance and relevance. These key emerging industries are: creative industries, eco industries, experience industries, maritime industries, mobile services industries, mobility industries, and personalised medicine industries.

Chapter 4 conducts a detailed analysis of the 7 key emerging industries that were identified. We decided to use our database to build up a **metrical approach through scatter charts** in order to better segment every emerging industry and to investigate the most active NACE codes. In order

to complete the analysis, **sector growth potential** based on official statistics was assessed. The findings show how added value generated by the employees is not always proportional to the number of deals. Some of the new emerging industries are more efficient than others. In personalised medicine, for example, added value per employee is high, while the number of deals per employee is among the lowest. The experience industry has the highest number of deals per employee, while the value added generated is the lowest. An **analysis of patent data** over the last years showed a general decline in patent production across all countries. Overall the most productive countries are Israel and Japan, while Europe and the US fall behind these leaders. Among the EU 27, in general the Scandinavian countries (including Finland) are the most active. The Netherlands, Germany, Austria and Belgium are also well positioned, while countries such as Italy, France, and UK are less active.

Finally, we mapped the **geographical localisation of the key emerging industries** based on European Cluster Observatory data as well as data on companies raising funds resulting from our methodology for classifying the new emerging industries. Our analysis shows that in most of the cases, the companies which are most successful in raising funds are located in strategic European regions, where the VC industry is active. For all industry sectors most of the companies raising funds are located in Paris or London. Nearly all sectors also present companies with an intense fundraising activity in the Nordic countries (Stockholm, Copenhagen, and Oslo).

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1 Introduction

The European Cluster Observatory was established in 2006 to inform policy makers, cluster practitioners and researchers about the clusters, the cluster policies and cluster initiatives that exist in Europe and about the conditions and factors that favour their emergence and development. The first phase of the project (**ECO-I**) undertook the **first systematic statistical mapping of European clusters**. Based primarily on the analysis of available public statistics, in particular employment data aggregated by country and economic sector, this mapping enabled the identification of more than 2,000 clusters in the EU's 27 Member States, and including Iceland, Israel, Norway, Switzerland and Turkey.

Beyond cluster mapping, the ECO-I also provided information about policies and programmes related to clusters, as well as a comprehensive database and mapping of cluster organisations[1]. The mapping was based on available public statistics, such as EUROSTAT and OECD data, aggregated by country and sector. This work contributed to a better understanding of the positive impact of geographical specialisation, in particular on broad economic outcomes like GDP per capita.

The second phase of the project (**ECO-II**) then provided additional, **deeper and broader data concerning regional business environments**, both general and cluster-specific, and about cluster initiatives, with a view to help policy makers understand how geographical specialisation relates to other factors that might have an impact on economic outcomes, and what policy levers and options exist to try to enhance these economic outcomes.

The European Commission, Directorate General for Enterprise and Industry (DG ENTR), launched the third phase of the "European Cluster Observatory" (**ECO-III**) in 2011, and the project will continue until 2013. Building upon the achievements of the European Cluster Observatory to date, the third phase of the project aims **to support the development and implementation of better and more effective cluster policies** at the European, national and regional levels. Rather than promote the further development of clusters or cluster organisations – the results of the ECO-I mapping exercise having shown that there is no shortage of business clusters in Europe – its objective is to help ensure that clusters, existing or future, can be used and leveraged more effectively to create new competitive advantages on a global scale for Europe, its Member States and regions.

The objective of this study is to investigate, classify and analyse **"emerging industries"**, i.e. industrial sectors, usually based on new products, services, technologies or ideas, which are in early stage development and are **characterised by high growth rates and market potential**. Emerging industries therefore hold a key to future European competitiveness and prosperity, and the mission of the ECO-III project is to help the European Commission, the Member States and the European regions to design strategies and initiatives to develop, through clusters, new and globally significant competitive advantages in "emerging industries".

To this end, the project involves the following activities:

- Establishment and management of a "European Cluster Cooperation Forum" (ECCF), an open policy learning space aimed at investigating how cluster programmes and policies at regional, national and European levels could be consolidated to better promote the development of competitive advantages in emerging industries (*Work Package 1*);

1 "Cluster organisations are the legal entities operating the clusters, in charge of managing the participation and access to the cluster's premises, facilities and activities. They are considered as new and highly efficient forms of innovation support providers that provide or channel specialised and customised business support services, especially to SMEs. Cluster organisations are often also in charge of managing cluster initiatives". Source: Commission Staff Working Document - Annex to the Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: "The concept of clusters and cluster policies and their role for competitiveness and innovation: Main statistical results and lessons learned. Brussels, 17.10.2008. SEC(2008)2637

- Identification and analysis of favourable "cluster-specific framework conditions" that lead to the emergence and development of world-class clusters in "emerging industries", based on case studies (*Work Package 2*);

- Development of a pilot "European Cluster Excellence Scoreboard" (ECES), with the aim of developing the methodology of a composite indicator and to apply it as a test case to three "emerging industries" (*Work Package* 3).

The first task to be performed as part of Work Package 3 is the development of a classification scheme for emerging industries. A methodology will then be defined for **establishing a scoreboard measuring the relative strengths of European clusters in emerging industries**, with respect to the three key dimensions commonly seen as conducive to the emergence and development of "world-class clusters":

- **Framework conditions**: the existence of favourable cluster-specific framework conditions;
- **Cluster firm strength**: the strength and dynamics of cluster firms and related actors;
- **Cluster management quality**: the quality of the management of clusters and cluster organisations.

A pilot version of a "European Cluster Excellence Scoreboard" will then be developed and applied to a limited number of identified and classified emerging industries in order to provide policy-makers with a tool in support of the development of "world-class clusters" in emerging industries in Europe.

This report presents a proposed **methodology for establishing a classification system for emerging industries**. Its **objectives** are to:

- Define and assess a variety of possible options for classifying emerging industries;

- Provide a sound and robust methodological underpinning for the identification, definition, composition and delimitation of those economic sectors that will be considered as "emerging industries". This will be based on an analysis of the transformation of existing industries, resulting in new industry configurations, structural changes in the market and the formation of new specialisation patterns;

- Propose a robust and consistent classification scheme for a limited number of key emerging industries;

- Identify those emerging industries that shall be subject to further analysis as part of the ECO-III project, in particular the development of the "European Cluster Excellence Scoreboard" in Work Package 3, but also the identification and analysis of favourable framework conditions that lead to the emergence and development of world-class clusters in "emerging industries" in Work Package 2.

The proposed methodology takes into account and builds upon the work that has already been carried out in recent years to identify and analyse emerging industries, in particular during the previous phases of the European Cluster Observatory. It also draws on new data analysis which captures some key aspects of the emergence of new economic activities that could potentially be conducive to the creation of new global competitive advantages for the EU, its Member States and regions.

2 The challenges of identifying and classifying emerging industries

The emergence of new industries is often supported by clusters that offer a favourable business environment from the initial phase. This environment fosters both competition and cooperation between firms with different industrial backgrounds, technological or business expertise. Clusters represent a microcosm providing an ideal ground for experimenting with new business solutions and bringing them successfully to the market. In this way, **clusters play an important role as catalysts for structural change**. They bring together a critical mass of innovative firms, related innovation actors (e.g. universities and researchers, financiers, etc.) and cluster organisations which provide specialised business and innovation support services.

A better understanding of the crucial elements for the **development of strong clusters in emerging industries**, as well as where regional competences exist, is needed to facilitate the development of more fact-based policy-making. This would allow for smart specialisation strategies to concentrate on strengthening specific competitive advantages and to avoid a misallocation of scarce resources at an early stage. This would also ensure that cluster policy, at a EU, national and regional levels, can be geared towards supporting the development of emerging industries that are oriented toward reaching a globally competitive advantage.

The European Cluster Observatory will provide information and analysis about the new industries that are emerging in Europe and internationally; in particular those driven by new key enabling technologies, service innovation and eco-innovation. Further, it will provide information and analysis on their localisation, as well as on the factors impacting – positively and negatively – on this emergence and localisation, with a view to supporting the European Commission, its Member States and regions in their efforts to foster the development of emerging industries, in particular through building and developing "world-class" clusters in these areas.

From an industrial policy point of view the aim is to build on those clusters that have the greatest potential to **improve the global competitiveness** of European industries and to **drive structural change in this direction**. In this sense, the issue is not to identify the strongest clusters in Europe with the aim of supporting them but rather to exploit the concept of clusters in a broader sense. The hypothesis is that enterprises benefit from favourable "eco-systems" that foster competition as well as collaboration – thus providing gateways to knowledge, finance and markets.

Therefore, the **classification of emerging industries needs to be the object of a concrete study**, based on data related directly to existing companies, their field and degree of activity, and their geographical localisation. Structural changes in the market could therefore be spotted to better frame the industrial sectors and their classification, and related to new localisation patterns.

2.1 Understanding the development of new emerging industries

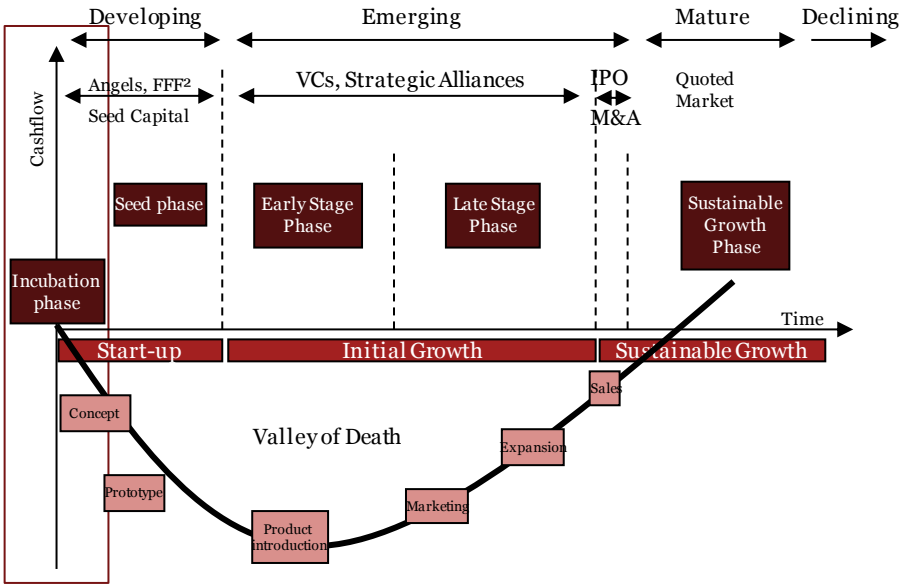
To be able to develop a classification scheme for emerging industries, we have to first define 'emerging industries'. There is already an abundance of literature concerning emerging industries in general and some of these industries in particular. However**, there is not a single, commonly accepted and operational definition of 'emerging industries'**. Emerging industries have long been a subject of research in different spheres (academia, policy, business analysis, and industry itself) and in different regions of the globe.

Given the lack of agreement in the literature on what constitutes an 'emerging industry', we decided to broaden our scope in order to develop a global and coherent picture. We analysed the different stages of the life cycle of an industry and investigated the **transformation requirements from a traditional industry to a new emerging industry** to understand the main characteristics of the key emerging industries.

2.1.1 The life cycle of an industry

Industries experience a life cycle which is comparable to the life cycle of an individual company or a single product. The different stages of the life cycle are similar for all industries. The duration of the stages differs between emerging industry sectors and they also face different challenges. After analysing the different growth stages we are able to understand the driving factors of the emerging industry. Figure 1 illustrates these different stages of an industry life cycle.

Figure 1: Industry life cycle



At the ***developing phase*** the cash flow of firms and industries profits is usually negative. A lot of investment is required for creating new product offerings, developing and testing prototypes, recruiting talents, and marketing products or services. During the emerging phase, all profits generated are typically reinvested into the company to solidify its position and boost R&D and industrialisation phase. At the maturity phase, sales then begin to stabilise and in contrast, profits generally continue to increase throughout the life cycle, as companies leverage on their expertise and economies of scale and scope to reduce unit costs over time.

The ***emerging phase*** can be also divided into two parts (which are the two investment stages this study is especially focusing on). The first stage is the "early stage phase", when a new, unique product offering has been developed, the underlying IP has been registered, and the technology protected. At this early stage it can happen that a small entrepreneurial company, in most of the cases funded on research and development skills, can own a unique technology proposing a true added value within its industry sector. According to the research results of Hitt, Ireland, and Hoskisson[2], firms establish a niche for dominance within an industry during this phase.

It is often the case that during this stage companies are able to reach technological superiority or advantageous relationships with vendors within the supply chain to develop a competitive advantage, when they are getting into the second stage called "late stage phase". Firms may also cluster together in close proximity during the emerging phase of the industry life cycle to have access to key materials or technological expertise, such as in Silicon Valley, US.

2 Hitt, Ireland & Hoskisson. Strategic Management: Competitiveness and Globalization, Concepts and Cases. 8th Edition. (Cengage, 2009).

During our analysis we looked at **companies who have "access to finance"**, which mainly starts from the "early growth stage". The investors are mainly venture capitals/private equity funds, but can be institutional investors as well who are investing in the emerging phase of a company. Usually, institutional investors do not invest directly in privately held companies, lacking the expertise and resources necessary to structure and monitor the investment. Instead, institutional investors will invest indirectly through a private equity fund. Institutional investors are covered by fewer protective regulations and they account for a majority of overall volume.

The role of **institutional investors**, for example pension funds and insurance companies, is very important in several sectors such as Personalised Medicine. The reason is that personalised medicine has the potential to increase people's life span, which in turn will increase pension costs, leading to decreased gains to pension funds. The reverse is true for insurance companies whose purpose is to gain from better medicine and increased longevity. Both pensions and insurance sectors need a clearer view of future changes in the market landscape, so they can plan their investments accordingly. Engagement in funding the Personalised Medicine sector is a very good way to gather insights of the major requirements of these profiles of investors. In fact, much of the money in financial centres is tied up in pension funds and insurance companies.

The driving factors for Ventures Capitals can differ in the different investment stages (see Box 1).

Box 1 – Stages of Investments

During the life cycle of a firm several rounds of financing might take place. These can be characterised by the stage at which they occur in the development of their venture. Each stage of financing is matched by investments, so that the aggregate investment activity is often reported by the total amount of different stage's financing[3]:

1. **Seed-stage:** the financing consists into a capital amount provided for a business idea. The capital generally is non-dilutive, and provided by public entities. It generally supports product development and market research.
2. **Early stage:** the financing consists of capital provided for companies moving into operation and before commercial manufacturing and sales have occurred. (e.g. capital for Start-ups not yet having marketed products or services. The capital might also support marketing and initial marketing.)
3. **Formative-stage:** the financing is provided by venture capitals (VCs), and aims at sustaining product scaling up, and global expansion.
4. **Later-stage:** financing is capital provided after commercial manufacturing, sales have begun and expanded geographically, however no initial public offering (IPO) or acquisition has occurred.

Dealing with potential acquirers and with potential investors is one of the most important steps a company operating in a new emerging industry has to manage, and this experience would most likely determine the degree of its possible future success and growth potential. These categories of investors have diversified investment strategies and preferences. For example, Venture Capitals (VCs) are measuring companies on the following key criteria:

1. Developed and tested product, ready for scaling-up the production phase;
2. Complete management team with a strong leadership and vision;
3. Sales record (even limited);
4. Distinguished competitive roadmap, and clear and formalised added value of products and/or services;
5. Intellectual property (IP) protection;
6. Others.

3 See for example Thomson Venture Economics, the National Venture Capital Association, the European Venture Capital Association, and the British Venture Capital Association.

When VCs are deciding on whether to invest into a company, first they look at their Business Plan. Sufficient, reliable, and realistic business plans are the roadmap for a growing company, the vehicle by which companies "get in the door". These are the documents most heavily scrutinised by investors, particularly in today's financing environment. Business plans also serve to communicate the company's value proposition to employees, advisors, partners, customers and investors, which contain:

- *A Firm's past accomplishments:* New companies must show how the past successes of the management team will enable the company to overcome expected challenges;
- *Understanding and defining the "market":* understand their market size and market need (supply-demand) and able to make feasible market research (i.e., demonstrate sustainable competitive advantage, the potential for an expedited regulatory approval pathway, growing market, etc.);
- *Understanding and catering to customer needs*: a company must clearly communicate how its products and services meet specific customers' wants and needs, and identify which target markets most exemplify these needs;
- *Developing realistic financial assumptions:* Such a business plan distinguishes a company from the thousands of other companies seeking to raise capital, and signals to investors that the company is soberly managed and poised for success.

The management team is equally important for the success of a company. It is critical to show that the company has a team with skill sets appropriate for the stage of the company, capable of executing the plan. At this early stage the company is mostly dependent on its founders, but ultimately it is important to show that it has value as a separate entity apart from the founders. For several sectors, such as biotechnology companies, IP is usually the heart and soul of the business, so a strategy for developing a solid patent position is essential.

Fast growth is one of the key objectives of a firm. In this respect, the VC-backed firms that have achieved commercialisation of their technologies are becoming the most attractive **targets of mergers and acquisitions (M&As)**. This drive towards increasing consolidation is influenced by several factors, most notably the mergers and acquisitions of novel technologies and the achievement of sales synergies.

For a company, the potential advantage of being acquired offers the prospect of achieving economies of scale, to combine complementary resources (e.g. market access, distribution, production), and to eliminate inefficiencies. Among the advantages for the acquirers, the most important consists in obtaining proprietary rights to products and services, in increasing market power by purchasing competitors, in gathering new talents and resources, in shoring up weaknesses in key business areas, and in penetrating new geographic regions (geographical diversification).

Phase 3, the ***mature phase*** occurs when a company has reached its peak, earnings have stabilised or slowly rise, growth is slow and growth prospects are few and far ahead;

Phase 4, the ***declining phase*** occurs where the growth of an industry is either negative or slower than the overall economic growth rate, due to decreasing demand, depletion of specific natural resources or emergence of substitute products or services.

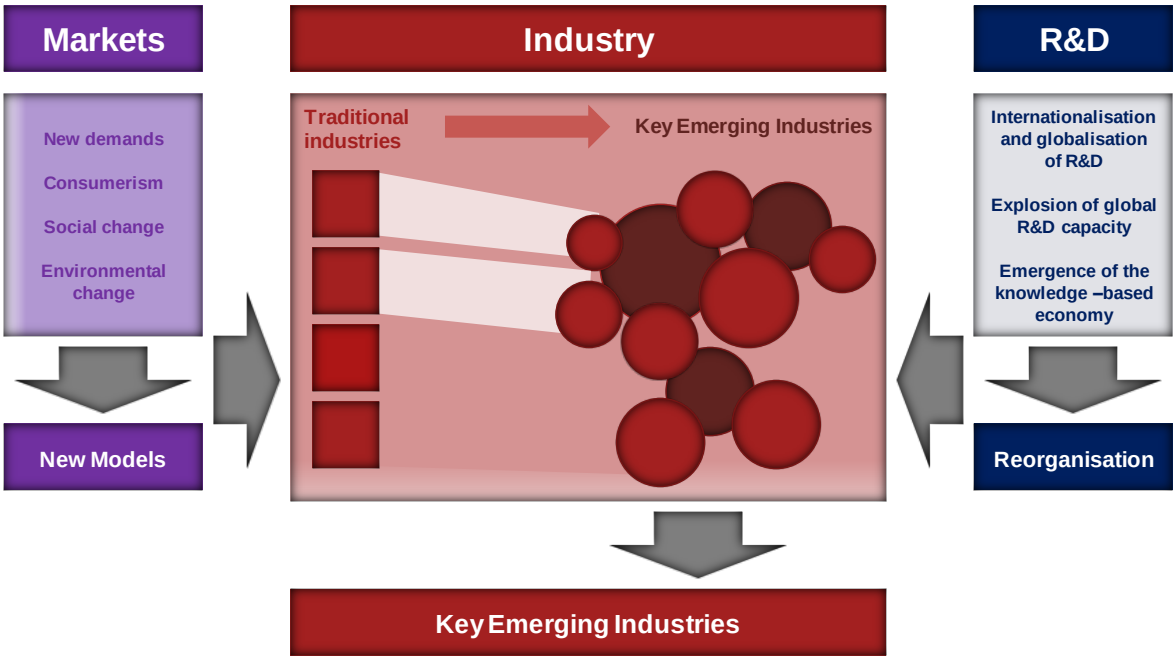
2.1.2 Key characteristics of emerging industries

Emerging industries are characterised by a **high growth potential** rather than by actual high growth. Even if they are growing faster than the overall economy, most of their growth potential has yet to materialise and their growth rates are usually still lower than those of other industries that have already entered their high growth phase.

There are other elements that need to be taken into account to understand emerging industries and how they emerge. In addition to their high growth potential and sometimes higher-than-average growth rate, they also have a set of other key characteristics, including:

- They are usually **formed on the basis of a new product, service or idea** and come into being when consumer needs change, new technologies replace older ones, or when new socio-economic conditions emerge (Figure 2). They are most often driven by key enabling technologies (KETs)[4] new business models such as innovative service concepts, and by societal challenges that industry must address as a matter of survival, e.g. climate change, the ageing society, etc;

Figure 2: Paradigm shifts in terms of markets and R&D drive the transformation from traditional industries to key emerging industries



- They consist of either entirely new activity sectors, or, more often, of restructured sectors that transform, evolve or merge into new industries (Figure 2). In the latter case, they usually result from **cross sector spillovers**, i.e. the process by which industries mutate through their entrepreneurial and technological convergence with other industries of a 'relational variety'[5]. This idea of relational variety captures the positive economic impact that high complementarily, absorptive capacity, and geographical agglomeration can have on previously un-related activities[6]. Cross-sector spillovers can be perceived as the 'evolutionary fuel'[7] driving the development of emerging industries, as in these spillovers lie the existing and potential future knowledge for meeting new needs and addressing new challenges[8];

[4] Key Enabling Technologies (KETs) are those technologies that enable the development of new goods and services and the restructuring of existing industrial processes. They are of systemic relevance as they enable the modernisation and competitiveness of the EU industry and the transition to a knowledge-based and low carbon resource-efficient economy. They play an important role in the R&D, innovation and cluster strategies of many industries and are therefore key to strengthening the research, development and innovation base in Europe. In 2009 the Commission issued a Communication on "Preparing for our future: Developing a common strategy for key enabling technologies in the EU" COM(2009)512, which identified those KETs that strengthen the EU's industrial and innovation capacity to address the societal challenges ahead and proposed a set of measures to improve the related framework conditions. KETs that have been identified as priority areas for improving European industrial competitiveness include advanced materials, nanotechnology, micro- and nano-electronics including semiconductors, biotechnology and photonics.

[5] Jacobs, J. (1969) The Economy of Cities, New York, Vintage.

[6] Frenken, K., Van Oort, F. and Verburg, T. (2007) Related variety, unrelated variety and regional economic growth, Regional Studies, 41, 685-697.

[7] Fornahl, D., Henn, S., Menzel, M.P. (2010) Emerging Clusters: Theoretical, Empirical and Political Perspectives on the Initial Stage of Cluster Evolution, London, Edward Elgar Publishing Ltd.

[8] European Cluster Policy Group (2010) Consolidated Set of Policy Recommendations on Four Themes, www.proinno-europe.eu.

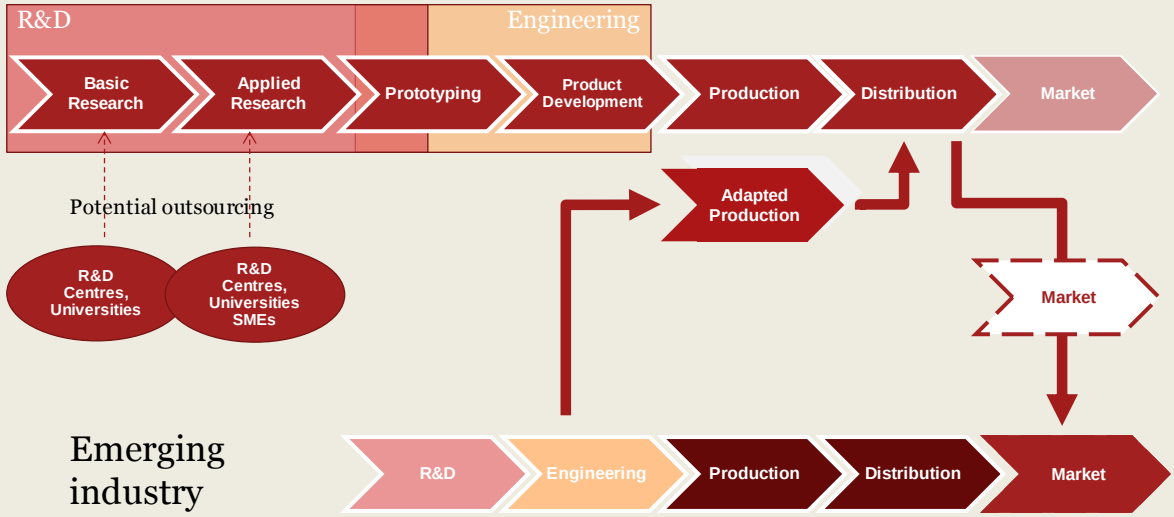
- They tend to be **research and knowledge** intensive industries, as their emergence and development usually results from applied creativity and disruptive innovation;

- They typically **nurture entrepreneurship and an innovative spirit**, which incorporates a kind of behaviour that involves taking initiative, the organisation and re-organisation of socio-economic mechanisms to turn resources into products and services that meet consumer needs, and the acceptance of the risk of failure[9]. Entrepreneurs are the essential actors who make the link between cross-sector spillovers and economic development, as they draw on existing knowledge to develop commercially viable innovative activity through new business models that facilitate the development of new markets that in turn create wealth, economic growth and jobs[10];

- They **trigger and enable structural change in the market**, giving rise to new suppliers, customer bases, business models, products and services;

- They are characterised by a state of disequilibria, as their **emergence often results from a disruptive idea that impacts value chains**, social acceptance and market demand[11], and triggers, at an aggregate level, a re-allocation of resources from pre-existing activities and companies to new ones (see Box 2). As a result, there is uncertainty in emerging industries as demand for product, growth potential and market conditions of the companies and the industry itself are still largely unknown and there is a limited track record;

Box 2 – Value chains are being reconfigured from traditional industry to emerging industry



- New emerging industries use some or part of the value chains of traditional industries
- They consist of either entirely new activity sectors or of restructured sectors that transform, evolve or merge into new industries
- Service innovation is a key factor in these transformations
- Traditional sectors undergo a reconfiguration into new emerging industries with transformations usually occurring at the design and engineering phases
- New emerging industries have some key technologies-based services in common, which include ICT, business services and engineering

[9] Shapero, cited in Kuratko, D.F. & Audretsch, D.B. (2009) Strategic Entrepreneurship: Exploring Different Perspectives of an Emerging Concept, Entrepreneurship Theory and Practice, 33(1), p.1-17.

[10] Audretsch, D., Boente, W., & Keilbach, M. (2008) Entrepreneurship capital and its impact on knowledge diffusion and economic performance, Journal of Business Venturing, 23(6), p.687-698.

[11] Research approach for the Emerging Industries Programme, Institute for Manufacturing, University of Cambridge http://www.ifm.eng.cam.ac.uk/imrc/eip/approach.html, 25 November 2011.

- They have a **high propensity to cluster**, as companies in emerging industries tend to agglomerate and do so geographically. Such spatial concentration and geographical proximity between firms acting in emerging industries indeed facilitate inter-organisational linkages that support the exchange of ideas, knowledge spillovers, the mutualisation of some costs and capabilities, and the accumulation of trust – all elements that are important to supporting the emergence and development of new industries.

2.2 Traditional industry classifications

Reliable industry classification, organising activities and companies into industrial groupings based on similar production processes, similar products, or similar behaviour in the markets, is an essential foundation of sound economic policy making. Governments in the western world began collecting industry data in the 19th century; though clear industry definitions were not consistently applied until the middle of the 20th century, when a more systematic collection of economic data required universal classification systems to be developed.

The purpose of industry classification systems is to organise information through the **systematic and standardised grouping of data by economic activity**. The creation of such classification systems requires the development of an exhaustive, structured, and mutually-exclusive set of well-described economic activities, typically reflected by the formulation of an appropriate numerical or alphabetical hierarchical structure. Within this framework, statistical data can, through classification codes, be grouped by economic activity, which in turn enhances the data analysis process that supports policy decision-making and implementation.

A wide variety of classification systems are in use across the world, sponsored by different countries or organisations, and based on different criteria. They include:

- **ISIC**[12] (International Standard Industrial Classification of All Economic Activities), sponsored by the United Nations Statistics Division (UNSTAT), and which was first introduced in 1948;

- **NAICS**[13] (North American Industry Classification System), sponsored by the Statistical bureaus of the United States, Canada, and Mexico, and which has largely replaced the older Standard Industrial Classification (SIC) system since its introduction in 1997;

- **NACE**[14] (European Classification of Economic Activities, or ***N****omenclature statistique des* ***A****ctivités économiques dans la* ***C****ommunauté* ***E****uropéenne*), which is the classification system used in the EU and its Member States and was developed since 1970. NACE is an integral part of the statistical infrastructure used within the European statistical system for producing comparable statistics. Since its development in 1970, EU Member States have used NACE or national classifications derived from NACE for the production and the dissemination of statistics related to economic activities. NACE is itself derived from ISIC and forms part of an integrated global system of statistical classifications, developed mainly under the auspices of the United Nations Statistical Division. NACE has exactly the same items as ISIC at the highest levels, while NACE is more detailed at lower levels. The definitions and the guidelines established for use of NACE within the EU are consistent with those published in the introduction to ISIC.

This integrated global system of statistical classifications is meant to allow the comparability of statistics produced internationally, but also in different statistical domains. For instance, statistics on the production of goods, reported in the EU according to Prodcom surveys, could be compared

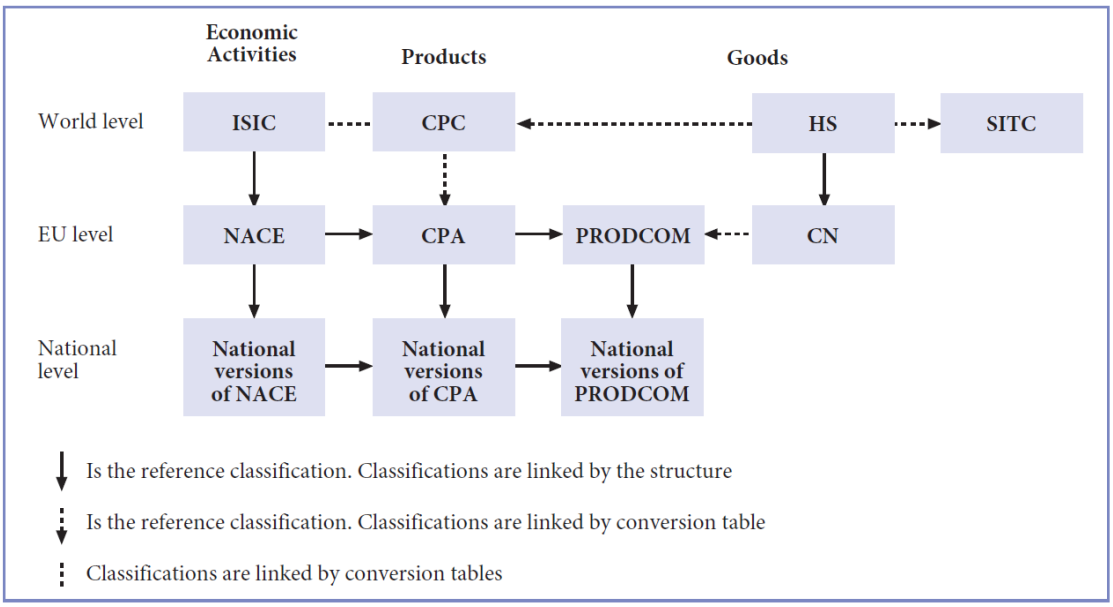
[12] http://unstats.un.org/unsd/cr/registry/isic-4.asp

[13] http://www.census.gov/eos/www/naics/

[14] http://epp.EUROSTAT.ec.europa.eu/portal/page/portal/nace_rev2/introduction

with statistics on trade, in the EU produced according to CN. From a European point of view, this system can be represented as illustrated in Figure 3.

Figure 3: The integrated system of economic classification (Source: EUROSTAT[15])



Acronyms:

- *ISIC is the United Nations' International Standard Industrial Classification of all Economic Activities.*
- *CPC is the United Nations' Central Product Classification.*
- *HS is the Harmonized Commodity Description and Coding System, managed by the World Customs Organisation.*
- *CPA is the European Classification of Products by Activity.*
- *Prodcom is the classification of goods used for statistics on industrial production in the EU.*
- *CN stands for the Combined Nomenclature, a European classification of goods used for foreign trade statistics.*

Industry classifications are not fixed and are subject to **periodic revisions to account for changes in the structure of the economy**. Indeed, changes in economic structures and organisations, as well as technological developments, give rise to new activities and products, which in some cases may supersede existing activities and products. Such changes imply a constant challenge for industry classifications and for the compilation of economic data and statistical information. The relevance of industry classifications therefore diminishes with time and periodical revisions are needed.

This is the case for all classification schemes internationally:

- **ISIC**, which was first established in 1948, is now it is fourth revision;
- **NAICS**, introduced in 1997, was revised in 2002 and is currently undergoing a second revision which will come into effect in 2012. With the first version, NAICS offered enhanced coverage of the service sector relative to SIC. The 2002 revision accommodated significant changes in the Information Sector, and the new revision now underway addresses classification challenges stemming from factory-less production among other things;
- **NACE** has undergone several revisions since its introduction in 1970. A first revised version, called NACE Rev.1, was established in October 1990 to provide for better alignment with the international standards (i.e. with ISIC Rev.3, which was adopted by the United Nations Statistical Commission in February 1989). In 2002, a minor update of NACE Rev.1, called NACE

[15] EUROSTAT (2008) NACE Rev.2: Statistical classification of economic activities in the European Community, Luxembourg, Office for Official Publications of the European Communities http://www.geodirectory.ie/Downloads-(1)/NACE-Rev-2.aspx

Rev.1.1, was established to reflect new activities that did not exist when NACE Rev.1 was developed (e.g. call centres), activities that had grown in importance due to either technological or organisational changes, and to correct some errors in NACE Rev.1. The current NACE Rev.2, which is the new revised version of the NACE Rev.1 and of its minor update NACE Rev.1.1, was adopted in December 2006[16] as the outcome of a major revision work of the international integrated system of economic classifications (for further details see Box 3). NACE Rev.2 reflects the technological developments and structural changes of the economy, enabling the modernisation of the EU statistics and contributing, through more comparable and relevant data, to better economic governance at both EU and national level. It is used, in general, for statistics referring to economic activities performed from 1 January 2008 onwards.

Box 3 - Introduction of NACE Rev.2

NACE Rev.2 consists of a hierarchical structure comprising of four levels:

- A **first level** consisting of headings identified by an alphabetical code (**sections**), e.g. A: Agriculture, Forestry and Fishing, or B: Mining and Quarrying.
- A **second level** consisting of headings identified by a two-digit numerical code (**divisions**), e.g. 01 Crop and animal production, hunting and related service activities, 02 Forestry and logging, 03 Fishing and aquaculture, all forming part of Section A: Agriculture, Forestry and Fishing.
- A **third level** consisting of headings identified by a three-digit numerical code (**groups**), e.g. 03.1 Fishing and 03.2 Aquaculture, forming part of Division 03 Fishing and Aquaculture.
- A **fourth level** consisting of headings identified by a four-digit numerical code (**classes**), e.g., 03.11 Marine Fishing, 03.12 Freshwater Fishing, forming part of Group 03.1 Fishing.

In some cases, a given level of the classification is without further sub-classifications. In such cases "0" is used in the code position for the next more detailed level, whose label is similar. For example, the group "Silviculture and other forestry activities" (code 02.1) contains only one class, also labelled "Silviculture and other forestry activities" and coded 02.10.

In some cases a division may contain only one group and only one class, in which case the labelling is the same for all three levels and "0" is added each time in the code for the lower levels. For example, division 12 "Manufacture of tobacco products" contains only one group labelled "Manufacture of tobacco products" and coded 12.0, which in turn contains only one class labelled "Manufacture of tobacco products" and coded 12.00. In other cases a division (e.g. "Manufacture of beverages", code 11), may contain only one group ("Manufacture of beverages", code 11.0), itself subdivided in several classes (e.g. 11.01 "Distilling, rectifying and blending of spirits", 11.02 "Manufacture of wine from grape", 11.03 "Manufacture of cider and other fruit wines", etc.).

In order to ensure continuity with previous versions and hence the comparability of statistical data over time, NACE Rev.2 left the overall characteristics of NACE unchanged. It did significantly alter some of its rules of application, criteria for construction, explanatory notes, and structure. Above all, it completed the hierarchical partition of economic activities with a view to providing a more complete and finer representation of the economy. The changes in numerical terms between NACE Rev.1.1 and NACE Rev.2, as shown in the table below, reflect the enhanced coverage and granularity of the resulting classification:

[16] European Parliament and Council (2006) Regulation (EC) No. 1893/2006: Establishing the statistical classification of economic activities NACE Revision 2 and amending Council Regulation (EEC) No 3037/90 as well as certain EC Regulations on specific statistical domains, Official Journal of the European Union.

Table 1: Changes in numerical terms between NACE Rev.1.1 and NACE Rev.2

Level	NACE Rev.1.1	NACE Rev.2	Difference
Sections *(alphabetical code)*	17	21	+4 (+24%)
Divisions *(2-digit numerical code)*	62	88	+26 (+42%)
Groups *(3-digit numerical code)*	224	272	+48 (+21%)
Classes *(4-digit numerical code)*	514	615	+101 (+20%)

As with all statistical classification systems, NACE and other industry classifications, aim to:

- Provide a hierarchical partition of the universe of statistical observations (i.e. economic activities) into finer and finer categories, with a view to making it possible to collect and present the information at various levels of aggregation;
- Enable an exhaustive coverage of the observed universe (economic activities);
- Contain only categories that are as homogeneous as possible and mutually exclusive, meaning that each element (economic activity) should be classified in only one category of the classification;
- Provide the methodological principles allowing the consistent allocation of the elements (economic activities) to the various categories of the classification.

2.2.1 Limitations of industry classifications

The periodic revisions of industry classifications result in more exhaustive, better structured and finer classifications of economic activities. They also increase harmonisation at an international level enabling the combination and comparability of statistical data globally.

A key objective of revisions, which tend to occur more often than before, is to ensure that classifications can better capture new and emerging industries, which themselves tend to appear and develop faster than in previous periods. For instance, the current revision of the NAICS classification, which is due to come into effect in 2012, pays special attention to the classification of new and emerging industries, in particular the classification of emerging economic activity in utilities, including solar electric, wind, geothermal, biomass, and other electric power generation.

The classification systems in use in Europe and elsewhere face a number of key **limitations with regards to the identification and full representation of emerging industries**:

- First, current classification schemes are meant to support the production of relatively stable statistical information over time and cannot constitute appropriate tools for identifying and classifying new activities that are in the process of emerging and appearing. They are indeed **built upon the observation of economic activities that exist at the time** of their construction or revision, while emerging industries are, by definition, industries that are in their early stages of development and whose existence can therefore is difficult to observe in some cases. Furthermore, they are meant to provide the tools to perform meaningful statistical analysis and forecasting and thus can only account for categories of activities that can be defined precisely and present sufficient stability over time, while emerging industries are the result of a continuous creation and innovation process and therefore "emerge", develop, transform and mutate all the time.

- Second, and more importantly, current industry classifications are built upon **categories of activities that are meant to be homogeneous and mutually exclusive**, and therefore

cannot constitute appropriate tools to identify and classify new activities that emerge from the combination and cross-fertilisation of different types of activities and sectors.

- Indeed, in most cases emerging industries result from **cross-sector spillovers between related but distinct sectors** that transform, evolve and combine or sometimes even merge into new industries. This process cannot be captured by statistical classification systems whose purpose is to distinguish between economic activities rather than to identify cross-activity linkages and spillovers.

A more accurate picture of an emerging industry would need to be based on an **aggregation of the different NACE Rev.2 classes that it encompasses, taking into account new cross-sector linkages** that define the emerging industry. NACE codes have some limitations in this context, even at the highest possible level of NACE granularity (4-digit codes). These limits need to be taken into account when developing a classification methodology for emerging industries based on NACE Rev.2 4-digit codes:

- **NACE classes do not distinguish between emerging and traditional industries:** e.g. *"Production of electricity"* can cover traditional production, or new ways of producing electricity such as photovoltaic, which is an emerging industry. In order to overcome this limitation, we looked at the dynamic of a sector from different perspectives, with a metrical approach rather than using only a uni-dimensional approach (e.g. by using as a stand-alone parameter M&A deals). We analysed merger and acquisition (M&A) deals in NACE Rev.2 four digit codes, and we integrated this element with a screening process for companies raising equity, which are typically initiating their life cycle starting from a new technology or process. The use of this method ensured that the characteristics of the newly emerging industries were covered;

- **Some NACE codes are quite general:** e.g. the *"Business consultancy"* code which can consist of consultancy for all kinds of industries.

2.2.2 An effective classification system for emerging industries

Amongst all the industry classification systems introduced in the previous part, the use of NACE Rev.2 codes to map newly emerging industries presents a significant advantage in that these codes can easily allow for the identification of companies in most of the databases commercially available.

A classification scheme for emerging industries can only provide a valuable tool to support the definition of better public policies to promote emerging industries if it can be used effectively for **a range of different purposes**. This would include measuring the economic importance and value of the activities concerned, comparing this value between European countries and regions as well as with international competitors, but also identifying the location of these new industries in Europe and the factors that impact this location. This can only be achieved if the proposed classification system can be **related to existing statistical information systems** such as NACE Rev.2.

We are aware of the fact that industry statistics based on the NACE Rev.2 classification have their limitations. In isolation, they are insufficient for the purpose of identifying and classifying emerging industries because:

- they cannot be updated in real time to reflect the continuous creation and innovation process from which new activities and industries emerge; and,

- they cannot capture cross-activity linkages and spillovers from which most emerging industries arise.

A specific classification system needs to be established in order to be able to understand and analyse emerging industries and to support the definition of appropriate policies to promote their emergence and development in Europe. In the following section we introduce four approaches and

related methodologies that could address some of the above shortcomings in the process of establishing a classification system for emerging industries.

2.3 *Approaches for identifying and determining the scope of emerging industries*

While there is an abundance of literature dealing with the concept of emerging industries, inconsistencies remain in defining, identifying and classifying them. Attempts made to classify emerging industries typically involve the allocation of industry codes (e.g. NACE codes) to possible candidates of emerging industries, but they have limitations and fail to capture the cross-sectoral nature which characterises emerging industries.

Our understanding and analysis of the emerging industries life-cycle lead us to explore four possible classification approaches based on **key underlying assumptions about emerging industries** (Table 2). The first approach is to capture firms still at their early stage of development, while capable of showing potential for growth to the most important stakeholders (financing entities). The second approach captures companies able to attract interest and cross-sector investments from acquirers. The third approach is to look at patenting data and the fourth approach focuses on sector growth potential.

Table 2: Key assumptions and related approaches for classifying emerging industries

	Assumptions	Approaches
1	Firms in emerging industries **attract risk capital**	Classification system based on *firm capital raising data*
2	Firms in emerging industries **attract interest from companies in previously un-related sectors**	Classification system based on *cross-sector investment data*
3	Firms in emerging industries are **highly innovative**	Classification system based on *firm patenting data*
4	Firms in emerging industries **grow fast**	Classification system based on *sector growth potential*

2.3.1 *Approach 1: firm capital raising data*

There is considerable uncertainty in emerging industries as the demand for products, growth potential and market conditions are unknown and compounded by a limited track record. Companies in an emerging industry tend to have little or no positive income while **trying to raise funding for research and development** to underpin growth. Companies in these industries are often highly speculative and the promise of their success mostly relies upon the willingness of the risk capital industry to inject money into the new technologies and services they produce.

One of the most compelling factors facing the new emerging industries is a **lack of market knowledge and of market potential** by the entire stakeholder community (policy makers, academia, cluster organisations, other more traditional industry players). Both individual companies and the new emerging industries as a whole have yet to establish themselves in the larger market. From this reasoning, the only entities which could play a significant role in creating a pivotal change in the market are the ones able to understand to what extent an idea can bridge the gap between a new technology and customer demand.

Entrepreneurs engaging in new ventures that draw on innovative activity to meet new and existing demand typically face capital and time constraints in bringing their products or services to market. These constraints often compel entrepreneurs to seek **financial support from business angels and venture capitalists**. Should such entrepreneurs be successful in their capital raising efforts by meeting their financial requirements relatively early, key personnel would be able to transfer their energies from business development functions (fund raising, operations, human resource management etc.) to product or service development, sales and marketing.

The sourcing of venture capital by entrepreneurs is likely to be more complex in the case of new emerging industries[17]. As previously mentioned, emerging industries have a tendency to operate in a state of disequilibria, typified by **uncertainty in terms of their value chain, social acceptance and market demand**. In these contexts, venture capitalists are likely to focus on the operational, technical and commercial risks but may profit significantly from the realisation of the high growth potential of such new ventures.

Therefore, by identifying capital raising intensity through the flows of risk capital to SMEs, it is possible to **identify which economic activities are perceived by investors as high growth**, and thus, emerging. However, the drawback of capital raising data is that the exhaustiveness and reliability of applicable data sources cannot always be fully assured, as parties to the deal often ask for names and amounts *not* to be publicly disclosed.

2.3.2 Approach 2: cross-sector investment data

Capital raising data enables the identification of trends of investment in emerging industries by financial entities. Yet it fails to capture the **cross-sector knowledge spillovers** influencing the design of these emerging industries. One approach for further understanding dominant standards and trends in emerging industry design is the analysis of cross-sector merger and acquisition ('M&A') deal activity.

Most emerging industries draw on knowledge from a combination of previously un-related, pre-existing industries. Therefore, by analysing the frequency by which **established companies merge with or acquire new firms operating outside of their traditional sector of activity**, it is possible to deduce, which previously un-related industries are drawing on each other's knowledge to capitalise on emerging industry opportunities.

The advantage of such an approach is that the identification of the primary economic activity of targets and acquirers facilitates the need to map cross-sector deal activity. In addition, the ease and exhaustiveness with which a database can be formulated on recent M&A data, offers an exhaustive approach to identifying and classifying emerging industries. Therefore, the advantage is that the deals probably reflect strength and growth of the acquirer, whereas intra-sector mergers can reflect weakness of both companies.

However, like its capital raising equivalent, the reliability of M&A data cannot always be fully assured as parties to M&A deals disclose deal information at their discretion.

2.3.3 Approach 3: firm patenting data

Breitzman and Hicks[18] compiled a database of nearly 1,300 U.S. small and large technology firms and tied these firms to more than 1 million patent records. The database was used to compare the extent of innovative activity garnered by small and large technology firms, and investigate several hypotheses regarding emerging industries.

[17] Hsu, D.H. (2007) Experienced entrepreneurial founders, organizational capital, and venture capital funding, Research Policy, 36, p722-741.

[18] Breitzman, A. & Hicks, D. (2008) An Analysis of Small Business Patents by Industry and Firm Size, report developed for the Small Business Administration, Office of Advocacy.

Through this approach, emerging industries were identified and classified as sub-sets of the following two groups (see Table 3):

1. *Manufacturing industries,* i.e. those concerned with the commercialisation of new technology.

2. *Information industries,* i.e. those concerned with innovations in business models.

Table 3: Allocation of emerging industries by patent records

2.4 Type of industry	2.5 Custom codes not dominated by either large or small firms	2.6 Custom codes dominated by small firms
Manufacturing	• Fluid handling machines • Alternative energy • Defence contractor • Filtration equipment • Gaming machines • Radio frequency identification (RFID) • Semiconductor assembly and testing outsourcing • Contract manufacturing, various	• Photonics, optical components • Imaging and display • Nanotechnology • Power supplies • Quirky Technology Seeking Market (QTSM)
Information	• Digital Security • Electronic design automation (EDA) • Positioning information, services, devices	• Biomedical pipeline: drug and device • Biotech pipeline: non-biomedical • Communications technology design and market • Fabless semiconductor • Pure play licensing • Unclassified

In spite of the different features of these two types of industries, Breitzman and Hicks noted that they share the common trait of **small firms playing a disproportionately large role in the development of emerging technologies**. In fact, despite accounting for a mere 8% of all patents in the database, small firms contributed 24% of the patents of U.S. firms in emerging industry clusters. This study emphasised that small firms are a significant source of innovation and patenting activity within emerging technologies and industries, as they tend to develop, file and obtain more patents per employee than larger, more established firms.

Furthermore, this approach demonstrates that the exhaustiveness of patenting data, which remains a respected indicator of innovation, may be used to identify and classify emerging industries in the **early stages of their industry life-cycle**. On the other hand, the application of patenting data for classifying emerging industries has two main drawbacks:

1. patents have a tendency to be filed or obtained at the initial stages of an emerging industry life-cycle and so may **fail to capture the marketability** of the emerging industries themselves; and

2. a recent report by the OECD[19] states that the **quality of patent filings has declined** dramatically over the past two decades, as organisations rush to protect incremental innovative activity. Although, in many respects one good patent is worth many average patents.

[19] OECD (2011) OECD Science, Technology, and Industry Scoreboard 2011: Innovation and Growth in Knowledge Economies.

Thus it is arguable whether patenting activity captures the radical innovative activity that characterises emerging industries.

2.6.1 Approach 4: sector growth potential

In terms of identifying and classifying emerging industries, GS Sustain[20], a Goldman Sachs research team, released a report in 2010, identifying 56 emerging industry leaders. In doing so, their methodology applied a different operational definition of emerging industries, as emerging industries were implicitly characterised by firms that:

- Offer long-term investment opportunities;
- Offer high growth and outperformance;
- Are well-positioned for navigating global economic realignment;
- Are relatively undervalued in respect of their growth prospects.

Therefore, and perhaps unsurprisingly, GS Sustain's stance towards identifying and classifying emerging industries is financially and investment focused. Yet what is of particular interest is Goldman Sach's identification of **structural changes that will shape the sustainable growth of industries** and emphasis on emerging industries comprised of firms that are well-positioned to navigate the following trends in the world's economic realignment:

- Significant infrastructure investment requirements;
- Emerging market consumption growth;
- Debt/capital imbalances;
- Human capital shortages;
- Rising social expectations of companies;
- Resource constraints;
- Rise of emerging market competition;
- Public finance pressures;
- Media proliferation and technology disruption;
- Increased regulation.

The output of GS Sustain's top-down analysis shows six 'demand growth industries' likely to profit from rising demand and nine 'solution provider industries' expected to benefit from rising investment in solutions to emerging constraints (Table 4). The advantage of GS Sustain's approach is that it is based on both past and forward-looking data, as it uses a combination of recent trends and forecasts to identify industries with the highest growth potential. However, such a market-based approach focuses on well-established, often listed companies in which a wealth of data is publicly available, and subsequently **ignores the less visible SMEs** that operate within emerging industries, and possibly play a disproportionate role in tackling demand growth and supply constraint issues.

[20] GS Sustain (2010) Emerging industries: Identifying pure-play growth opportunities in a changing world, Goldman Sachs.

Table 4: Division of emerging industries by theme

2.7 Demand growth themes	2.8 Solutions provider growth themes
• **Emerging Markets Consumer** • **Global Consumer Preferences** • **Global Food Production** • **Medical Devices & Services** • **Global Medical Therapies** • **Global Infrastructure**	• Agricultural Productivity • Resources Exploration & Services • Alternative Energy Technology • Alternative Power Generation & Alternative Fuels • Energy Efficiency • Waste, Recycling & Environmental Services • Water Services & Solutions • HR Solutions • Technology & New Media

2.9 Criteria for choosing a classification methodology and the proposed approach

The different approaches for identifying and classifying emerging industries presented and assessed in the previous section have both advantages and disadvantages. From our analysis we concluded that none of them could, in isolation, be sufficient to build a sufficiently accurate, reliable and meaningful classification system that would provide a sound foundation for policy-making. There can be no *single*, *simple* approach to classifying emerging industries; **a combination of different approaches needs to be used** to support the establishment of a meaningful classification system. The next part will lists three classification requirements that are essential for building the right database with the right classification scheme on emerging industries.

2.9.1 Selection criteria

The following key criteria should be met by a classification system for emerging industries:

1. Capture those activities that truly constitute significant "emerging" industries by **targeting the right phases of the industry life cycle**, i.e. the phases when a significant number of firms engaged in similar or closely related activities experience or start to experience significant growth and have an impact or start to have an impact on the markets and on market structures. This implies focusing on the initial growth phases of the industry life cycle, when companies already have products and/or services on the market (i.e. are not in a start-up phase, while they start raising sufficient levels of capital to finance their development and expansion, and start to engage in mergers, acquisitions, alliances and joint-ventures).

2. Capture the **cross-sector spillovers and combinations** that give rise to emerging industries, and that are seen in such events as mergers, acquisitions alliances and joint-ventures between firms active in different sectors of activity.

3. Remain linked to, and even tied into, the NACE Rev.2 classification system of economic activities in the EU, to ensure that the classification can be **related to existing statistical information** systems and hence used as a valid tool to measure emerging industries.

2.9.2 Adopted approach

Amongst the four approaches presented in the previous section, the first two approaches are the ones that meet the above requirements to the largest extent. We have therefore based our analysis

on integrating these different approaches by, firstly, building a database using primarily approaches 1 & 2 and, secondly, complementing our assessment by following approaches 3 & 4.

We set up a **database with firm-level data on capital investments and mergers and acquisitions** to serve as the basis for our identification and classification of new emerging industries**.** The combination of approaches 1 and 2 meets all three criteria for the classification system and enables us to collect data using NACE code classification system to construct the database.

We propose to use these two approaches in combination in order to provide insight into the activities of firms that raise capital to finance their development and engage in mergers and acquisitions with firms active in other sectors. This would help **capture data on firms that already have an impact on the markets as well as on cross-sector spillovers** and a variety of combinations that give rise to emerging industries. Furthermore, we would use company data extracted from commercial databases, which could in principle be tied to the NACE Rev.2 classification system.

Equity investments and mergers and acquisitions occur during two critical phases in the industry growth cycle (Figure 4). By assessing the level of cross-sectoral M&A between different traditional industries alongside the level of equity investments in traditional as well as new industries and technologies we will be able to determine the scope of new emerging industries (Figure 5).

Figure 4: Two signals in the industry life cycle for identify emerging industries: equity investments and M&A deals

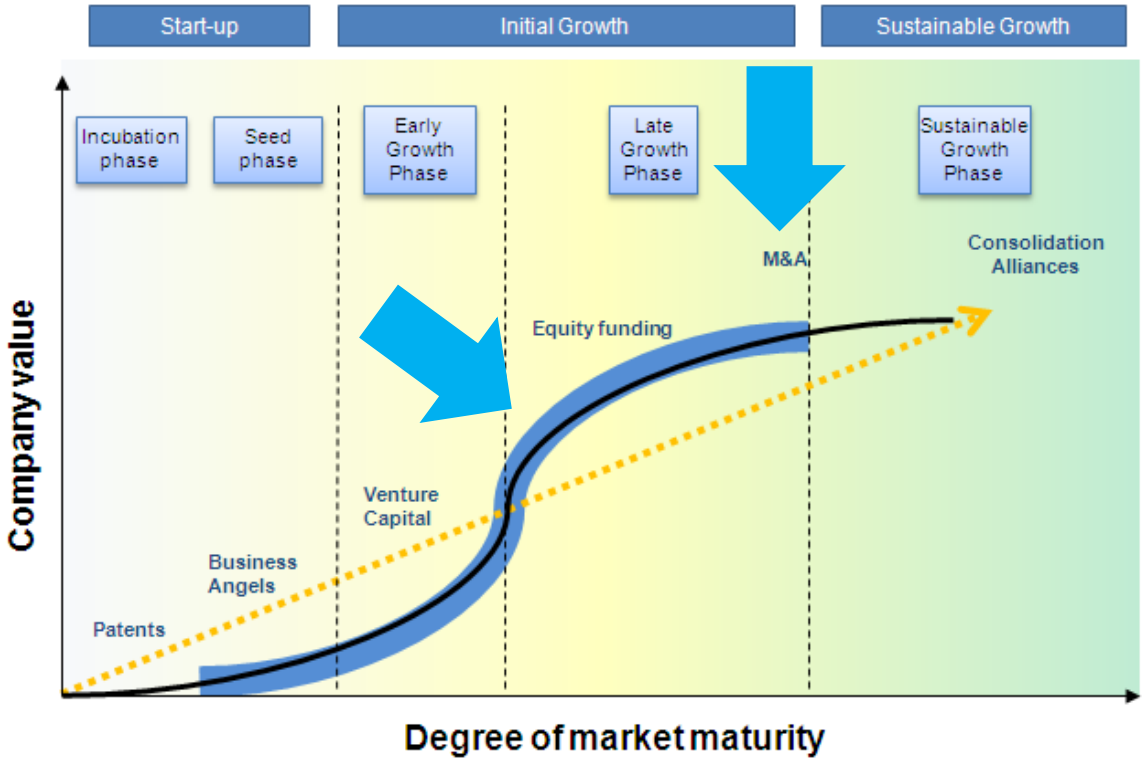
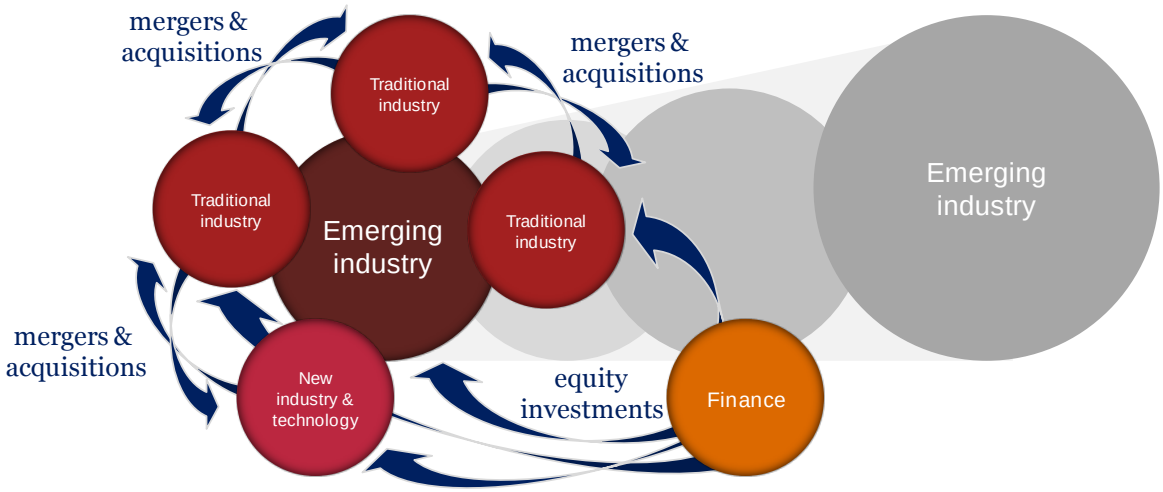


Figure 5: The two market signals (equity investments and M&A deals)



We complemented our analysis by following approaches 3 and 4, examining firm patenting data and sector growth data. These approaches do not meet the three requirements for the classification but they can be used to compare the results of our database analysis with official indicators. In particular:

- Approach 3 focusing on a **firm patenting data, may help capture valuable information about emerging and future technologies**. It would essentially provide insight into the activities of companies that are in the very early stages of their establishment, sometimes only engaged in research and development, rather than companies that are already selling products and services and have an impact on the market;

- Approach 4 focusing on sector growth potential, would provide relevant **information about growth sectors**, but would probably not bring much insight into those sectors that have the potential to generate future competitive advantages for Europe.

We therefore propose to take into consideration information coming from approaches 3 & 4 as complementary information, which will be included in our analysis only as a second step to better characterise the newly emerging industries which we have classified.

2.9.3 External quality review

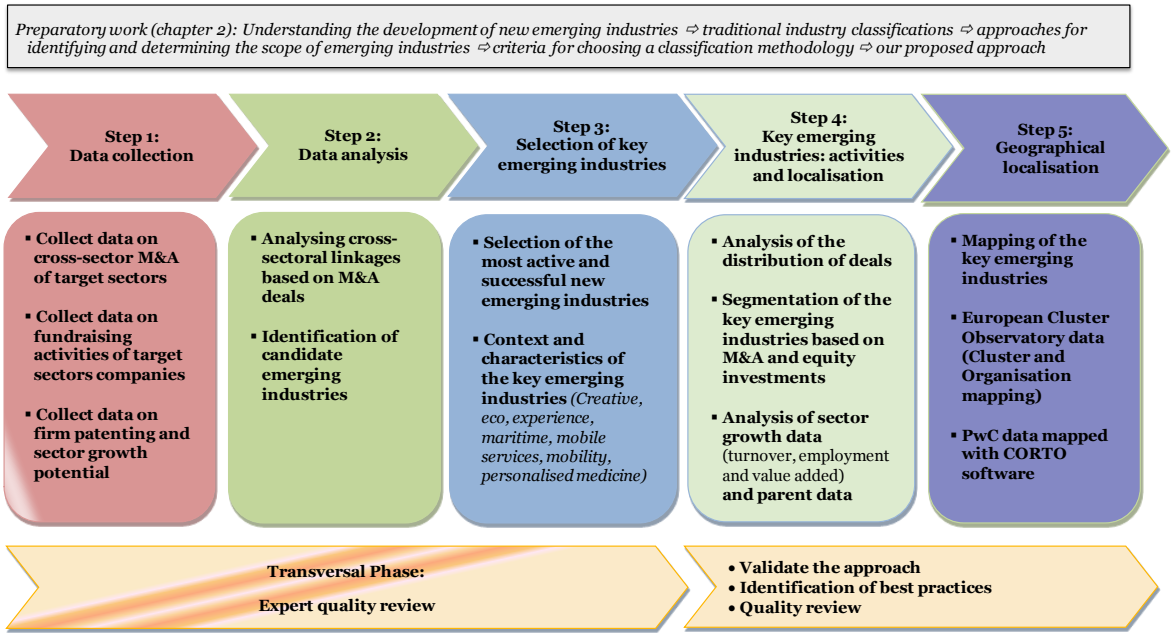
Even a combination of the four approaches would most likely be insufficient to support the establishment of a robust and reliable classification system for emerging industries. Since the literature and data available on this topic are limited, more **'qualitative' aspects need to be taken into account** to ensure that the proposed classification system integrates all relevant knowledge and practical insight.

We therefore selected several **experts with thorough experience in emerging industries and classification matters**, to bring in further knowledge and practical know-how on the selected industries and companies involved and to complement the understanding and knowledge gained through the methodological study. This combination of external expertise is essential to ensure that the proposed system is complete and reflects the emerging market reality in an accurate and reliable way.

3 Classification methodology for emerging industries: application and findings of our approach

The proposed methodological approach for the establishment of a classification system for emerging industries combines the following elements as shown in Figure 6. This chapter will start off with the data collection based on the approach selected in the previous chapter. Steps 1 to 3 will be covered in this chapter and steps 4 and 5 in chapter 4.

Figure 6: Approach for identifying and classifying emerging industries



3.1 Data collection

To ensure diversified and complementary information set for the analysis, a database was constructed by compiling data coming from different sources. As explained previously we based our data collection on the first approaches and decided to use two sources of information:

- *Zephyr* is a database used by M&A and fundraising professionals that contains comprehensive M&A data with integrated detailed company information[21]. Zephyr, published by Bureau Van Dijk, is a comprehensive database of deal data with integrated and detailed company information. It contains information on M&A, IPO, private Equity and venture capital deals and rumours. Zephyr's coverage as of July 2011 was almost 900,000 deals;

- *Europe Unlimited* provides critical business resources to innovative technology entrepreneurs, corporations, investors and researchers, and it has the data of approximately 10,000 companies in the process of raising funds or still looking for investors[22].

For collecting data on the last two approaches, we used the European Patent Office (EPO)[23] to have the companies' patenting data in order to capture companies' activities that are still in their early

21 https://zephyr2.bvdep.com/version-2012117/Home.serv?product=zephyrneo
22 http://www.e-unlimited.com/corporate/background.aspx
23 http://www.epo.org/

stages of their establishment, sometimes even only engaged in research and development, rather than companies that are already selling products and services and have an impact on the market. Furthermore, we used EUROSTAT[24] data to abstract sector size, and to estimate growth potential.

Figure 7: Data collection from different sources

3.1.1 Data on fundraising activities of target sectors companies and on cross-sector M&A

Zephyr

The database to be used as main source of information was selected among the most relevant deal data collections (M&A data and fundraising data): Mergermaket, Thompson and Zephyr were taken into closer consideration. All these databases constitute reliable and sophisticated tools for deals analysis, and they are all used by subject matter experts (corporate finance professionals, bankers, and investors) for their analysis.

However, as Zephyr was the only database using NACE Rev.2 codes for classifying industry sectors, this last was considered as the best choice to use. Further investigation was consequently carried out to validate our choice, mainly aiming at better characterising the quality of the data provided by Zephyr.

We have tested several data sources and concluded that Zephyr was the most relevant source of data as it provides the most complete coverage of:

- The intensity of deal activity per economic sector (based on NACE codes over the last few years), enabling the identification of flows of risk capital (equity) as well as cross-sector investments (M&A);

- The locations of firms engaging in deal activity, which is needed to spot existing or forming clusters in emerging industries.

Limitations of the data from Zephyr:

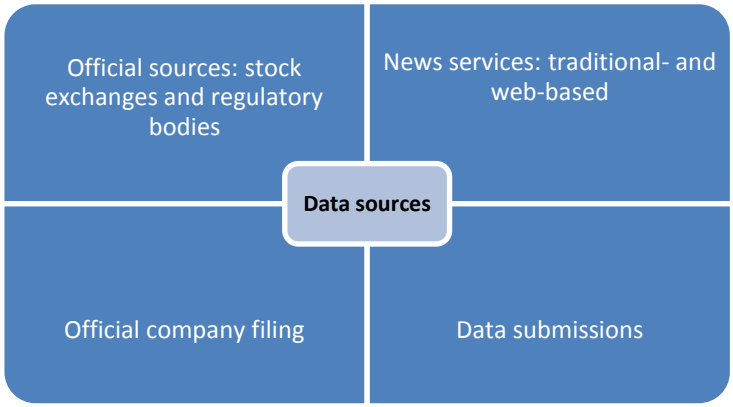
24 http://epp.EUROSTAT.ec.europa.eu/portal/page/portal/EUROSTAT/home/

- Many companies had several NACE classes describing all of their different activities and also several locations where they have subsidiaries. So to further purify the data we only considered for each company their primary NACE class and their primary location as we reasoned that SME's have not many activities and not many locations;

- Some companies did not have the NACE code at four digit level or no code at all, which made it more difficult to rely on it afterwards for a specific emerging industry.

Zephyr is using four different data sources in their database as shown in Figure 8.

Figure 8: Zephyr is using data sources based on four main pillars



Zephyr's data quality is assured through frequent updates and certified by ISO 9001:

- The data draws on IDs from the Mint/Orbis database and the Zephyr database is updated every 90 minutes. The company IDs are based on a two letter ISO code followed by a local company ID (e.g. UK company incorporation number, US DUNS number or German VAT number);
- The data is proven by external certification as the BvD is ISO 9000 accredited and as such all its subsidiaries must be accredited. Therefore as a subsidiary of BvD, Zephyr is also accredited by ISO 9000.

We have conducted an interview with Zephyr representatives to gain further assurance concerning data quality done internally:

- Zephyr's structure of teams is split on the geographical focus and linguistic skills of its analysts and deal specialists in order to ensure knowledge of the deal activity. Analysts always work in their local language and specialists provide greater experience and level of expertise for quality control;

- Zephyr has put in place a data assistance and apprentice team, responsible for data cleansing and quality control. This has to be done as analysts assemble relevant NACE codes for each deal by using keywords to highlight NACE codes in which companies with such typical NACE codes are placed. There is an inevitable element of subjectivity in terms of classifying targets and acquirers to NACE, which needs appropriate data cleansing and quality control;

- Regular internal checks are made based on two factors: the 'experience of each analyst' is reviewed as well as the 'priority of deals' covered by the analyst. Random samples of deal activity are reviewed by more experienced analysts and the error sheets are returned to junior analyst, who makes appropriate amendments.

To ensure that our analysis could be performed on relevant data and to refine the search, we used a set of selection criteria to filter the data extracted from the Zephyr database from its complete coverage of almost 900,000 deals (Table 5).

Table 5: Criteria for selecting deals from the Zephyr database

	Criteria	Filter
1	Deal target must be an SME	• Number of employees of target companies below 250 • Operating revenue/turnover of target companies must not exceed €50 M
2	Deal target must be a young company	• Target companies incorporated after 2000
3	Deal must be recent to be representative	• Deals completed between 01/01/2005 – present

The following information has been used to construct the database:

- **Deal information** [Deal type, Deal financing and the Investment amount];
- **Information on the company** which has been targeted by the investment [Name of the company, Location data /such as address, postcode and country/, and Industry information /such as main description of the company's activity and NACE Rev.2 classification/];
- **Information of the acquirer,** the company which has made the investment [Name of the company, Location data /such as address, postcode and country/, and Industry information /such as main description of the company's activity and NACE Rev.2 classification/].

Furthermore, we separated the database between equity capital raising deals and M&A deals according to the first two approaches (Table 6). First, we analysed the data received covering the equity capital raising deals from a 'financial investment' perspective, by selecting 'financial' NACE codes. M&A deals were selected by following more an 'industrial mergers and acquisition' perspective. The deals, for which the Acquirer code was unknown, or missing, were integrated into the database as such: for 'Equity' by knowing their financing classification (e.g. VC, private equity etc.), and the rest was allocated to the M&A database.

Table 6: Separation of Database for Equity and M&A deals by NACE codes

	Equity	M&A
Name of the NACE codes	Equity deals were identified by isolating all deals in which the acquirer NACE code was one of the following: • Code 64: Financial service activities, except insurance and pension funding; • Code 65.3: Pension funding; • Code 66: Activities auxiliary to financial services and insurance activities;	M&A deals were identified by all the remaining NACE codes, which are not part of Equity deals.
Financing classification (no NACE codes)	• venture capital (VC), • private Equity, • business angel, • development capital, or • an individual person.	All the others, which does not fit into Equity deals

The database compiled from the Zephyr data included the details of 10,328 companies involved in equity deals and 13,678 companies involved in M&A deals (Table 7).

Table 7: Number of deals classified by NACE codes from Zephyr database

Type of deal	Target NACE code	Number of deals	% of total codes	Number of companies	% of total companies
M&A deals	Section level (1 digit)	-	-	-	-
	Division level (2 digits)	81	0.4%	64	0.5%
	Group level (3 digits)	915	4.7%	778	5.7%
	Class level (4 digits)	18,478	94.5%	12,771	93.4%
	Blanks (no code)	72	0.4%	65	0.5%
	TOTAL	**19,546**	100%	**13,678**	100%
Equity deals	Section level (1 digit)	363	2.1%	119	1.2%
	Division level (2 digits)	1,101	6.4%	395	3.8%
	Group level (3 digits)	1,231	7.2%	771	7.5%
	Class level (4 digits)	14,090	82.5%	8,922	86.4%
	Blanks (no code)	287	1.7%	121	1.2%
	TOTAL	**17,072**	100%	**10,328**	100%

Europe Unlimited

In order to gain a more complete picture, alongside the Zephyr data (which is based on already existing financial deals), we also wanted to identify those companies which are in the process of raising funds or are still looking for investors (start-ups in the incubation/seed phase of their life-cycle and before they have a product).

Europe Unlimited provided the data for approximately 10,000 companies. 813 of these companies were identified as already in the portfolio of the VCs while it appeared that the rest of the companies had not yet raised funds, which gave us the opportunity to analyse them further as companies 'under fundraising processes'.

First we looked at the 813 companies (the ones with raised funds) from the Europe Unlimited database and cross-checked these with the Zephyr data. This analysis allowed us to complement and enlarge our sample population by an additional 770 additional companies; since these were not part of the Zephyr dataset (only 43 companies were already present in Zephyr). These additional 770 companies were labelled as 'fundraising' and this enlarged the number of equity deals. Together with the two databases we have gathered more than 11 thousand companies, which have already raised funds (Zephyr 10 328 companies and Europe Unlimited 813 companies).

Table 8 shows the NACE Rev.2 codes which were available for the 813 companies having raised funds. Our aim was to match the two databases with the four digit NACE codes, but as they were mostly provided in two digits NACE codes (45.02%) we had to use further specifications.

Table 8: Europe Unlimited database: number of companies having raised funds and availability of NACE codes

Target NACE code	Number of deals	% of total codes
Section level (1 digit)	123	15.13%
Division level (2 digits)	366	45.02%
Group level (3 digits)	117	14.39%
Class level (4 digits)	123	15.13%
Blanks (no code)	84	10.33%
TOTAL	**813**	100%

The specification used during our cross-checking process between the Europe Unlimited and Zephyr data are reported below:

- Name of the company;
- Location of the company (the street, postcode, city, country and county ID);
- Primary NACE code;
- Number of rounds the firm went through; and
- Name of the investor.

The nearly 9,000 companies remaining, which appeared as not yet having raising funds, were added to the database with the label 'under fundraising processes'. Even though these companies cannot be considered to be market leaders for the rise of new emerging industries, we think that including them in the data set could nevertheless represent a valuable element. This information could help better illustrate some market dynamics and could provide concrete elements for analysing specific geographical locations of finalised fundraising activity.

Indeed, from our experience, the Regional Biotechnology Report[25], also confirmed by other sources of information (EIF publications by Roger Kelly[26]), the process of fundraising in Europe is getting more and more difficult, and represents a barrier to the growth and development of new industrial sectors. A view of the most important industrial sectors, with high concentrations of companies that are attempting to finalise fundraising would therefore bring an additional useful insight to this matter.

3.1.2 Data on firm patenting data and on sector growth potential

European Patent Office (EPO)

The classification of the data we received followed the International Patent Classification (IPC) system, for the periods 2000-2008. Data (number of patents/M inhabitants) covered all countries of the world producing patents during this period. Unfortunately, no data is available from 2008 onwards. We looked at the number of patents and aggregated them by emerging industry.

[25] Regional Biotechnology 'Establishing a methodology and performance indicators for assessing bioclusters and bioregions relevant to the knowledge-based bio-economy in Europe, 3rd February 2011, published by PwC and the European Commission DG Research & Innovation.

[26] Roger Kelly (EIF) 'The performance and prospects of European Venture Capitals, working Paper 2011/09, EIF Research and Market Analysis.

This analysis has allowed us to better characterise the level of maturity of the industry sectors, and to establish possible correlations with the level of activity in M&A and fundraising (equity). Even though we think that the number of patents could not be considered as a stand-alone parameter for understanding the impact of market dynamics, they could nevertheless provide a valuable tool to **assess the future market potential of some key growing sectors**, and to possibly spot where the highest funding demands could be for the upcoming 5-10 years.

This analysis could allow us to determine the critical mass of patents for the various emerging industries, to spot where the most likely investor interest will focus in the future, and which emerging industries would need the most urgent support of performing technology transfer offices, capable of accelerating the market reach of the innovation produced in the universities and research centres. Moreover, we think that this analysis should represent a point of focus for policy makers and regulators, when taking decisions on the most compelling priorities for the development and internationalisation of the SMEs (e.g. policies on framework conditions, funding, and industry sector-specific regulations).

EUROSTAT

Calculating the growth of industry sectors, which are still 'in the process of fundraising', is not a simple and straight forward task. The analysis carried out by Goldman Sachs research team "GS Sustain (2010)", as described above, used company valuation data to measure industry sector growth for spotting new emerging industries. We have considered this option as unviable in our study, since it would not have been possible to calculate company value for such a large number of entities, and with such complex required variables. We have therefore gathered some relevant information from official statistics (EUROSTAT) to complement our analysis and made some complementary conclusions.

EUROSTAT only provided us with data relative to NACE Rev.1 four digit codes and only from 2008 to 2009. In order to perform this exercise, the NACE Rev.1 codes had been aggregated to NACE Rev.2 codes for every new emerging industry, to match with the database we have built up. Since the only two periods we were provided cover 2008 and 2009, we could not carry out an analysis for the growth covering other periods, neither earlier nor more recent. The following statistical data have been used to determine the growth of the various new emerging industries:

- Employment;
- Turnover; and
- Value-added.

This exercise is a similar approach to the one used by the European Cluster Observatory in its first and second phase. One important point and limitation of using EUROSTAT data for new emerging industry analysis is worth mentioning is that the EUROSTAT variables are normally only used for assessing market trends in mature markets. Company turnover, employees, and added value are not applicable in some cases to SMEs or to small companies at their first phase of development, as their market potential has not been proven in most instances, and certainly not on a global scale.

The results coming from this data would therefore give more of a sense of the potential that every emerging sector has for creating future markets. Indeed, this data is generated by companies already selling and producing employment within one emerging industry sector.

3.2 Data analysis

Our study is based on the hypothesis that structural changes in the market are driven by changes of relations occurring between different industry sectors. These changes are reflected in mergers and acquisitions and in the capability of new companies have to raise funds through VC rounds. The methodology we have put together aims to analyse the major relations or "linkages" existing between NACE codes and to spot which codes have the highest activity in the market, meaning M&A and Equity raising.

General definitions and main important concepts

- *'Targets'*: these are, for a given emerging industry, companies targeted for a merger or an acquisition. As explained before, our selection criterion for targets was to examine companies, which are either 'SMEs' or 'young companies';
- *'Acquirers'*: these are, for a given emerging industry, companies investing in companies as targets for their acquisitions. No specific screening has been applied for acquirers, other than separating 'industrial acquisitions' from 'financial investments';
- *NACE Rev.2 four digit codes*: these are taken as one unit for the selected new emerging industries to analyse acquirers and targets of the deals, and for the companies raising equity;
- *'Cross-sector deals':* these are M&A occurring between different NACE Rev.2 four digits codes. Indeed, we assume that only cross-sector deals to a large extent lead to structural changes in the market (e.g. merger of products and technologies coming from different industry sectors);
- *'Numbers of deals':* this is the unit which has been chosen for the deal analysis, since we assume that the frequency of the deals is the most important variable within this context, in order to analyse the interaction between the different companies. We decided not to look into the value of the deals, because the deal value was undisclosed in several instances, and therefore there was little chance that an accurate picture could be provided. We are convinced that such a lack of data would have impacted the reliability of the study results. Furthermore, the purpose of the current assignment is not to determine the market value of companies belonging to an emerging industry (for which probably an accurate analysis of deal value would be relevant), but rather the composition of the emerging industries and their companies, along with the degree of interaction that exists between different industry sectors;
- *'Degree of activity/linkages' between different NACE codes:* this is represented by the number of deals each NACE Rev.2 four digits code has undertaken.

3.2.1 Spatial distribution of M&A and equity deals

This exercise was performed for all regions in our database in order to investigate how Europe performed versus other regions of the world. The number of M&A deals, equity deals, and companies raising equity was found to be mostly concentrated in the EU 27, in the US, Canada, Japan, and Russia (Table 9).

Table 9: Number of M&A and equity deals by region/country

	Europe (27)	USA	Canada	Russia	Japan
Number of M&A deals	6,559	4,027	4,422	2,020	455
Number of Equity deals	7,505	5,284	2,127	718	208
Total	14,064	9,311	6,549	2,738	663
Number of companies having raised funds	4,058	3,792	1,270	438	127

The maps on the following pages (Figure 9 to Figure 14) show M&A firms from our database in blue colour, and equity firms in red colour. The main hot spots are located across US and Europe (EU-27). Firms at this stage are not yet been allocated to a specific emerging industry, and this analysis is performed only from a geographical perspective.

M&A firms are much more spread out both in the US and in Europe than equity firms. In Europe, the three major locations for M&A and equity firms are in London, Paris and Stockholm, where the number of firms is significantly above average in comparison with the other cities within the EU-27 Member States. Among the three top locations, London is far above all the other cities within the EU (with 15% of all equity deals); furthermore the UK has the highest share among the other

Member States including cities such as Cambridge, Manchester, Edinburg, Oxford, Reading and Glasgow.

The remaining concentration of firms can be found in the Scandinavian/Baltic countries, in Germany and in the Benelux countries. In these countries the government is also investing substantially in entrepreneurship and SMEs development.

There is also some activity at locations in Eastern and Central Europe. Cities such as Warsaw, Budapest and as previously mentioned the Baltic States (with the capitals: Tallinn, Vilnius and Riga) are becoming now visible on the map.

Our database shows that the three focal points outside Europe are in Russia, the US/Canada and Japan. There is a clear difference between the firm’s geographical locations in Russia and in the US. Russia has a very large concentration of M&A and equity firms in Moscow and in Saint-Petersburg, while in the US/Canada the locations are much more equally spread between the different States.

Figure 9: Localisation of M&A firms (blue) and equity firms (red) in the United States and Canada

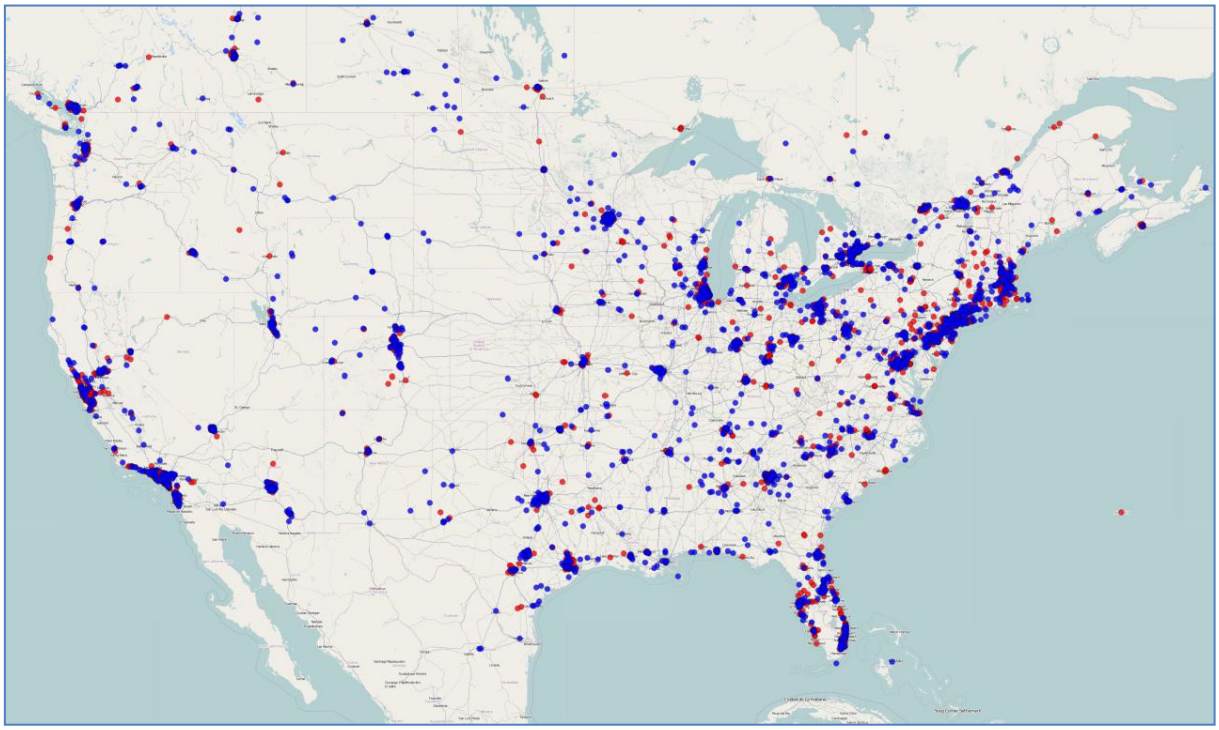


Figure 10: Localisation of M&A firms (blue) and equity firms (red) in Europe

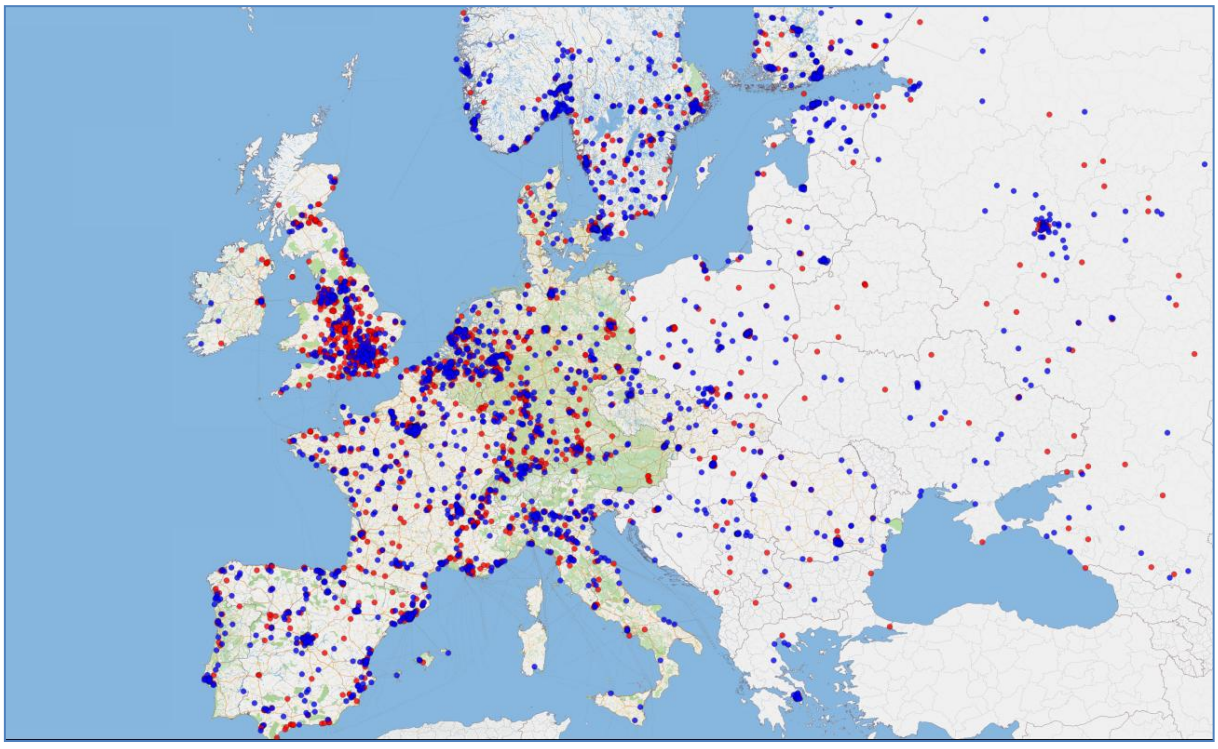


Figure 11: Localisation of M&A firms (blue) in the US and Canada

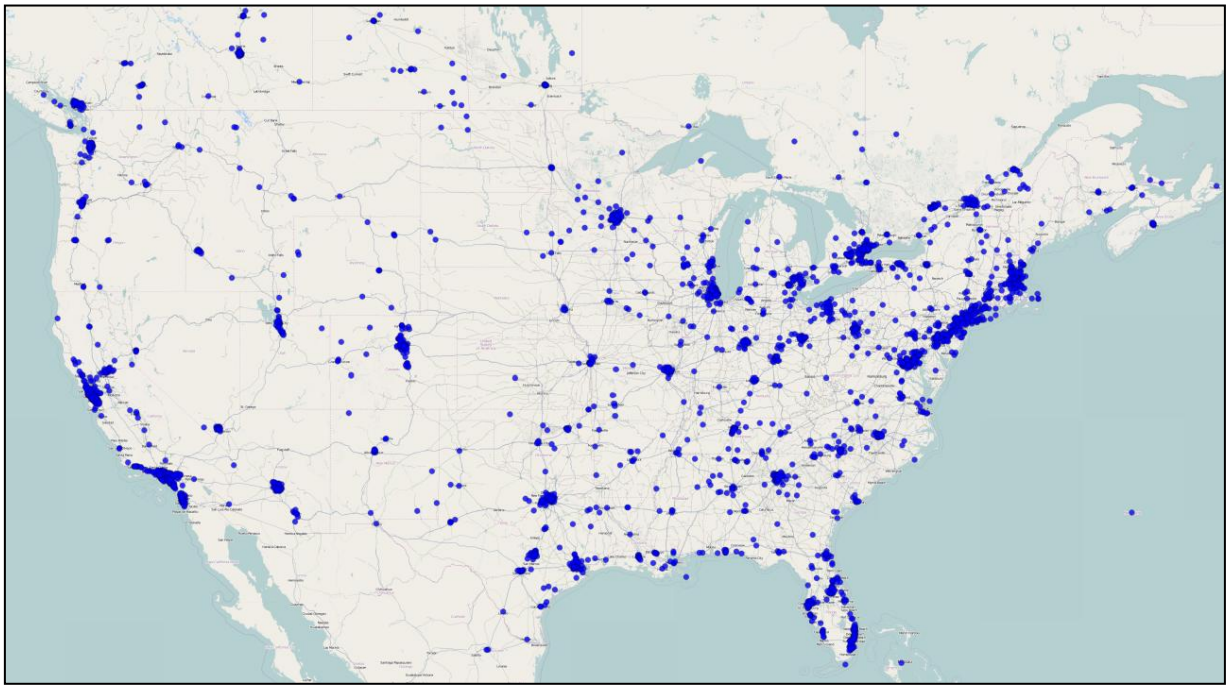


Figure 12: Localisation of equity firms (red) in the US and Canada

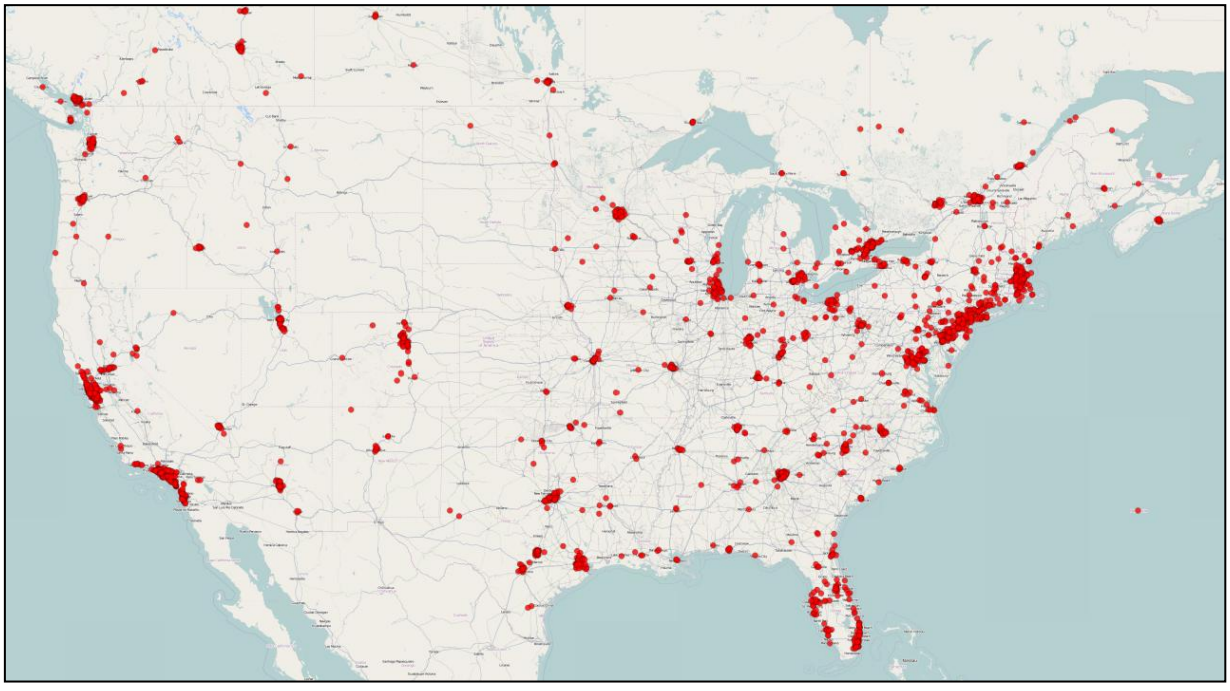


Figure 13: Localisation of M&A firms (blue) in Europe

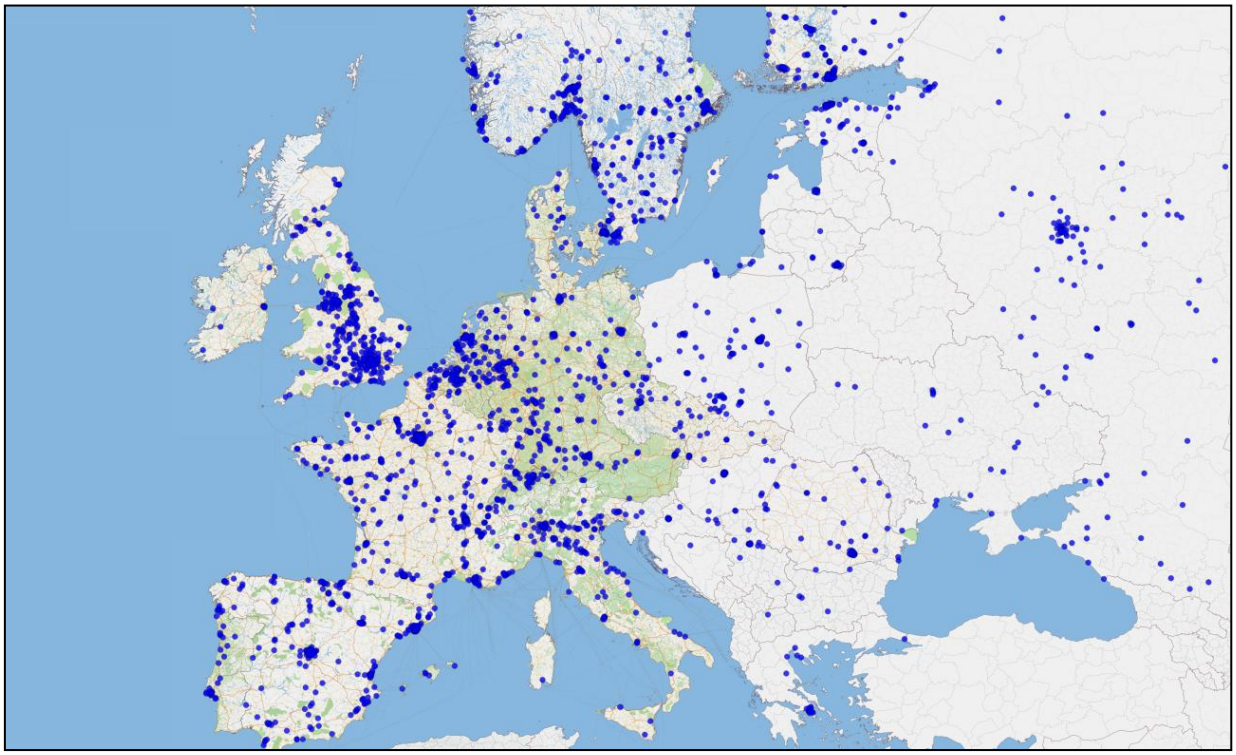
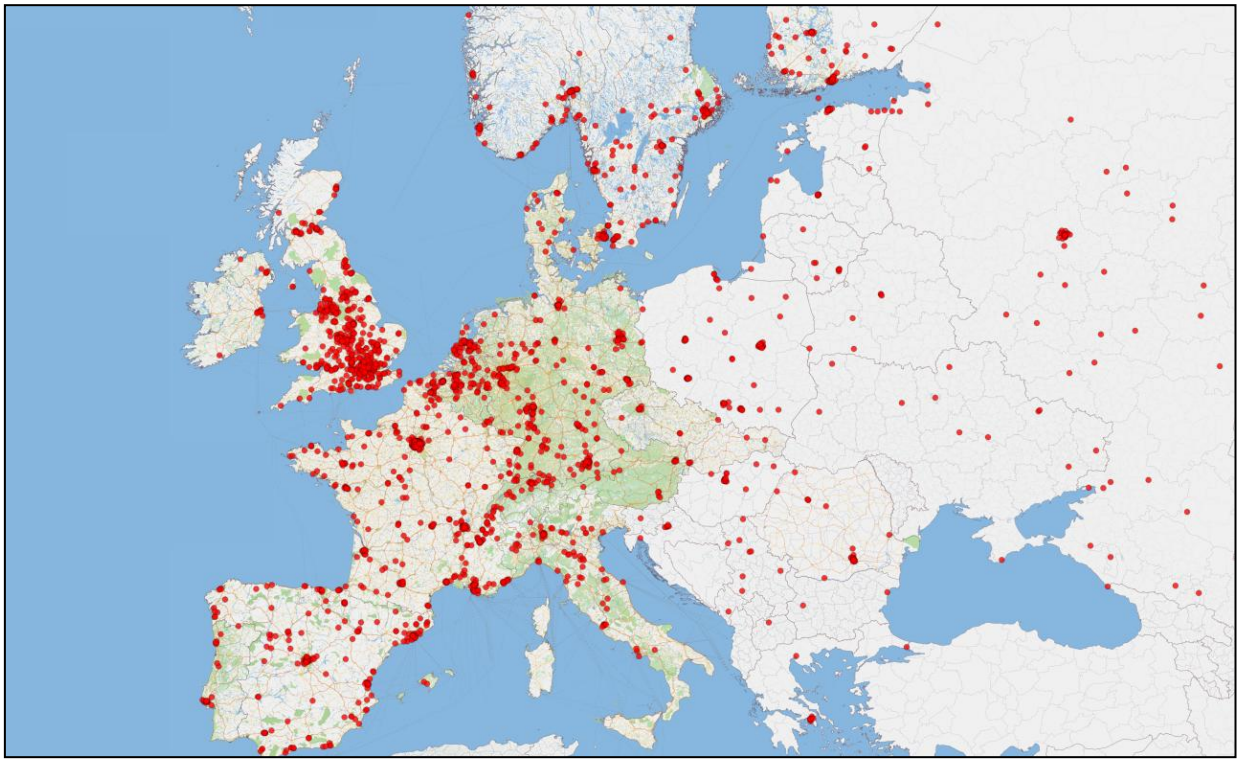


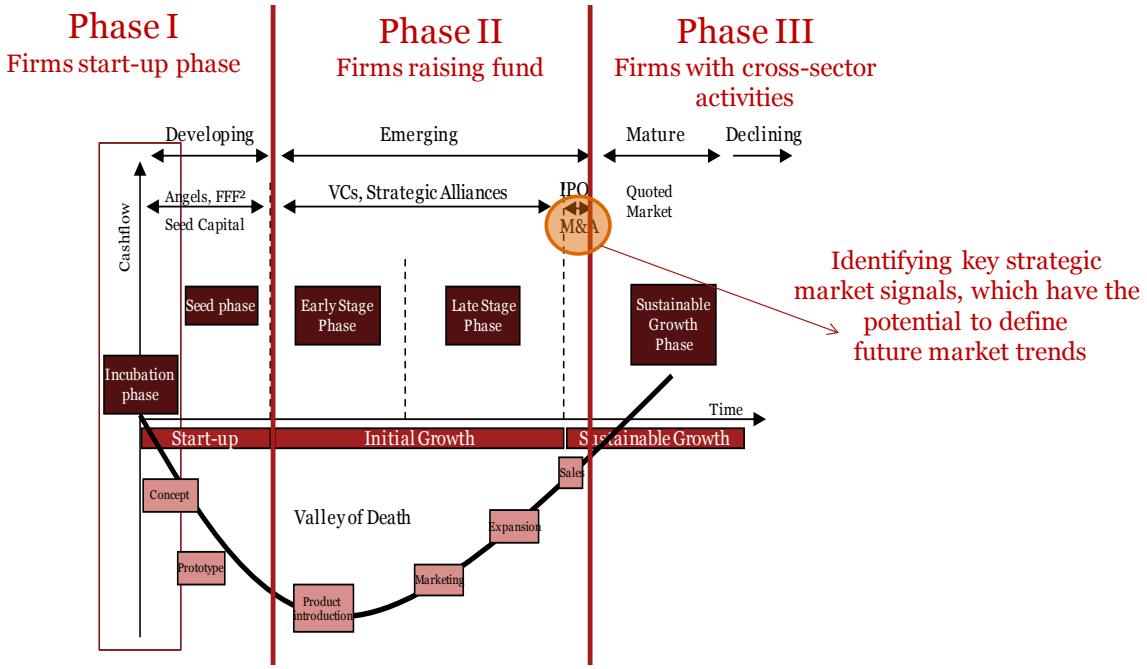
Figure 14: Localisation of equity firms (red) in Europe



3.2.2 Analysing cross-sectoral linkages based on M&A deals

The early stages of industry reconfigurations can be captured by exploring data on cross-sectoral mergers and acquisitions (M&A). This M&A data can be used to identify key strategic investment decisions made by companies in different industries that are driving current market trends or have the potential to define future market trends (Figure 15). By assessing the intensity and scope of these market signals we can assess the extent to which traditionally separate but now increasingly inter-connected economic activities are converging into a new emerging industry.

Figure 15: Industry growth cycle



The data from Zephyr covering M&A deals in all industries over the past five years was used to identify the interlinkages between different NACE codes. Each deal in the dataset identified a financial transaction between two companies with the same or different NACE codes. The total number of deals for each NACE code pairing was computed. For example, as shown in Table 10, there were 16 M&A deals between companies manufacturing pharmaceutical preparations (NACE code 2120) and companies involved in other research and experimental development on natural sciences and engineering (NACE code 7219). The same number of 'links' were found between computer programming activities (NACE code 6201) and business and other management consultancy (NACE code 7022).

Table 10: Interlinkages between different NACE codes

NACE code 1	No of deals for pairing	NACE code 2
2120 - Manufacture of pharmaceutical preparations	16	7219 - Other research and experimental development on natural sciences and engineering
6201 - Computer programming activities	16	7022 - Business and other management consultancy activities
5020 - Sea and coastal freight water transport	10	7112 - Engineering activities and related technical consultancy

Each pair of linked NACE codes was then classified based on whether the two codes were within (see Table 11):

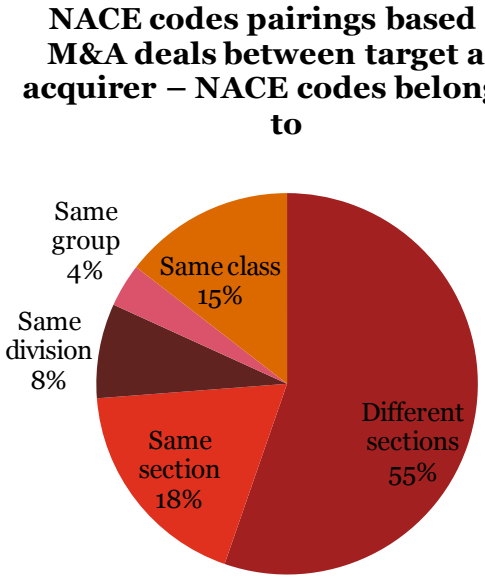
- the same class : 0 degrees of separation;
- same group : 1 degree of separation;
- same division: 2 degrees of separation;
- same section: 3 degrees of separation);
- different sections: 4 degrees of separation of the NACE classification.

Table 11: Classification of the NACE code pairs

Division	Group	Class		ISIC Rev. 4
			SECTION J — INFORMATION AND COMMUNICATION	
58			Publishing activities	
Same class	58.1		Publishing of books, periodicals and other publishing activities	
		58.11	Book publishing	5811
		58.12	Publishing of directories and mailing lists	5812
		58.13	Publishing of newspapers	5813*
Same group		58.14	Publishing of journals and periodicals	5813*
		58.19	Other publishing activities	5819
	58.2		Software publishing	
		58.21	Publishing of computer games	5820*
		58.29	Other software publishing	5820*
59			Motion picture, video and television programme production, sound recording and music publishing activities	
	59.1		Motion picture, video and television programme activities	
		59.11	Motion picture, video and television programme production activities	5911
		59.12	Motion picture, video and television programme post-production activities	5912
		59.13	Motion picture, video and television programme distribution activities	5913
		59.14	Motion picture projection activities	5914
Same division	59.2		Sound recording and music publishing activities	
		59.20	Sound recording and music publishing activities	5920
60			Programming and broadcasting activities	
	60.1		Radio broadcasting	
		60.10	Radio broadcasting	6010
	60.2		Television programming and broadcasting activities	
		60.20	Television programming and broadcasting activities	6020
61			Telecommunications	
Same section	61.1		Wired telecommunications activities	
		61.10	Wired telecommunications activities	6110
	61.2		Wireless telecommunications activities	
		61.20	Wireless telecommunications activities	6120
	61.3		Satellite telecommunications activities	
		61.30	Satellite telecommunications activities	6130
	61.9		Other telecommunications activities	
		61.90	Other telecommunications activities	6190
Division	Group	Class		ISIC Rev. 4
			SECTION D — ELECTRICIT Y, GAS, STEAM AND AIR CONDITIONING SUPPLY	
35			Electricity, gas, steam and air conditioning supply	
	35.1		Electric power generation, transmission and distribution	
Different section		35.11	Production of electricity	3510*
		35.12	Transmission of electricity	3510*
		35.13	Distribution of electricity	3510*
		35.14	Trade of electricity	3510*

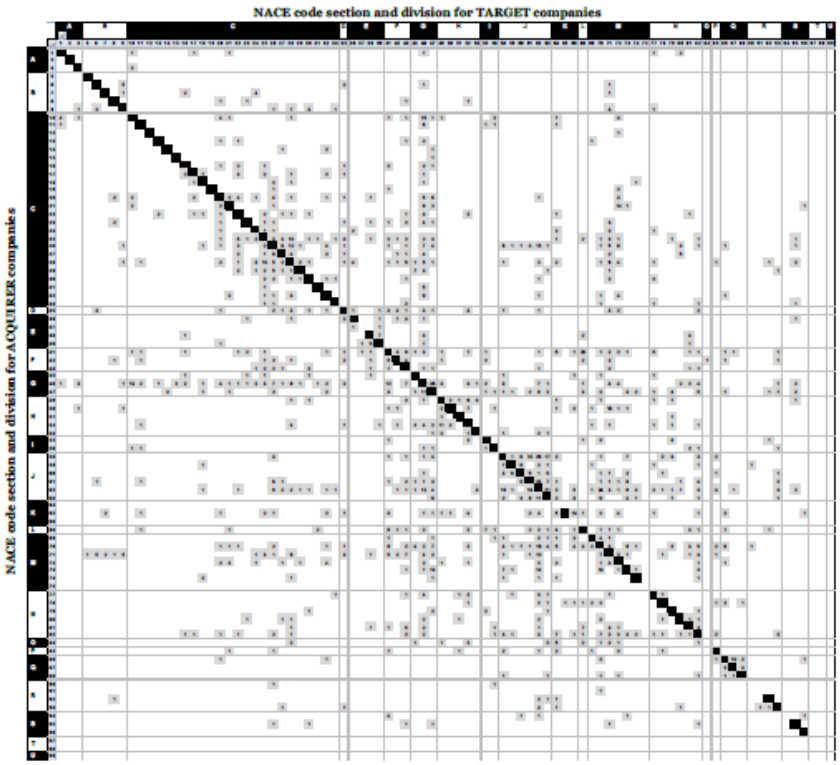
We then focused our attention on M&A deals involving companies with NACE codes that were in the same section (3 degrees of separation) and different sections (4 degrees of separation) of the NACE classification. 55% of pairings were in different sections and 18% of pairings in the same section but different divisions, groups and classes (see Figure 16). These M&A deals represent the types of non-traditional linkages between firms that characterise new emerging industries. This also allowed us to exclude vertical linkages along the value chain (e.g. between companies in manufacturing, production and retail within the same sector). We were thereby able to focus on diagonal linkages between companies in different sectors and in different stages of the value chain.

Figure 16: Focus on identifying cross-sectoral linkages



We proceeded to map the cross-sectoral M&A deals for all industries in a matrix format (Figure 17, see Appendix A, section 6.1). The matrix shows the interlinkages between different NACE code sections and divisions based on the number of M&A deals between companies with the corresponding NACE codes. Both target and acquirer deals for each NACE code division are represented. The number of deals between a particular NACE code division as a target and other NACE code divisions can be read vertically by column. The number of deals for a given NACE code division as an acquirer are shown horizontally by row.

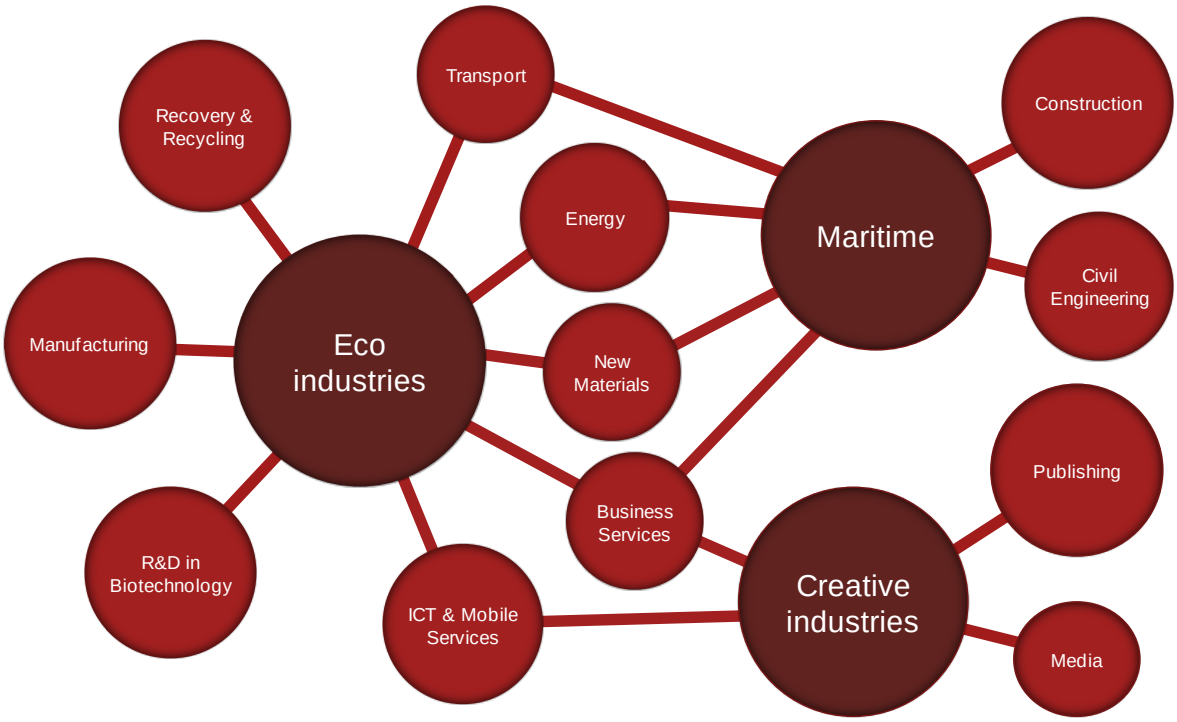
Figure 17: Cross-sectoral M&A deals - Matrix reproduced in the appendix (section 6.1)



We analysed the distributions of cross-sectoral linkages represented by the NACE code pairings and classified them in order to identify the perimeters of new emerging industries. For example, the link between sea and coastal freight water transport (NACE code 5020) and engineering activities and related technical consultancy (NACE code 7112) shown in Table 10 was assigned to maritime industries and both NACE codes allocated to this new emerging industry. Similarly, the pairing between manufacture of pharmaceutical preparations (NACE code 2120) and other research and experimental development on natural sciences and engineering (NACE code 7219) as well as the two codes were assigned to the personalised medicine industries.

By following this process we were able to trace new industry configurations based on the financial transactions between firms and identify the perimeters of new emerging industries. Figure 18 illustrates some of the linkages that were identified. The maritime new emerging industry, for example, includes NACE codes from the construction, civil engineering, energy, transport, new materials and business services sectors. Figure 18 also shows that there are overlaps between new emerging industries. The maritime and eco new emerging industries, for example, share codes from the transport, energy, new materials and business services sectors.

Figure 18: New industry configurations based on financial transactions between firms



3.2.3 Identification of candidate emerging industries

The analysis of cross-sectoral linkages based on M&A deals, complemented with an analysis of equity investments and informed by consultation with experts and of relevant references, led to the identification of 18 candidate emerging industries. These initial candidate emerging industries included: Construction, creative, eco industries, energy, experience, finance, food, geoengineering, personalised medicine, mobile services, management and business services, maritime, mobility, new materials, security, sensors, space, and wellbeing and active ageing.

Following this initial identification of candidate emerging industries, we reviewed the NACE codes assigned to each of them to determine any potential overlaps and complementarities. This exercise showed that the NACE codes for some of the candidate emerging industries were partly or mostly included in other candidate emerging industries. We therefore proceeded to merge some of the

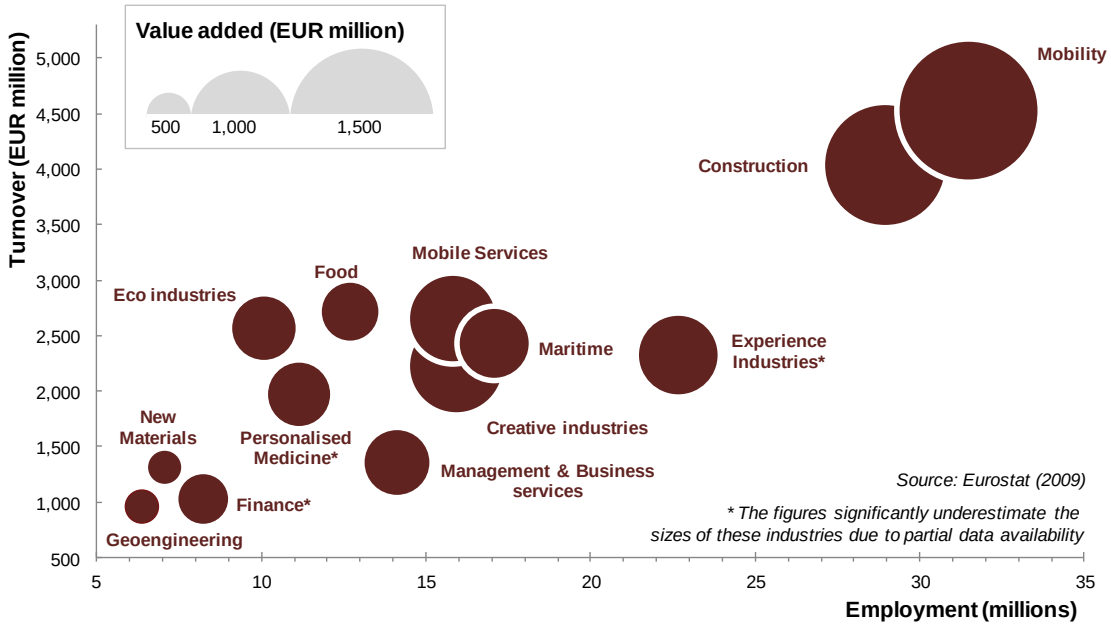
candidate emerging industries and reducing their number to 13 (Table 12). Wellbeing and active ageing was merged with personalised medicine, space with mobility. Security and sensors were merged with eco, mobile services, mobility and management and business services.

Table 12: Merging the initial 18 to 13 candidate emerging industries

	18 candidate emerging industries	Changes	13 candidate emerging industries
1	Construction		**Construction**
2	Creative		**Creative**
3	Eco industries	*Part of Sensors included*	**Eco industries**
4	Energy	*Part included in Eco*	
5	Experience		**Experience**
6	Finance		**Finance**
7	Food		**Food**
8	Geoengineering		**Geoengineering**
9	Personalised Medicine	*Wellbeing and Active Ageing included*	**Personalised medicine**
10	Management and Business Services	*Parts of Security and Sensors included*	**Management and Business Services**
11	Maritime		**Maritime**
12	Mobile Services	*Parts of Security and Sensors included*	**Mobile Services**
13	Mobility	*Space Included*	**Mobility**
14	New Materials		**New Materials**
15	Security	*Included in Mobile Services, Management and Business Services*	
16	Sensors	*Included in Eco, Mobile Services, Mobility and Management and Business Services*	
17	Space	*Included in Mobility*	
18	Wellbeing and Active Ageing	*Included in Personalised Medicine*	

We then conducted a comparative analysis of employment, turnover and value added data for these 13 candidate emerging industries (Figure 19). Construction and mobility have the largest turnover and employment amongst the candidate emerging industries. Geoengineering and new materials were on the other end of the scale with the lowest employment and turnover figures. The figures for finance, personalised medicine and experience are included in Figure 19 but it is important to stress that these are based on partial data as data on employment, turnover and value added was not available for a significant number of the NACE codes that were included in these candidate emerging industries.

Figure 19: Employment, turnover and value added for candidate emerging industries



We also ranked the candidate emerging industries based on the level of M&A and equity investments as well as their turnover, employment and value added (Table 13). The construction and mobility industries were again at the top overall but if we only consider the ranking in terms of M&A and equity investments the two candidate emerging industries that come out on top are mobile services and creative industries. Geoengineering and new materials were ranked the lowest.

Table 13: Ranking the candidate emerging industries

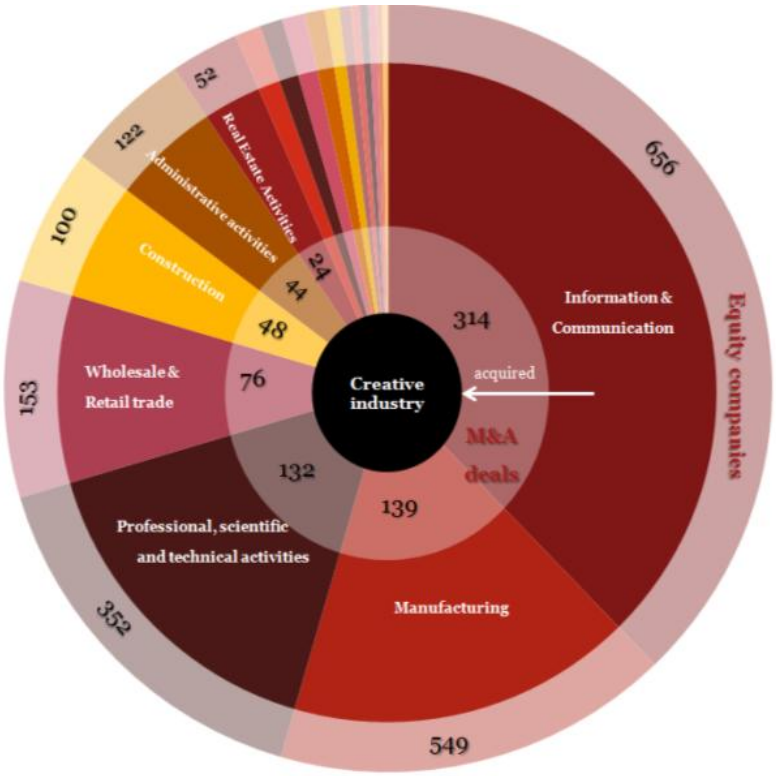
Emerging Industry	Rank - M&A	Rank - Equity	Rank - Turnover	Rank - Value added	Rank - Employment	Average rank
Construction	3	3	2	2	2	2.4
Creative industries	2	2	5	3	4	3.2
Eco industries	9	9	3	6	8	7.0
Experience industries	7	7	8	5	3	6.0
Finance	6	5	11	8	9	7.8
Food	10	10	6	10	11	9.4
Geoengineering	13	13	13	12	13	12.8
Management & Business services	5	6	9	7	5	6.4
Maritime	11	11	10	11	7	10.0
Mobile services	1	1	4	4	6	3.2
Mobility industries	4	8	1	1	1	3.0
New Materials	12	12	12	13	12	12.2
Personalised medicine	8	4	7	9	10	7.6

The following section illustrates our approach for analysing emerging industries by assessing cross-sector linkages.

3.2.4 Assessing cross-sector linkages for the emerging industries: the creative industries as an example

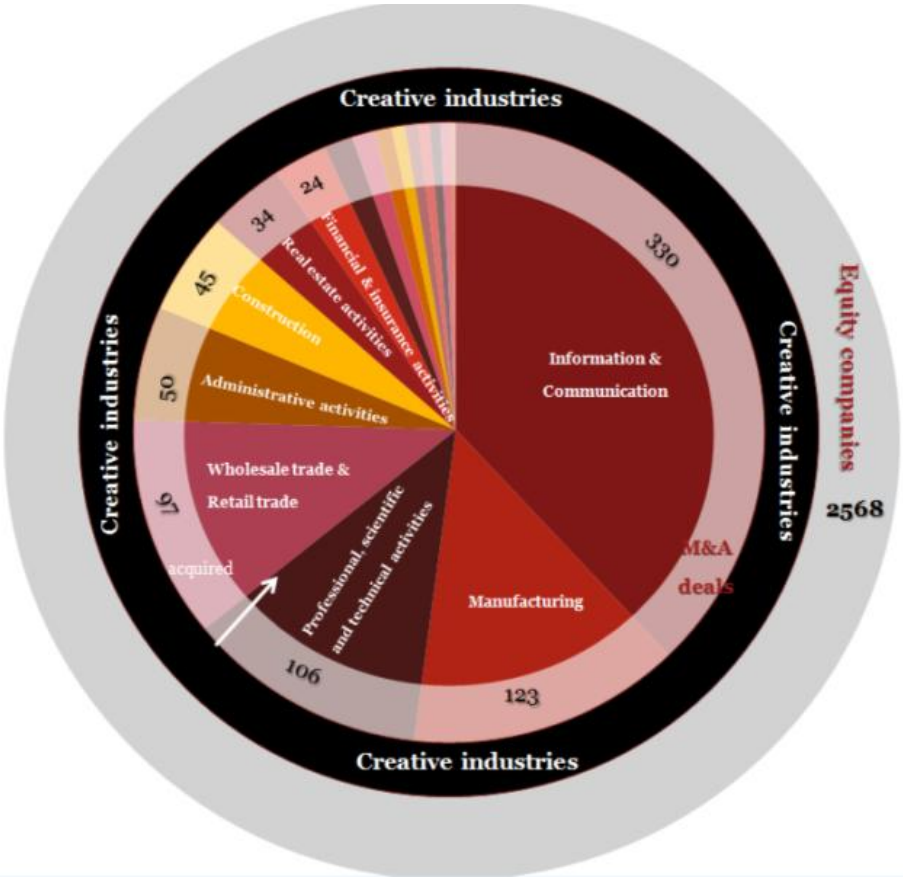
We conducted an analysis of the **emerging industries as a 'target' of other industries**. All the NACE Rev.2 classes defined as the emerging industries were taken as the target and all the acquirers were analysed. Figure 20 shows the creative industries as a 'target' of other industries in Europe. The creative industries, located in the centre of the graph are receiving many M&A investments by other industries (shown by the first inner-circle). For example the 'Information & Communication' (314 deals) and the 'Manufacturing' (139 deals) industry is invested in the creative industries between 2005 and 2011. To add another level of analysis, the outer-circle shows the number of equity companies investing into the concerned acquiring industries.

Figure 20: The creative industries as a 'target' of other industries in Europe (2005-2011)



We also conducted an assessment of the **emerging industries as 'acquirer' of other industries**. Figure 21 shows the creative industries as a 'target' of other industries in Europe. We have visually reported the result of our analysis to a lesser degree of granularity at NACE level one classification, in order to be able to fit all sectors into our graph. As explained in the previous graph, the targets are again in the centre of the circle, while the acquirers are located around. As the emerging industries in this step are analysed as acquirers, they are located in the outer circle, while their targets sectors are located in the inner one. The inner circle shows the number of M&A deals and the external circle shows the number of the equity companies.

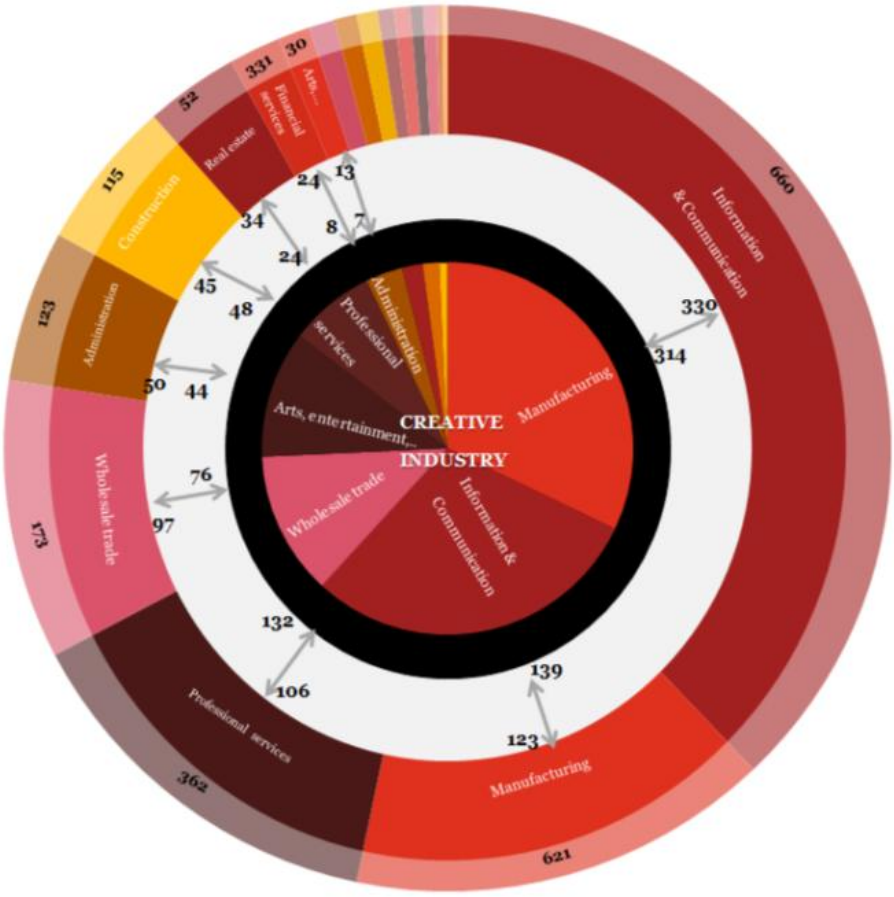
Figure 21: The creative industries as 'acquirer' of other industries in Europe (2005-2011)



In order to fully understand the scope of the investments, we also analysed the total deal activity. We considered the **emerging industry acting as both target and acquirer**: we summed up all the deal flow going backwards and forward, to obtain a full picture of the investments. To graphically represent this dynamic, we have grouped deal flows under NACE Rev.2 level one classification instead of four digits, just for illustration and graphical purposes.

Figure 22 shows the total deal activity for the creative industries. All NACE Rev.2 codes for one level classification sectors for this industry are seen in the middle to visually illustrate the industry composition. As already illustrated, the creative industries are mainly composed of 'Information & Communication' and 'Manufacturing' codes. Their strongest linkages go to the same NACE Rev.2 level one classification codes, meaning that those industries interact frequently with each other. The 'Information & Communication' sector is investing more (330 deals) into the creative industries than the creative industries are investing into it (314 deals), meaning that the emerging industry receives more investments than it is making.

Figure 22: Total deal activity for the creative industries in Europe (2005-2011)

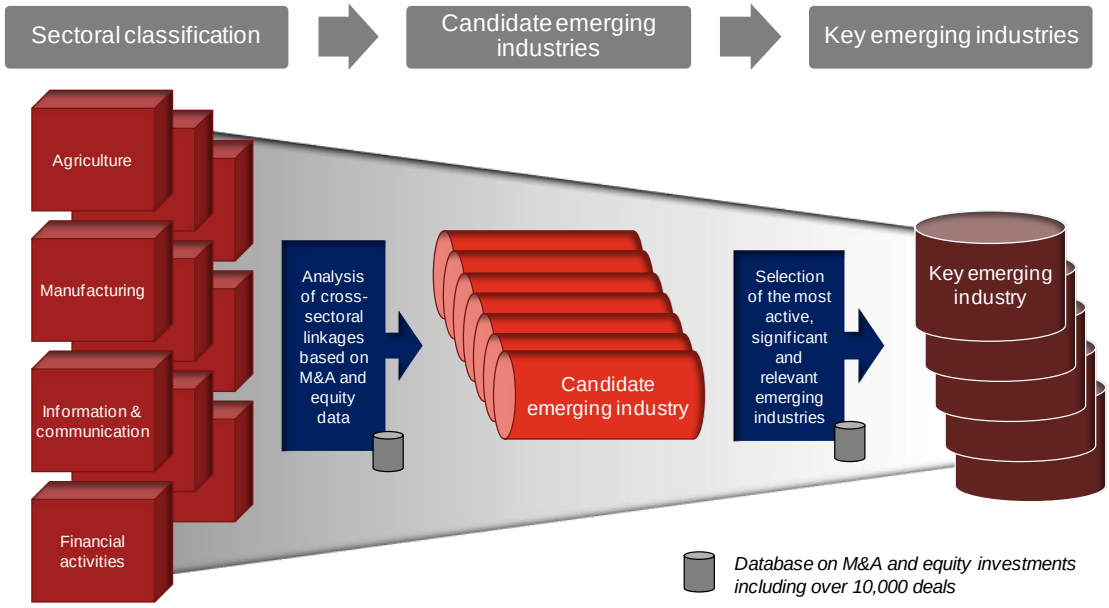


3.3 Selection of key emerging industries

Traditional industry classifications relying on a sectoral classification system are unable to capture the characteristics of emerging industries. Emerging industries by definition entail the transformation of traditional industries by responding to new market demands and exploiting new key enabling technologies. By analysing cross-sectoral linkages based on M&A and equity data, we were able to define the perimeters of industries that are in the process of emerging. We proceeded to move from a sectoral classification to a new cross-sectoral classification for emerging industries (Figure 23).

The classification methodology for emerging industries that we developed allowed us to identify an initial 18 candidate emerging industries, which we then merged into 13 candidate emerging industries. We then proceeded to select the most active, significant and relevant emerging industries on which our further analysis during the ECO III project will be based. The key emerging industries include (1) creative industries, (2) eco industries, (3) experience industries, (4) maritime industries, (5) mobile services industries, (6) mobility industries and (7) personalised medicine industries.

Figure 23: From sectors to key emerging industries



What are today's mega-trends in industrial transformation and how to spot them

A range of different criteria were taken into account in the selection of the key emerging industries. The selection was based on an assessment of the data collected on the candidate emerging industries (including the rankings in terms of M&A and equity deals, turnover, employment and value added), on a review of relevant literatures and on consultations with experts and the European Commission. We also ensured that the selection of key emerging industries provided an effective coverage of the cross-sectoral M&A deals identified earlier (see Figure 17). All but a handful of the interlinkages based on M&A deals were assigned to at least one of the key emerging industries (Figure 24). This indicates that the selected emerging industries take into account the wide range and are representative of the market signals observed in cross-sectoral M&A deals.

Figure 24: All 7 key emerging industries and cross-sectoral interlinkages based on M&A deals: number of emerging industries assigned to by NACE code division - Matrix reproduced in the appendix (section 6.2)

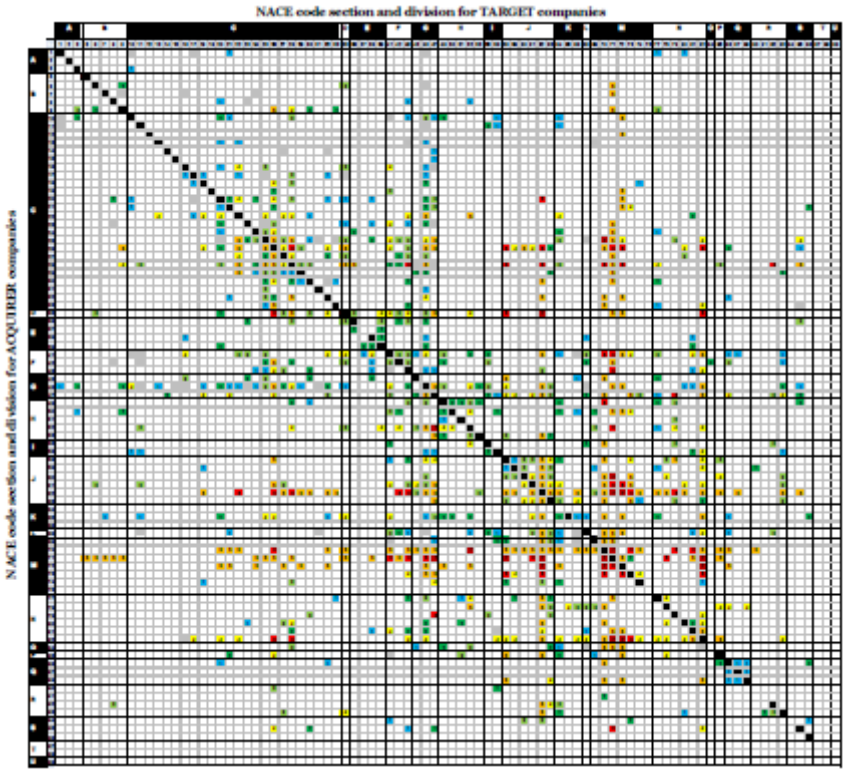


Figure 24 shows that NACE codes belonging to section N of the classification for professional, scientific and technical activities are most widely spread across the key emerging industries. A series of interlinkages between codes from architectural and engineering activities (division 71) and scientific research and development (division 72) with codes in manufacturing (section C) and information and communication (section J) are assigned to 6 or 7 of the key emerging industries. Activities related to human health and social work (section Q) on the other hand are only assigned to a single emerging industry.

We then plotted the number of M&A deals between targets and acquirers by NACE code division for all key emerging industries (Figure 25, see Appendix A, sections 6.3 to 6.9). The resulting matrices effectively illustrate how the perimeters of the new emerging industries are delineated through different combinations of cross-sectoral linkages. Creative industries are composed primarily of information and communication activities (which include publishing, media production and broadcasting) and professional and technical activities (which include advertising) but there are also interlinkages with manufacturing activities. Eco industries comprise mainly interlinked activities from manufacturing, the supply of energy and science and technology.

The most significant NACE divisions in terms of cross-sectoral M&A deals for experience industries are retail trade (47), computer programming and consultancy (62), information services (63), consulting (70), and business support activities (82) which include the organisation of conventions and trade shows. Maritime industries link primarily NACE codes from manufacturing activities (materials and products), energy supply, construction, transportation and scientific and technical activities.

Mobility industries comprise the widest range of cross-sectoral linkages with particularly intense relationships between the manufacturing of computer, electronic and electrical products and equipment, transportation and storage, information and communication activities, and professional, scientific and technical activities. Information and communication activities are also the most significant component of the mobile services emerging industry. Finally, personalised

medicine principally brings together human health and social work activities, the manufacturing of computer, electronic and optical products, the manufacture of machinery and equipment, computer programming, engineering and technical analysis, and scientific research and development.

Figure 25: Number of M&A deals between targets and acquirers by NACE code division for the key emerging industries - Matrices reproduced in the appendix (sections 6.3 to 6.9)

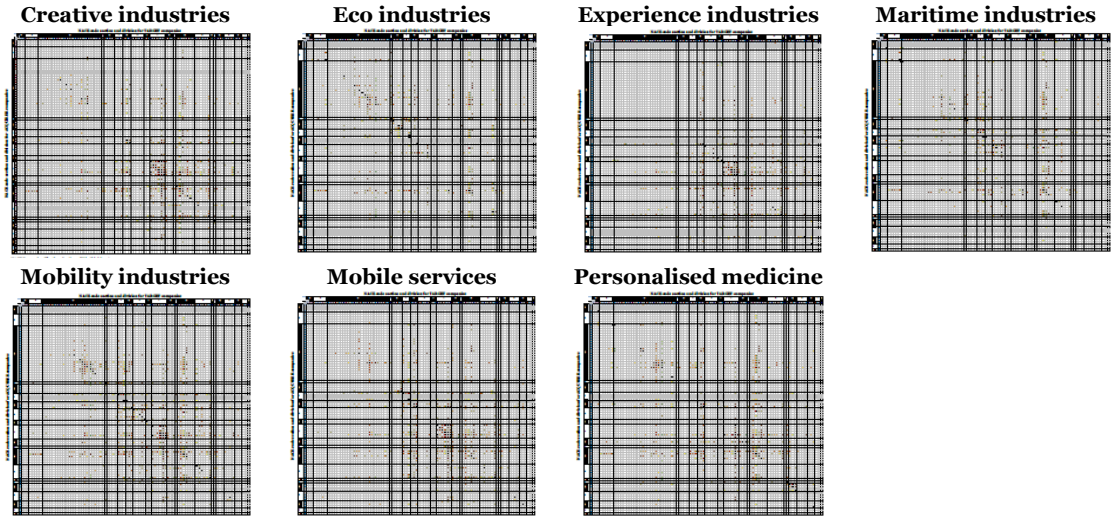


Table 14 shows the number and proportion of NACE codes that we have identified for each of the seven key emerging industries. The lists of NACE codes for the seven key emerging industries are included in the appendix of this report. From the total of 615 NACE Rev.2 codes we allocated 364 codes for the seven emerging industries. More than half of the codes are thus included, which gives us still a very broad view. Furthermore, for a number of codes, there is not a unique code allocation to a sole and unique emerging industry.

Table 14: The seven key emerging industries defined by the number of NACE codes

Name of the Industries	Creative	Eco	Experience	Maritime	Mobile services	Mobility	Personalised Medicine	Total existing
Nr. of NACE codes identified	67	45	55	42	38	77	40	**615**
% total	10.9%	7.3%	8.9%	6.8%	6.2%	12.5%	6.5%	

This finding brings us to the next step to further analyse those NACE Rev.2 codes, which belong to several industry sectors. In fact, one of the objectives of our methodology will be to frame the extent to which a single new emerging industry can be defined by a group of codes. Following this reasoning, the inner nature of a new emerging industry can be defined by its 'degree of purity', or instead by its tendency to integrate technologies and services from other sectors and so to share its industry codes with other sectors.

A summary of the code distribution among one or more new emerging industries is reported in Table 15. The majority, 63.5%, of the number of NACE Rev.2 codes belongs to a sole and unique new emerging industry. The remaining codes belong to two or more emerging industry sectors.

Table 15: NACE codes present in one or more newly emerging industry

Number of newly emerging industries	Number of codes	% codes
Codes present in 1 industry sector	188	63.5%
Codes present in 2 industry sectors	86	29.1%
Codes present in 3 industry sectors	17	5.7%
Codes present in 4 industry sectors	5	1.7%
Codes present in 5 or 6 industry sectors	0	0.0%
Total codes	**296**	**100%**

The objective of the classification methodology we are currently developing is to identify new trends and dynamics that the market is experiencing and to have a better view of which industry sector codes vary across several new emerging industries. From our analysis we will be able to understand the extent of this phenomenon and to provide the underpinning explanations for it.

3.4 Key emerging industries: context and characteristics

A wealth of literature exists on emerging industries and their significance is widely acknowledged. Emerging industries have significant potential to fuel economic growth, help renew or diversify a country's or region's economy, and create new and high value-added jobs. In the context of the Europe 2020 Strategy[27], the **development of these emerging industries is key for enhancing Europe's present and future competitiveness and prosperity**, for enabling its industrial renewal by fostering the development of robust and sustainable industrial platforms from which European companies can compete globally, but also for unlocking the innovation required to allow Europe to shift towards a low carbon, resource-efficient and knowledge-based economy.

Table 16 summarises some of the most significant studies on the key emerging industries identified through our analysis. On mobile services and maritime industries there is no comparable literature yet. For the maritime industry we examined all the maritime clusters in Europe[28] and reviewed several case studies, one of which is covered below.

Table 16: Selected literature on the identified emerging industries

Emerging industries	Literature source
Creative industries	1. Dominic Power & Tobias Nielsen (2010), Priority Sector Report: *Creative and Cultural Industries*- Methodological Appendix, Europe Innova & European Cluster Observatory
	2. Caroline Chapain & Lisa de Propis & Juan Mateos- Garcia (2010), *Creative clusters and innovation: Putting creativity on the map*, NESTA
	3. Pro Inno (2009), *Challenges for EU support to innovation in services- Fostering new markets and jobs through innovation*
	4. United Nations (2010), *Creative Economy Report 2010*

[27] http://ec.europa.eu/europe2020/index_en.htm

28 European Maritime Clusters, Niko Wijnolst, Jan Inge Jenssen, Sigbjørn Sødal, November 2003

Eco industries	5. European Commission (2009) *The environmental goods and services sector*, Luxembourg Office for Publications of the European Communities
	6. Ecorys SCS Group (2009), Study on the Competitiveness of the EU eco-industry- *Within the Framework Contract of Sectorial Competitiveness Studies*- Final report Part 1, Brussels
Experience industries	7. Göran Lindqvist & Sergiy Protsiv (2011), Priority Sector Report: Experience Industries, Europe Innova & European Cluster Observatory
	8. Dr Reinhard Büscher (2011), *From Tourism to the Experience Economy: Transformation through service innovation*, Europe Commission Enterprise and Industry
	9. http://experienceuk.org.uk/directory/alpha
	10. Danish Enterprise and Construction Authority (2008), *Growth through Experiences- an analysis of Denmark in the experience economy*, Denmark
Mobility industries	11. Niklas Andersson & Jan Annerstedt (2010), Priority Sector Report, *Clusters in the Mobility Industry: Automotive and Tourism Sectors*, Europe Innova
	12. ICF Consulting & Moving the Economy (2002), Building a New Mobility Industry Cluster in the Toronto Region, Toronto
Personalised Medicine industries	13. Elia Giovacchini (2011), *Priority Sector Report: Life Science, European Cluster Observatory*
	14. Andreas Blohm Graversen & Jorgen Rosted (2009), *Towards fact-based cluster policies: Learnings from a pilot study of Life Sciences in the Baltic Sea Region, Inno Nets & Monitor & Copenhagen Economics & Fora*

It is also important to mention that based on a review of the literature and knowledge of the different emerging industries we have gathered from our past experience, there are some overlaps between these categories, in particular with regard to their technological dimension. The technological overlap can be considered as a basis for cross-sector fertilisation, and inter-linkages which allow the industries to grow and differentiate. The following paragraphs describe the composition and characteristics of the key emerging industries

Eco industries comprise those industries that provide innovative products and services intending to positively influence the natural environment. It is commonly understood that eco industries correspond to what the Organisation for Economic Cooperation and Development (OECD) and the EU's statistical office EUROSTAT call the "environmental goods and services industry", consisting of "activities which produce goods and services to measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use"[29]. Among these are activities related to pollution control, collection and treatment of waste and sewage, renewable energy, recycling/recycled materials, sustainable water management, and eco-construction.

Creative industries comprise activities related to the creation, production and/or distribution of creative goods and services as well as with the integration of creative elements into wider processes and other sectors. Creative industries are sometimes referred to as the cultural industries, but the two terms are neither synonymous nor interchangeable. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), "cultural industries refer to industries which combine the creation, production and commercialisation of creative contents which are intangible and cultural in nature. The contents are typically protected by copyright and can take the form of a good or a service. Cultural industries generally include printing, publishing and multimedia, audiovisual, phonographic and cinematographic productions as well as crafts and

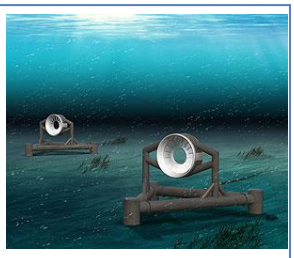
[29] The Environmental Goods and Services industry, Manual for Data Collection and Analysis, OECD and EUROSTAT, 1999

design. The term creative industries encompasses a broader range of activities which include the cultural industries as well as all cultural or artistic production, whether live or produced as an individual unit. The creative industries are those in which the product or service contains a substantial element of artistic or creative endeavour and include activities such as architecture and advertising[30]."Creative industries thus consist of activities drawing on "advertising, architecture, art, crafts, design, fashion, film, music, performing arts, publishing, R&D, software, toys and games, TV and radio, and video games"[31].

Maritime industries comprise companies whose activities supply innovative products and services related to the traditional maritime sector. By examining transformation of the traditional maritime industry into a new emerging industry we had the possibility to understand more about the characteristics and driving forces of the maritime emerging industry. One case study that is representative of the new maritime emerging industry is the current collaboration between DCNS and OpenHydro at the Port of Cherbourg (Figure 26, Figure 27 and Figure 28). The old and economically depressed shipyard of Cherbourg, in the North of France, is being completely reshaped and retransformed in response to a rising need for the construction of marine turbines. Open Hydro, an Irish company decided to install a new plant in the area. This plan was made possible by the naval competences present in Cherbourg and which Open Hydro could leverage upon. Open Hydro intends creating 300 jobs over the course of the next two years.

Figure 26: Maritime case study (1): The emergence of a new technolgogy

1990s — In a climate of increasing awareness of the global need for research and development in renewable energy, research begins on marine turbines to generate renewable energy from tidal streams



2005 — OpenHydro is formed after negotiation of world rights to the Open-Centre technology

- Design and manufacture of turbines for deployment in tidal farms throughout the world's oceans
- Sale of turbines with turnkey installation and maintenance services providing developers with an end to end solution

openhydro
tidal technology

2006 — Testing of the Open-Centre Turbine begins at the European Marine Energy Centre (EMEC) in Orkney, Scotland

30 Understanding Creative Industries: Cultural statistics for public-policy making, UNESCO, 2006
31 The Creative Economy: How People Make Money From Ideas, John Howkins, 2001

Figure 27: Maritime case study (2): DCNS and the Port of Cherbourg

1700s / 1900s — DCNS is a naval defence company based in France and one of Europe's leading shipbuilders, a company involved in both traditional and new activities

1990s — The Port of Cherbourg, highly dependent on the naval defence industry and the construction of nuclear submarines, enters a crisis after the end of the Cold War

1996 — 1700 jobs are lost at the shipyard of Cherbourg

2000s — The reconversion of the port and the shipyard presents an ongoing challenge

Attempts are made to identify new opportunities for the port and to diversify the local economy

Figure 28: Maritime case study (3): Development of a new industrial segment

2007 — DCNS acquires Sirehna, a specialist engineering company focused on the creation of key technologies for the naval, offshore and energy sectors

Acquisition

2011 — DCNS buys an 11% stake in OpenHydro

Test case

2012 — DCNS and OpenHydro win the Cleantech 2012 Award for the best investment in an innovative start-up by a major corporate group

New manufacturing process

2012 — A pilot project with four turbines is underway off Paimpol-Bréhat in Brittany

2014 — Planned start of operations of a new manufacturing plant for tidal turbines at Cherbourg

2018 — Production of 100 turbines annually expected at the new facility in Cherbourg creating 2-300 new jobs

Mobility industries comprise activities that provide products and services which aim to optimise the mobility of goods and people by combining or connecting different means and modes of transport (notably car/road, train/rail, airplane/air and ship/water), by optimising the effectiveness and resource-efficiency or reducing the cost or environmental impact of mobility (for example, through the use of new materials, new energy sources and grids, e.g. new technologies and devices such as GPS, Galileo for electric vehicles).

Mobile services industries comprise companies whose activities enable the provision of telecommunication, information, and entertainment services, including voice, internet, SMS, text,

and other data services. They include conversation services (mobile voice and person-to-person messaging), data access services (GSM, GRPS, CDMA, EDGE, UMTS, WLAN/Wi-Fi and other methods), and content services (SMS-based, MMS-based, browser-based, downloadable applications and others)[32], targeting both consumers (messaging services, transaction-based services, news/information services, entertainment services, mobile marketing services, consumer portal offers) and corporations (messaging services, Wi-Fi wireless access services, mobile office solutions, task-based applications, sector-based applications, corporate and professional portals). Due to the ubiquity of mobile phones and the rapid development of other connected mobile devices (tablets, e-books, etc.), mobile services industries constitute one of the fastest growing economic sectors worldwide[33].

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. Experience industries include activities traditionally associated with the sectors of tourism, culture, or leisure, in particular related to "the creation and operation of visitor attractions such as museums, galleries, science centres, heritage sites, zoos and aquaria, and theme parks", building on capabilities in "feasibility, architecture, construction, exhibit design, interpretation, equipment supply or management consultancy"[34].

Personalised Medicine industries comprise whose activities are designed to supply innovative products and services in the fields of medical technology, medical and surgical equipment and devices, Personalised Medicine information technology, Personalised Medicine infrastructure and services, clinical trials, as well as preventative Personalised Medicine care and general well-being (natural Personalised Medicine care, sport and recreation, community services, Personalised Medicine information, Personalised Medicine homes)[35]. These industries combine the fields of science, engineering and technologies to facilitate new innovations in the biomedical sphere and an increasing convergence of physical and biological technology platforms. They are key to supporting breakthroughs in medical knowledge and technologies, addressing major Personalised Medicine and societal challenges (such as the threat of new diseases, pandemics or ageing), enabling greater choice and the customisation of Personalised Medicine care (personalised medicine) and a move towards new Personalised Medicine lifestyles.

32 Mobile services in the networked economy, Jarkko Vesa, 2005

33 Sustainability Assessment of the Mobile Services Industry, by Rudi Anthony, Justin Bean, Jenn Coyle, Giles Hayward, & Kelly James, May 2011

34 EXPERIENCE UK, A guide to the UK's creative excellence in visitor attractions, UK Trade & Investment, 2010

35 Personalised Medicine and Wellbeing Industries: Exploring the Potential, Final Report, Prepared by Adroit Economics and GH Regeneration for and on behalf of Our Life, DH Northwest, the Strategic Personalised Medicine Authority and NWDA, 2010

4 Key emerging industries: activities and localisation

4.1 Analysis of distribution of deals

The collection of such an interesting data set also presented an opportunity for us to go further and to investigate which were the most active sectors, in terms of M&A deals and of fundraising events. In order to see whether the deal distribution was related to one or more emerging industries in particular, we decided to apply a statistical and ad-hoc method, aiming at measuring the distribution of data among a population. We used the Gini index (ε [0,1]) to analyse our database of NACE Rev.2 four digits codes, and the deals and fundraising events, being the Gini index used as a measure of disparity among different populations of data.

Indeed, the Gini index is normally used to measure the extent to which the distribution of income, wealth (or, in some cases, consumption expenditure) deviates from a perfectly equal distribution among individuals or households within an economy. This is done by assessing the area between the Lorenz curve and the hypothetical line of absolute equality, expressed as a percentage of the maximum area under the line. A Gini index of zero represents perfect equality, meaning wealth or income equally distributed among the individuals of a given population, while of 1, represents perfect inequality, meaning wealth or income consolidated within the wealth of a unique individual'. Table 17 below demonstrates the results for the seven emerging industries and their corresponding values.

Table 17: Results of the Gini index calculation

Emerging Industry	M&A	Equity
Personalised medicine	0.077	0.096
Maritime	0.085	0.199
Creative industries	0.131	0.133
Mobile services	0.219	0.186
Mobility industries	0.343	0.332
Eco industries	0.434	0.602
Experience industries	0.753	0.103

The results of the analysis coming from the Gini index bring a quite different perspective for the M&A and for the equity deals. In fact, the experience and eco industries have a high probability of concentrating M&A in a few sectors, while the personalised medicine and maritime industries are the emerging industries where equity deals are the most dispersed. Eco and mobility industries have a higher probability of concentrating equity only in a few sectors, while maritime, mobile services, creative, experience and personalised medicine industries have a more "homogeneous" distribution of equity among all sectors.

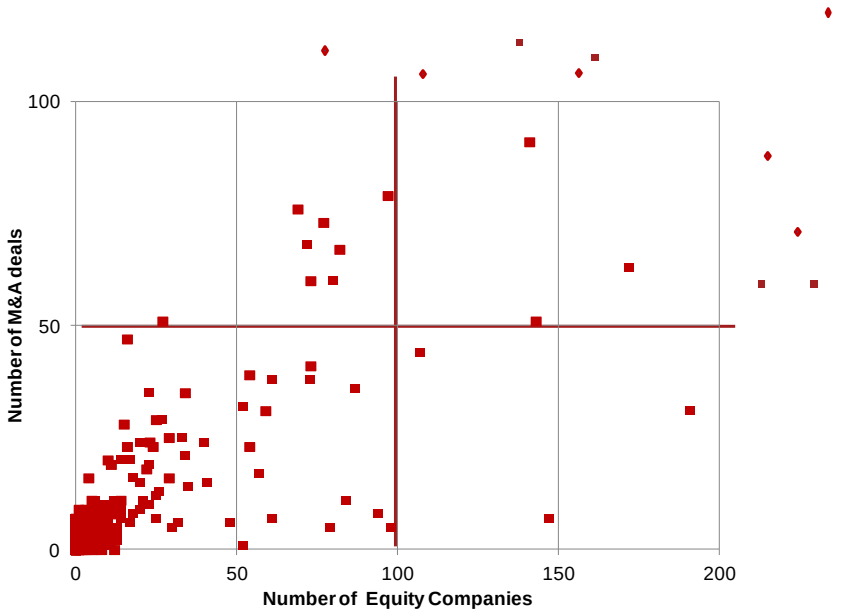
4.2 Segmentation of the key emerging industries

The results of our study so far have allowed us to better frame the perimeter of each of the emerging industries through the NACE Rev.2 4 digit codes deals analysis, and to define their major trends through the calculation of the Gini index. However, as such they could not bring us insights over the major characteristics of each emerging industry.

We therefore decided to use our database to build up a *metrical approach* in order to better segment each emerging industry, and to investigate which were the most active NACE Rev.2 4 digit codes, and which the less attractive from an investment stand point. This metrical approach was carried out through *scatter charts* representing NACE Rev.2 classes in which the M&A deals, and the number of companies raising equity were used as variables and plotted into a chart. Below is an

example of the scatter chart (Figure 29) we created for all emerging industries and including all deals worldwide recorded in our database.

Figure 29: Scatter chart illustrating the segmentation of the emerging industries based on M&A and on companies raising equity for every NACE Rev.2 four digits codes



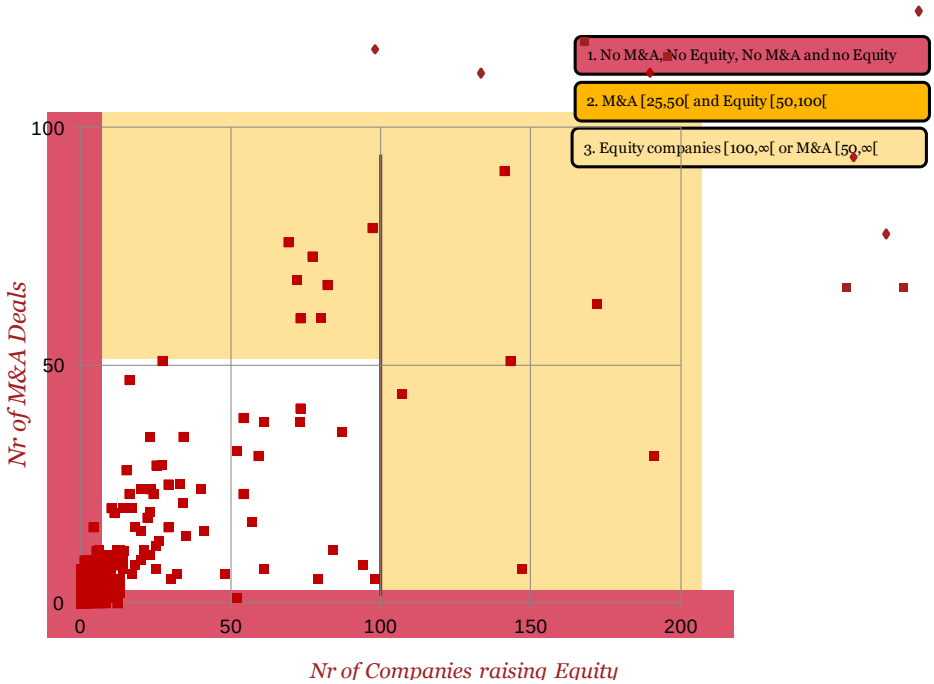
A more detailed description of the results found will follow in the following paragraphs.

Based on the scatters of all the emerging industries, the NACE Rev.2 4 digit codes of each were segmented into 7 main categories (Figure 30):

- *Upper left:* This section includes all industries where many M&A deals are occurring but fewer equity investments;
- *Upper right:* This section includes all industries receiving many M&As and also a lot of equity investments;
- *Bottom left:* This section includes all industries receiving only a low level of both M&A and of equity investments;
- *Bottom right:* This section includes all industries receiving many equity investments but only a low level of M&As;
- *No M&A but Equity:* This section includes all industries receiving equity but no M&A at all;
- *No Equity but M&A:* This section includes all industries receiving M&A but no equity at all;
- *No Equity and No M&A:* This section includes all industries receiving no M&A and no equity.

Following these main principles, every single segment of these charts has been screened in detail. As in all cases most of the deals were concentrated in the bottom left segment, and in several cases into the no Equity no M&A deals segment, special attention has been given to the analysis of these two segments. Deals included into the upper left, upper right, and lower right segment were regrouped into the same analysis, as a low deal flow was reported in all instances. Figure 30 illustrates how the segments were analysed for every emerging industry.

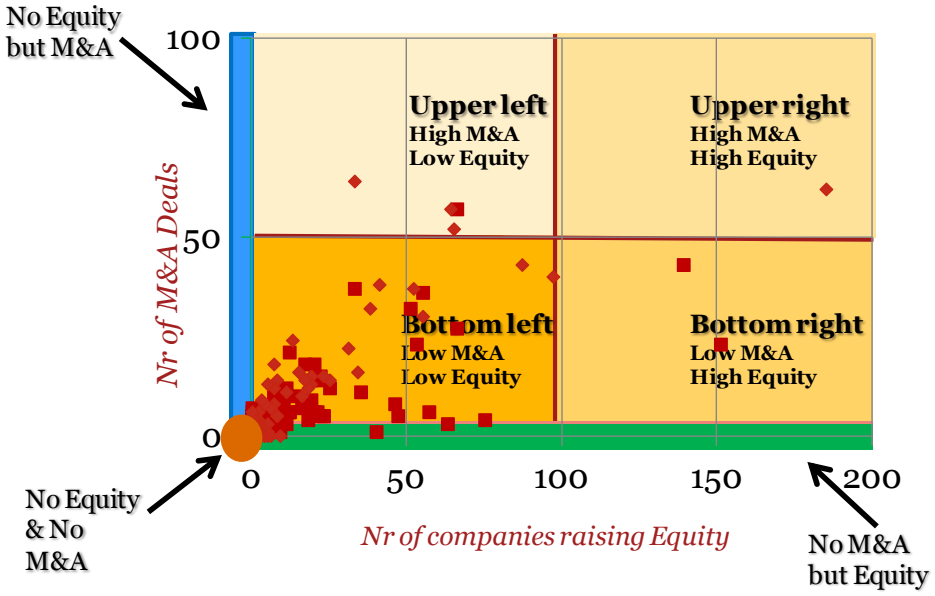
Figure 30: Schema illustrating the detailed analysis performed for the emerging industries



The scatter chart for M&A and equity investments for all the emerging industries (Figure 29 above) shows that the majority of the codes for all industries are concentrated on the segment having few companies raising funds and finalising M&A deals. In the subsequent analysis we look in more detail at the following three scenarios (illustrated in Figure 31):

1. No M&A but companies raising equity (green colour);
2. No Equity raising but companies with M&A (blue colour);
3. No Equity raising, and no M&A (orange colour).

Figure 31: Schema illustrating the segmentation of the emerging industries into 7 categories (focusing on no M&A, no Equity, no M&A and no rquity)



The summary table below (Table 18) shows for each emerging industries the 7 segments. The last three categories are the ones, which have no activities in equity/ M&A or both. For example of the 67 NACE Rev.2 four digits codes in 'Creative industries', 9 codes have no activity at all. This section might consolidate industries, which are at the end of their life cycle (no equity raising, no M&A deals), in which no major investments are being made (e.g. retail sale of music and video recordings in specialised stores), or it might possibly occur that the industries are so new, that their potential is not yet known (one example could be performing art and artistic creation).

Table 18: Summary table for all the different segments within each emerging industries

NACE codes	Creative industries		Eco industries		Experience industries		Maritime industries		Mobile services industries		Mobility industries		Personalised Medicine industries	
	nr	%	nr	%	nr	%	nr	%	nr	%	nr	%	nr	%
Upper Right	12	18%	6	13%	7	13%	4	10%	14	*37%*	11	14%	12	*30%*
Upper Left	2	3%	1	2%	3	5%	1	2%	3	8%	4	5%	0	0%
Bottom Right	3	4%	2	4%	0	0%	1	2%	1	3%	3	4%	2	5%
Bottom Left	30	*45%*	26	*58%*	31	*56%*	26	*62%*	17	*45%*	42	*55%*	24	*60%*
M&A but no Equity	8	12%	7	16%	4	7%	2	5%	1	3%	3	4%	2	5%
Equity but no M&A	3	4%	2	4%	4	7%	1	2%	1	3%	4	5%	0	0%
No M&A and no Equity	9	13%	1	2%	6	11%	7	17%	1	3%	10	13%	0	0%
	67		**45**		**55**		**42**		**38**		**77**		**40**	

In these categories, especially for the ones not showing any equity raising companies, it could also be that companies funded by family or high net worth individuals are included, which have not had to undergo an active fundraising activity. There is little likelihood, however, that this could occur as an established trend for a critical mass of companies within the same NACE Rev.2 four digit category.

As a follow up point for the readers of this report, we suggest that for every code having no M&A and no equity, a deep analysis of the market should be carried out. This would be extremely important, especially if we consider that special policies and framework conditions should be put in place for emerging sectors considered critical, and which are not capable of gathering the attention of VCs or of potential buyers.

The chart area delimited by M&A [25,50] and Equity [50,100] represents the emerging companies within NACE Rev.2 four digit codes which have managed either to raise some funds, or to be visible targets of some M&A, or both. These companies are the ones that most likely represent growth potential for the future, and which are right in the middle of creating structural changes in the market. The sector deal flow for both M&A and equity begins to be critical, companies clearly have passed or are about to pass local market clearance, and are getting ready for global expansion.

While some of the investments within this segment can certainly be seen as diversification of the investment portfolio of a fund or of an acquiring company, some others are of real interest for the emerging industries, as they could represent a strong future leverage.

The group of segments for M&A [50, 100] and Equity [100, 200] includes those which are most likely visible in the market, and for which a market structural change has been created. We hypothesise that companies belonging to a given NACE Rev.2 4 digits codes start by raising funds and are thus localised in the lower right segment. They then grow, and raise the attention of potential acquirers, and so then move to the upper left segment. As the market becomes more

mature, a higher number of companies finalising equity deals would appear, leading to further acquisitions. The code then would further move into the upper right segment. However, to prove our hypothesis, precise NACE Rev.2 code tracking for these emerging industries should be carried out over the next years.

The scatter charts for the seven key emerging industries are shown in Figure 32, Figure 33, Figure 34, Figure 35, Figure 36, Figure 37 and Figure 38.

Figure 32: Creative industries: M&A and equity deals by activity (EU27)

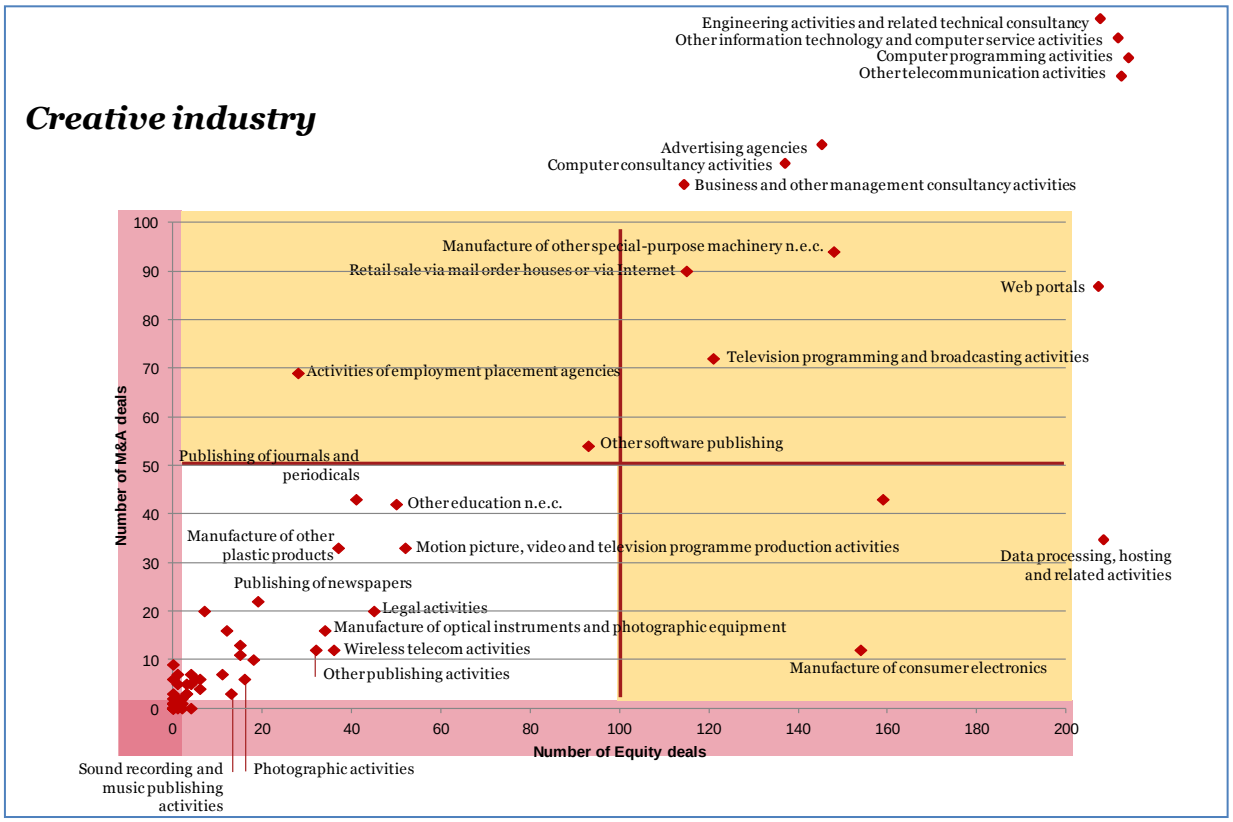


Figure 33: Eco industries: M&A and equity deals by activity (EU27)

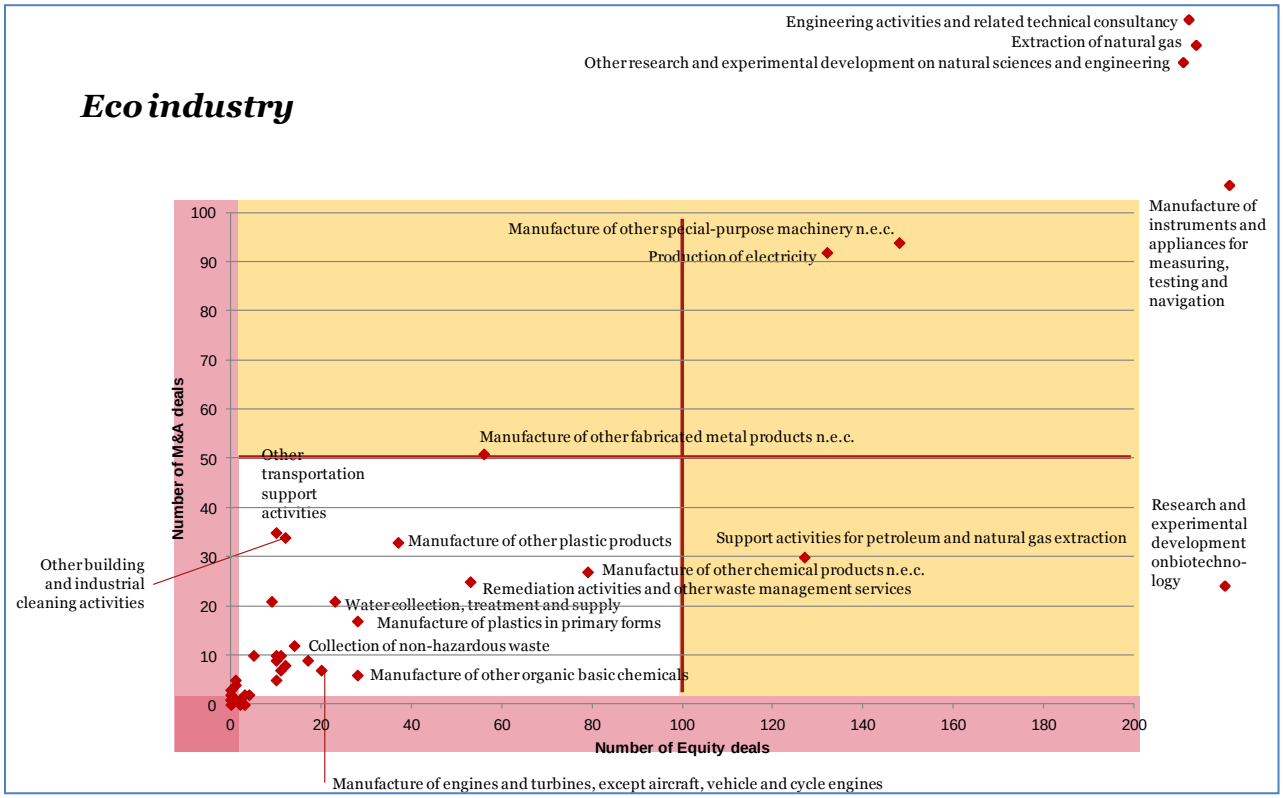


Figure 34: Experience industry: M&A and equity deals by activity (EU27)

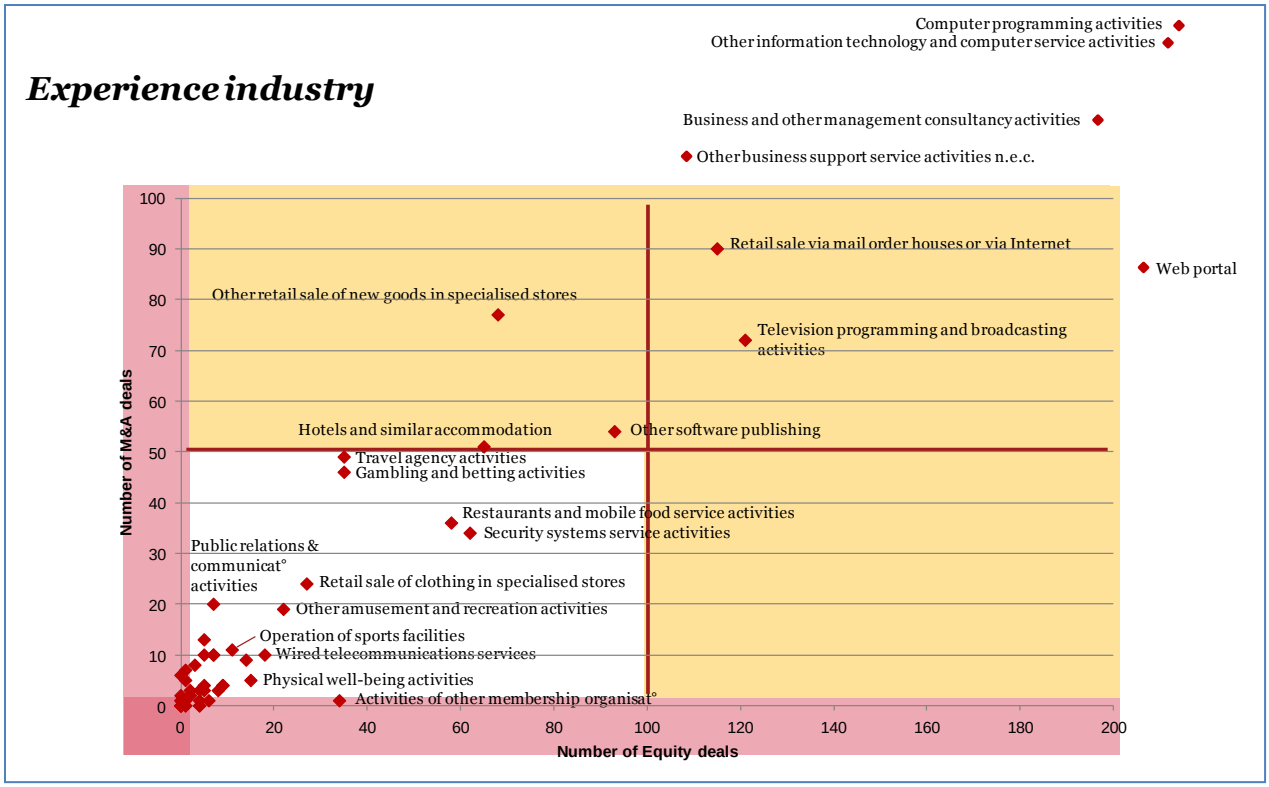


Figure 35: Maritime: M&A and equity deals by activity (EU27)

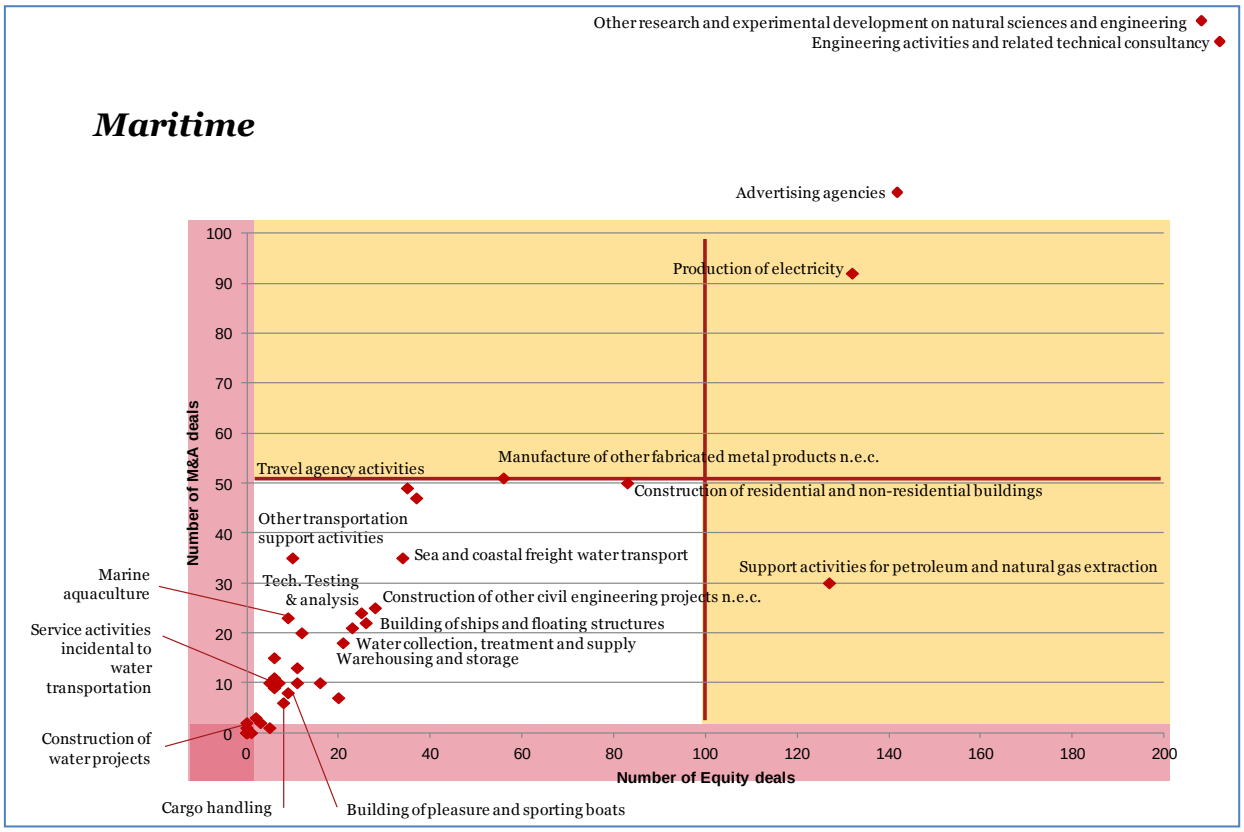


Figure 36: Mobile services: M&A and equity deals by activity (EU27)

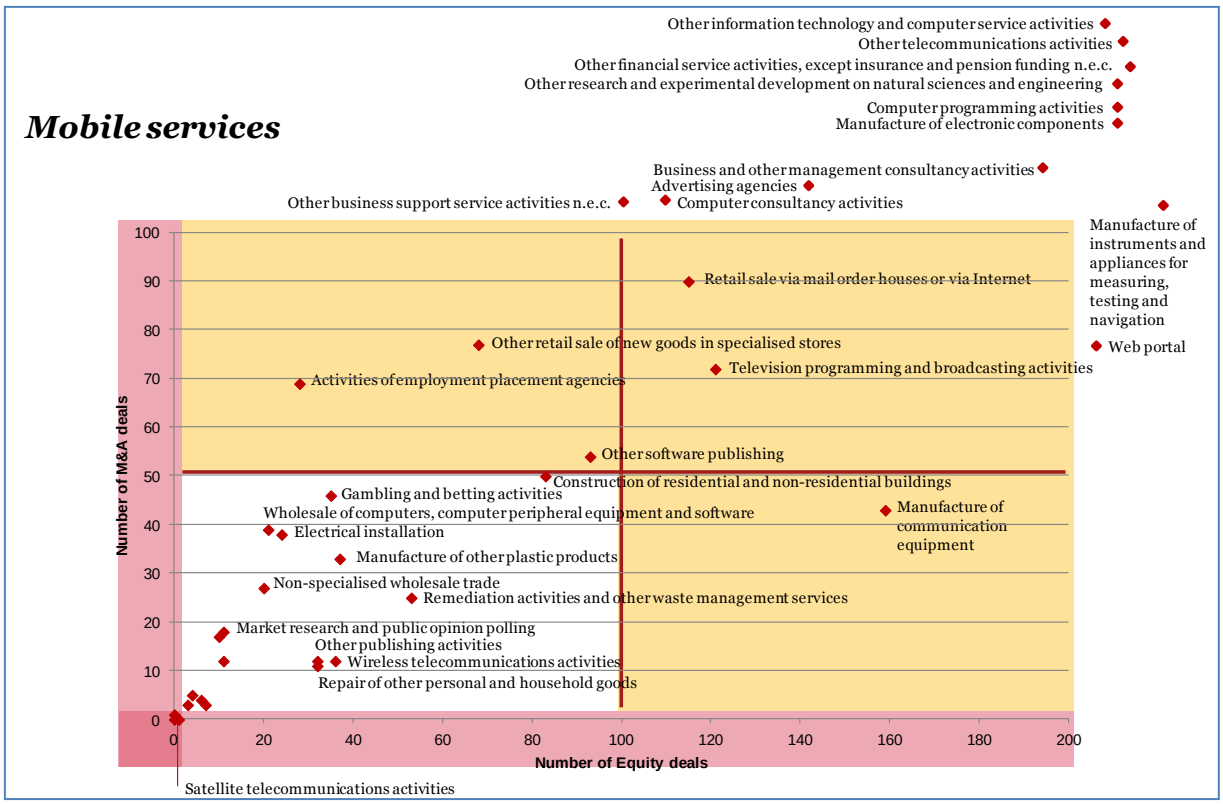


Figure 37: Mobility industry: M&A and equity deals by activity (EU27)

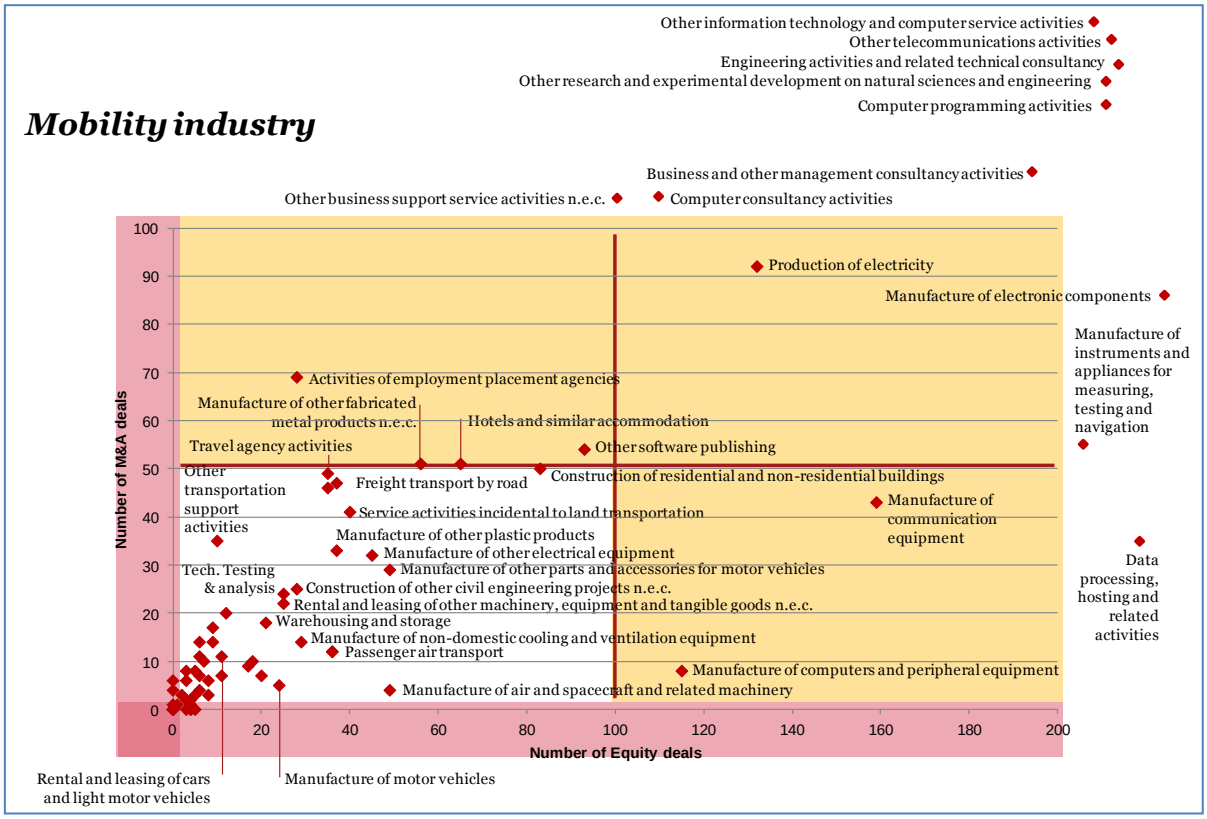
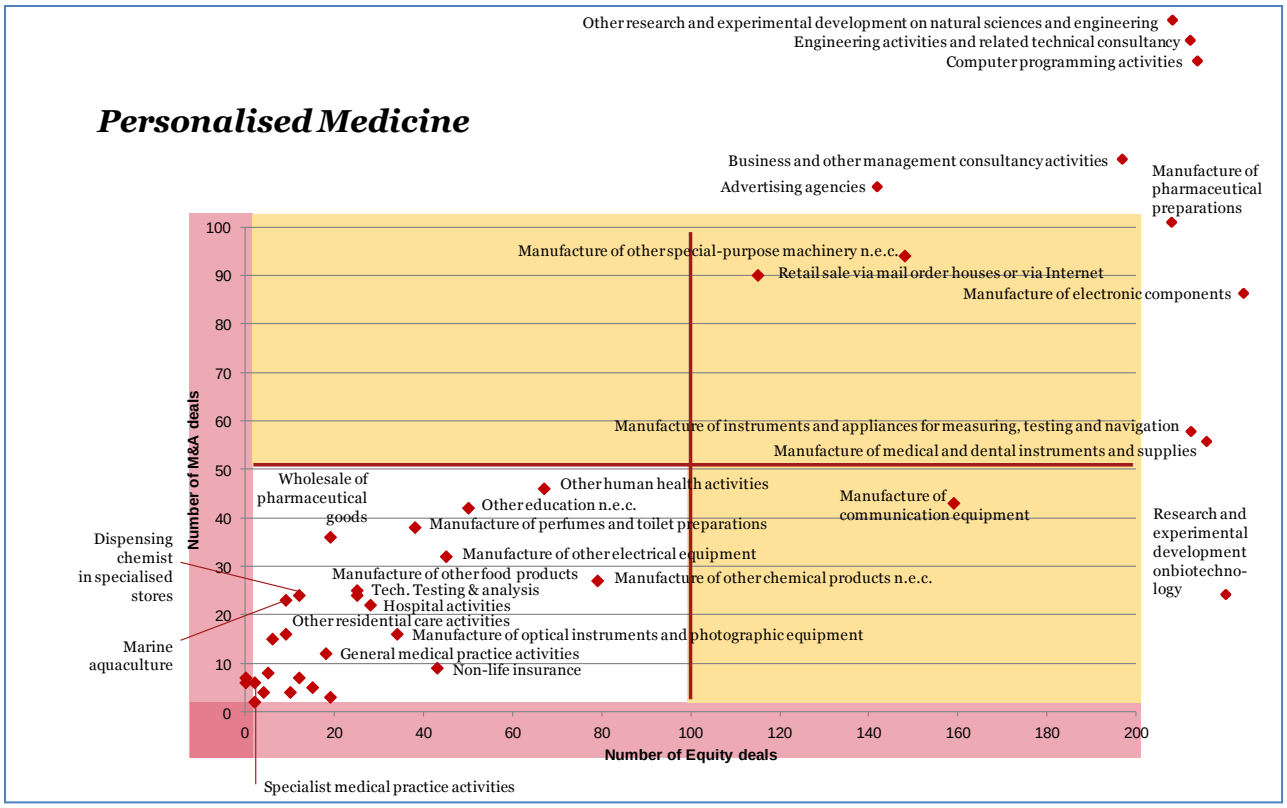


Figure 38: Personalised medicine: M&A and equity deals by activity (EU27)



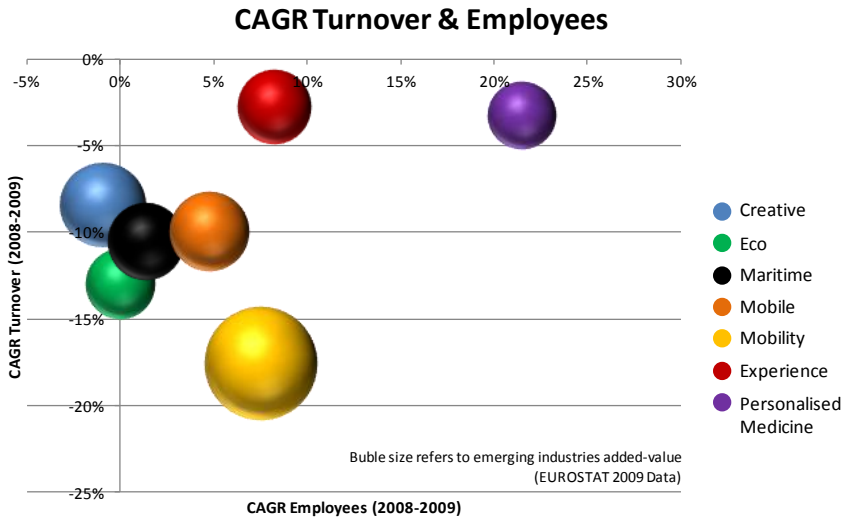
4.3 Turnover, employment and value added

In order to complete the analysis, sector growth potential based on official statistics was investigated. EUROSTAT provided the values for the Turnover, Employment and Value added for the years 2008 and 2009 in NACE Rev1 (4 digits level). Unfortunately data earlier than 2008 were not available, nor after 2009, while the data for 2010 will be available in the coming months.

The growth was therefore calculated only over these 2 years. In view of the global financial crisis, the change in turnover, employment and added value between 2008 and 2009 will not be representative of longer-term trends, and it could only give a rough indication of the relative dynamics of the different emerging industries. For this exercise, we have aggregated the NACE Rev.2 four digit codes following our analysis, including in the perimeter of a given emerging industry, and the ones which have been detected to be linked to these last ones by our methodology.

A consistent negative growth in terms of employment and of turnover has been shown in all emerging industries between 2008 and 2009 (Figure 39). Once again, it is important to underline that these numbers are related to indicators which measure not emerging companies, but well established industry sectors, within the same perimeter NACE Rev 2 4 digit codes of the newly emerging industry.

Figure 39: CAGRs for turnover and employees for the key emerging industries (2008-2009)



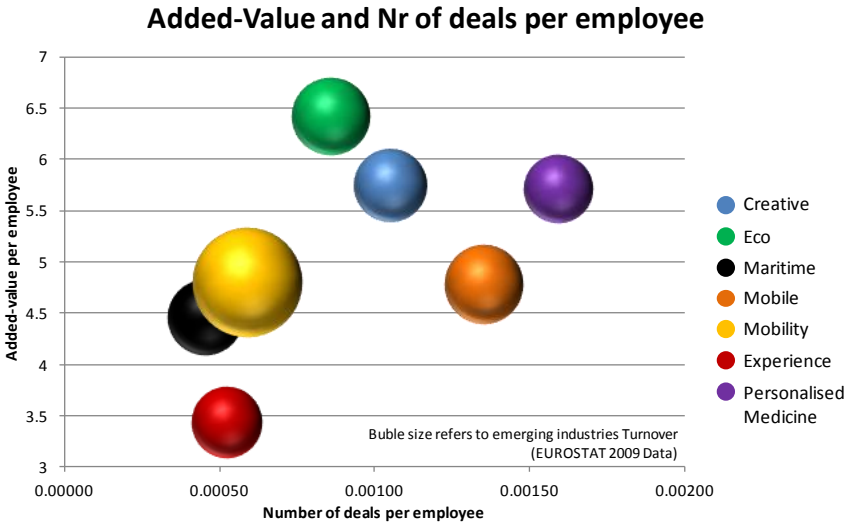
A follow up point for the persons and entities interested in this matter is to work closely with EUROSTAT, in order to gather further data for the years to come relative to the added value, turnover, and employees, for every NACE Rev.2 4 digit codes. This information would allow calculation of the CAGR for the abovementioned indicators, and could provide a more reliable analysis as it would concern an established trend, and not only values relative to two years.

Deal making, namely M&A, is an activity that traditional industry sectors regularly undertake. We thought it would be useful to assess the deal making performance of the employees, along with the added value each of them generate, among the different emerging industries. In order to do this we have aggregated the NACE Rev.2 4 digit codes as described previously for each of the emerging industries.

The deal numbers are derived from our database, while turnover, added value, and employees from EUROSTAT data. The picture we have drawn is rather interesting, as it shows how added value generated by the employees is not always proportional to the number of deals. Some of these industry sectors are efficient, such as Personalised Medicine: added value per employee is high,

while the number of deals per employee is among the lowest. The experience industry has the highest number of deals per employee, while the value added generated is the lowest (Figure 40).

Figure 40: Added value and number of deals per employee for the key emerging industries



4.4 Analysis of patent data

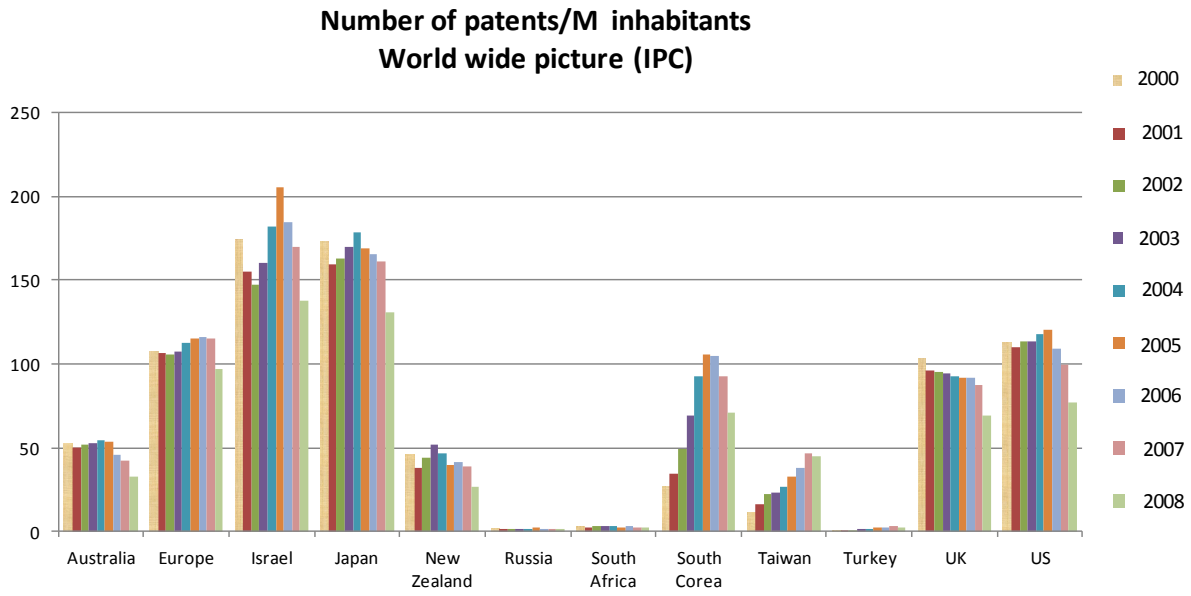
Patent data were sourced through the European Patent office (EPO), which liaised with the World intellectual Property Organisation (WIPO) for access to the full data set. The classification of the data we received followed the International Patent Classification (IPC) system for the periods 2000 to 2008. Data (number of patents/M inhabitants) covered all countries of the world producing patents over these years.

IPC Patents are organised across nine different classes, and 122 subclasses. As this classification doesn't correspond to the NACE Rev.2 industry classification, and no exhaustive conversion tables are available, a manual exercise was done, in order to allocate patents to each of the emerging industries investigated under this study. This exercise was performed by looking at the NACE Rev.2 4 digit codes: when a correspondence was found between the IPC code description, and the NACE Rev.2 4 digit code, the IPC code was allocated to the same emerging industry of the NACE Rev.2 4 digit code.

For some IPC codes overlapping descriptions were found, in industries such as experience and creative, and personalised medicine and eco. For these codes, specific experience/creative, and eco/personalised medicine categories were created. Following our analysis, most of the IPC codes corresponded to the NACE Rev.2 1 digit code 'Manufacturing' category, which is understandable, as most patents are used to improve the manufacturing processes across all sectors.

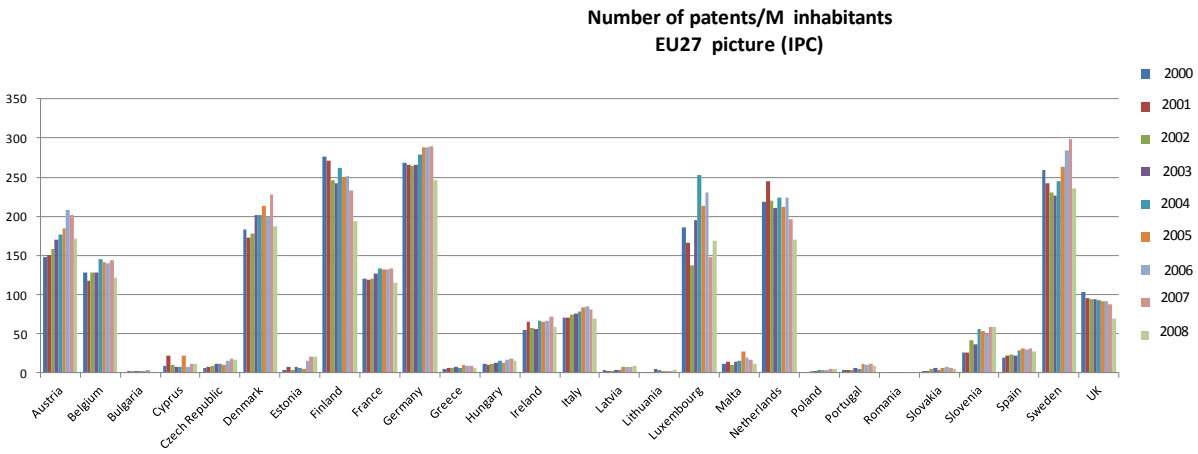
The graphs below summarise our results. Even though the geographical distribution of patents is out of the scope of this work, we thought it useful to include some graphs to understand the major sources of innovation in the world. An analysis based on patent data over the last years (Figure 41) shows a general decline in patents production across all countries. Overall the most productive countries are Israel and Japan, while Europe and the US fall behind these leaders.

Figure 41: Number of patents per million inhabitants (worldwide)



Among European countries (Figure 42), the Scandinavian countries (including Finland) in general are the most active. The Netherlands, Germany, Austria and Belgium are also well positioned, while countries such as Italy, France, and UK are less active. Luxembourg appears to be a high patents producer; however this data are most likely due to the fact that this country enjoys a favourable IP regimen, and that many people commute to work in Luxembourg, while residing in its neighbouring countries.

Figure 42: Number of patents per million inhabitants in the EU27



When we look at patent distribution for each of the emerging industries, it is not a surprise to us to see that the mobile industries have the greatest number of patent creation, both in 2000 (Figure 43), and in 2008 (Figure 44) for the worldwide comparison. Eco and personalised medicine industries are shown to be very active as well, while the number of patents are lower for creative, experience, and mobility.

Figure 43: Number of patents per million inhabitants by country and key emerging industry (2000)

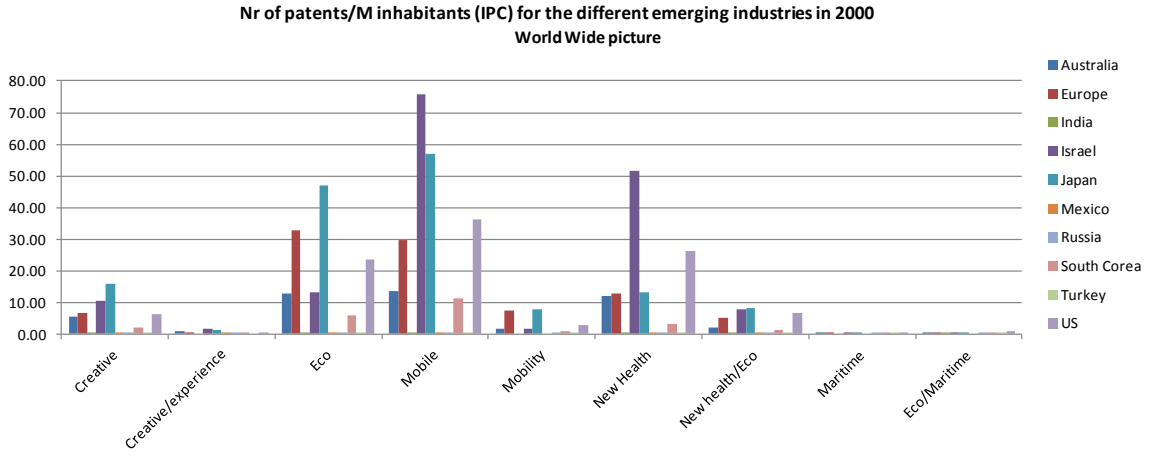
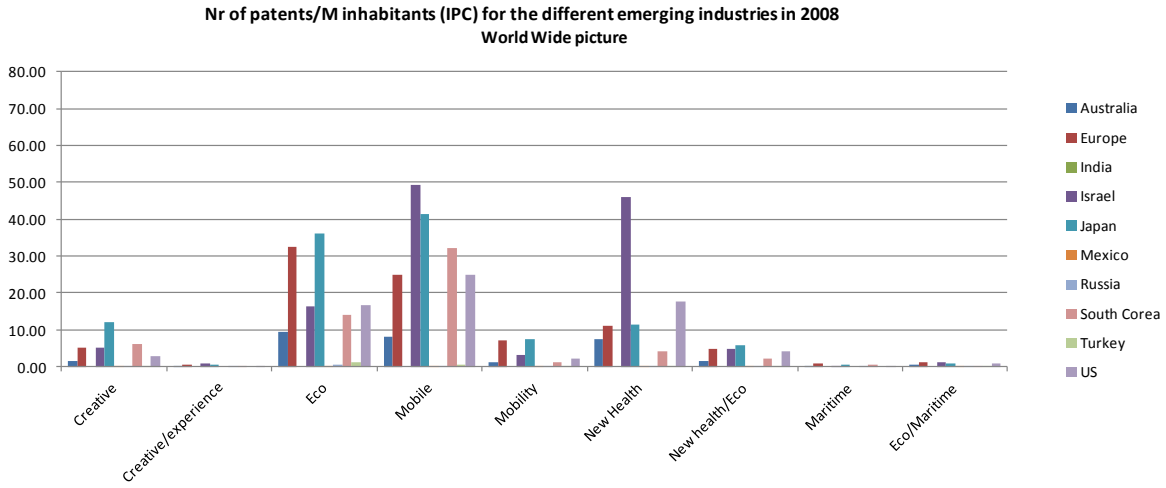


Figure 44: Number of patents per million inhabitants by country and key emerging industry (2008)



A similar analysis for the European countries reports that, interestingly, eco industries produced patents at a comparable rate to mobile industries (Figure 45). Personalised medicine also looks to be a field which is active, even though at a lesser rate than the previous ones. From a geographical perspective (Figure 46), Sweden, the Netherlands, Germany, and Denmark are the highest patents producers in the mobile services, personalised medicine, and eco industries. Following these, Luxembourg and Austria also significantly contribute to the patent output. This means that, actually, European scientists do not lack of innovation productivity in these important fields.

Figure 45: Number of patents per million inhabitants for the key emerging industries between 2000 and 2008

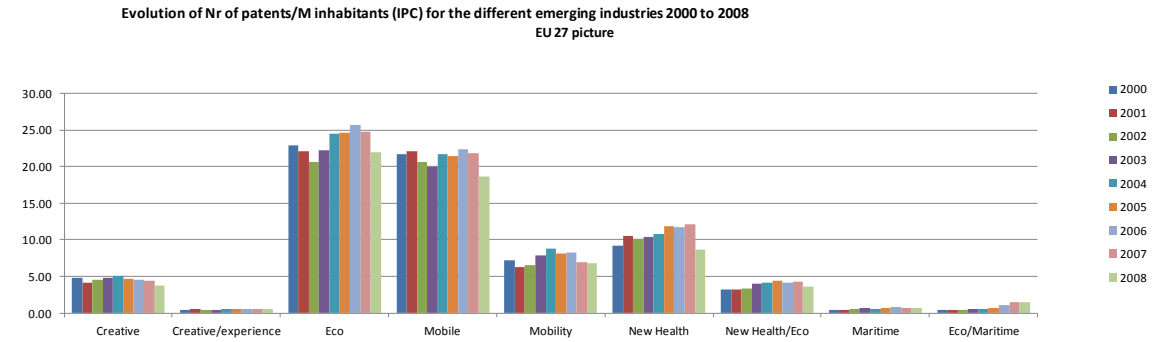
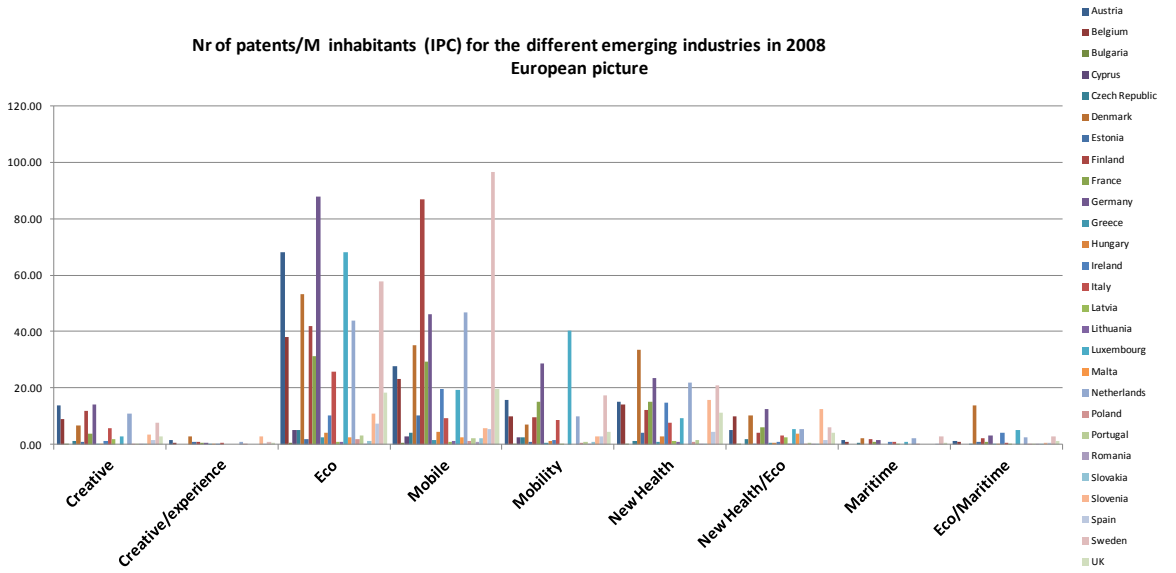
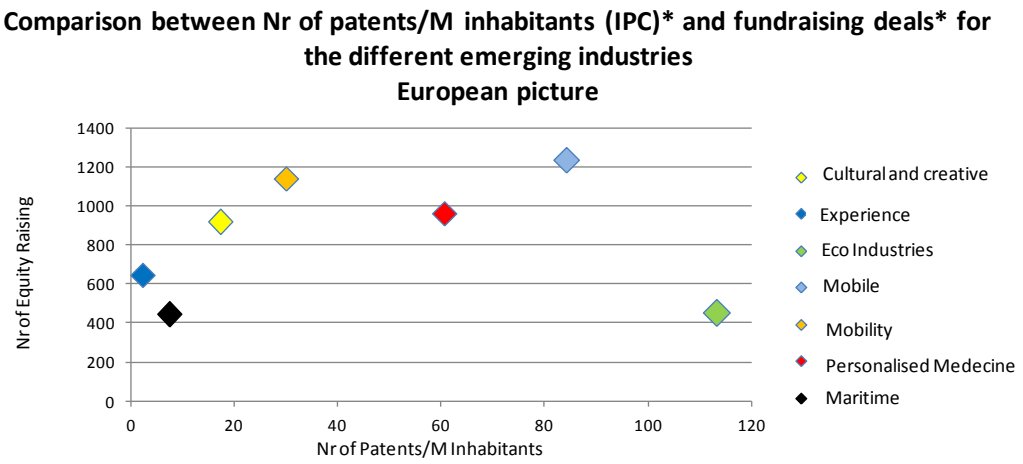


Figure 46: Number of patents per million inhabitants for the key emerging industries in the EU27



However, when we look at whether for every emerging industry sector, the number of produced patents is actually related to the fundraising performance, the result is somehow striking. Given the high amount of patents the three abovementioned emerging industries (mobile, eco industries, and personalised medicine) produce, we would expect them to be the highest positioned for raising funds. Our results show that, while this is indeed the case for the mobile industries, the same statement cannot be made for the eco industries (Figure 47).

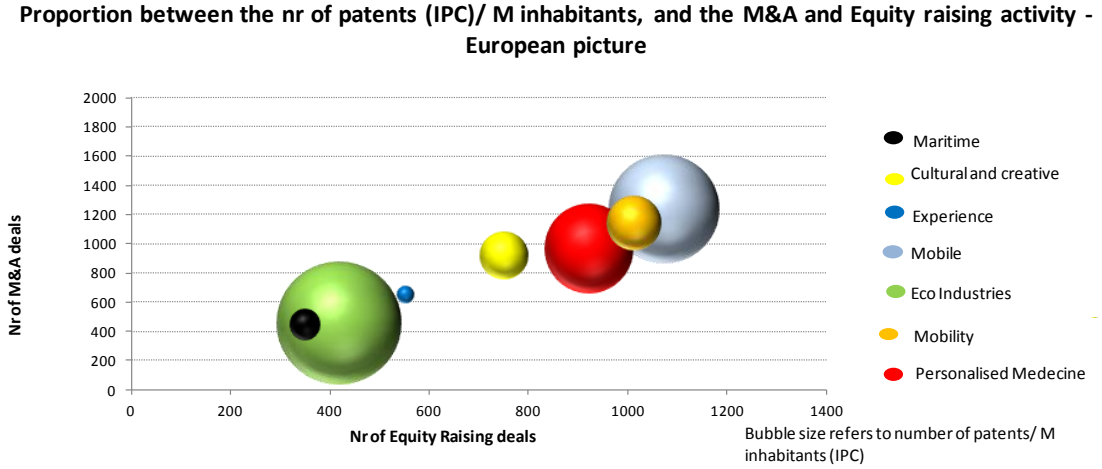
Figure 47: Number of patents per million inhabitants and equity deals for the key emerging industries



*Nr of patents refer to 2005 to 2008, and sourced from IPC, Nr of deals refer to 2005 to 2010, and are sourced from the PwC database described in the methodology

These observations are even reinforced if we add the M&A deals dimension. Indeed, from Figure 48, it is clear that companies operating within the eco and the personalised medicine industries still need to gather the attention of the VC industry, and of potential deal makers. These results are actually in agreement with what has been recently published in the report: "Diagnostics 2011"[36], which covers the whole market sector dynamics for the molecular diagnostic industry, included within our personalised medicine industry classification. As described in this report, small companies are not yet amongst those which efficiently raise funds, nor are they reliable acquisitions targets. From the results we have reported, the same market issue could be found for eco industries. These findings are also in agreement with what has been published in the Regional Biotechnology report[37].

Figure 48: Number of equity deals and number of M&A deals for the key emerging industries



*Nr of patents refer to 2005 to 2008, and sourced from IPC, Nr of deals refer to 2005 to 2010, and are sourced from the PwC database described in the methodology

[36] Diagnostics 2011, M&A surges, companion diagnostics accelerate, and early detection offers new prospects, PwC, November 2011

[37] Regional Biotechnology, Establishing a methodology and performance indicators for assessing Bioclusters and Bioregions relevant to the KBBE economy, EC DG RTD, and PwC, February 2011.

Indeed, with the critical success factors for new emerging industries such as personalised medicine, and the eco industries, funding is stated to be an underpinning element for boosting these sectors' growth. Following the analysis of these two sectors and the experience we have accumulated over the years, we are convinced that one of the major issues and barriers to the company's growth is the lack of a tailored regulatory framework, along with the presence of adapted framework conditions to sustain the companies at their inception and acceleration phase.

The markets eco and personalised medicine companies are addressing are heavily regulated, and the potential mostly still unknown, for sure by regulators in Europe, and in many cases also by the investors. For the regulators it results therefore a difficult exercise estimating the impact or benefit of the technologies which are produced by these industries. Framework conditions are perceived by investors as a stabilising element for the SMEs, as they guarantee adapted financial mechanisms, tax credits on R&D investments, favourable working conditions for skilled workforce, attractive wages for talents, etc.

As a follow up of this analysis, a precise investigation of patents versus equity raising and M&A deals could be performed in the years to come, as it results to be a powerful exercise for setting the right priorities for investors, entrepreneurs, and regulators.

4.5 Geographical localisation of the key emerging industry activities including fundraising

There has been a general understanding that clusters constitute a favourable economic development framework for companies with rapid access to markets and resources. Clusters are thought to generate productivity gains, leading to the boosting of emerging industries. In order to be able to determine the factors fostering the development of clusters in new emerging industries, a common agreement on a clear classification and mapping of these results is necessary.

After setting up the classification methodology we looked into the European Cluster Observatory (ECO)[38] data for cluster mapping. ECO offers data access on clusters and regions in the EU-27 via its cluster mapping tool. By defining clusters as "regional agglomerations of employment", the cluster-mapping database has been created by ECO through the collection and aggregation of data on a regional and industrial (sectors) basis. Even though the current statistical tools developed by the ECO represent a very good basis and a significant improvement, this method can still not capture all cluster dimensions, and some important dimensions critical for emerging industries, such as fundraising is for the SMEs.

Currently, limitations on data availability through all European States/Regions restrict the European Cluster Observatory to use only employment-based data to identify clusters, and to use this data when assessing the size and focus of clusters. These measures actually serve to determine the presence of employment-intensive clusters. The work performed by ECO could bring some additional elements to define the statistics required at cluster level, and to improve the visibility of their role on the economic development picture, thanks to the presence of some indicators applicable to clusters. In the ECO, data were aggregated by combining the two dimensions of geography and industry to statistically trace clusters and to detect clusters from the intensity of the employment in a given area.

The ECO is under continuous development to meet the expectations of national and regional policy agents, cluster organizations, and academia. These expectations were identified through the user surveys conducted during 2009-2010, and include several important points, which are also included within the objectives of this study.

38 ECO was established in 2007 under the Europe INNOVA Initiative and the Competitiveness and Innovation Framework Programme (CIP) as an online platform, aims to provide a single access point to information and analysis of clusters and cluster policies in Europe.

As a result of these surveys, it was suggested to the ECO to increase its service offerings by:

- Including data on localisation of new emerging industries, based on the new classification developed within the context of this work;
- Including parameters based on indicators tailored to the new emerging industries;
- Analysing factors fostering regional competitiveness and framework conditions;
- Incorporating new cluster data;
- Revamping the cluster mapping.

When we looked the ECO sectors in cluster mapping and organisation mapping tool, we found the following sectors, which had to be matched with the selected seven emerging industries[39]:

Table 19: European Cluster Observatory website: cluster mapping and organisation mapping sectors

Cluster mapping sectors	Organisation mapping sectors
Standard sector Creative and Cultural Knowledge intensive business services Life sciences	Standard sector Creative and Cultural Green technologies Micro and nanotechnologies Optics and Photonics

The following two tables (Table 20 and Table 21) show how we integrated the ECO sectors with our seven emerging sectors.

Table 20: ECO Sectors v PwC selected sectors for Cluster Mapping

Euro Cluster Observatory Sectors for Cluster Organisation Mapping	Breakdown of Sector – as per Euro Cluster Observatory	PwC's classification – 6 New sectors	Disaggregation of Standard Sectors to fit PwC's classification
Creative and Cultural	Artistic & Literary Creation Culture Design Fashion General Creative Industry	2. Creative and Cultural	Already matching
Green Technologies	Bioenergy / Eco-Construction / Environmental Technology Hydrogen and Fuel Cells / Recycling / Renewable Energy Solar Energy / Wind Energy / Sustainability Water / Wind Energy	3. Eco	Already matching
Standard Sectors	Aerospace / Agricultural Products / Apparel / Automotive / Biotech / Building Fixtures / Business Services / Chemical / Construction / Distribution / Education / Energy / Entertainment / Farming and Animal Husbandry / Financial Services / Fishing / Food / Footwear / Forest Products / Furniture / Health / Heavy Machinery / Instruments / IT / Jewellery and Precious Metals / Leather / Lighting and Electrical Equipment / Maritime / Materials / Media and Publishing / Medical Devices/ Metal Manufacturing / Miscellaneous / Oil and Gas / Pharmaceuticals / Plastics / Production Technology / Sporting and Children's Goods / Stone Quarries / Telecom / Textiles / Tobacco / Tourism / Transportation and Logistics	1. New Health	Biotech, Medical, Health, Pharmaceuticals, Medical devices
		4. Mobile	Telecom, IT
		5. Experience	Entertainment Media and Publishing Tourism
		6. Mobility	Aerospace, Automotive Transportation and Logistics

39 http://www.clusterobservatory.eu/index.html#!view=mainMenu

Table 21: ECO Sectors v PwC selected sectors for Organisation Mapping

Euro Cluster Observatory Sectors for Cluster Mapping	Breakdown of Sector – as per Euro Cluster Observatory	PwC's classification – 6 New sectors	Disaggregation of Standard Sectors to fit PwC's classification
Life Sciences	Biotech Medical Services Pharmaceuticals	1. New Health	Biotech Medical Services, Pharmaceuticals
Creative and Cultural	Advertsing / Artistic creation and literary creation Museums and preservation of historical sites and buildings / Other / Printing and publishing / Radio and television / Retail and distribution / Software	2. Creative and Cultural	Matching (confirm)
Standard Sectors	Aerospace / Agricultural Products / Apparel / Automotive / Biotech / Building Fixtures / Business Services / Chemical / Construction / Construction Materials/ Distribution / Education and Knowledge Creation / Entertainment / Farming and Animal Husbandry / Financial Services / Footwear / Furniture / Heavy Machinery / Instruments / IT / Jewellery and Precious Metals / Leather / Lighting and Electrical Equipment / Maritime / Materials/ Media and Publishing / Medical Devices / Metal Manufacturing / Oil and Gas / Paper Products / Pharmaceuticals / Plastics / Power generation and transmission / Processed food / Production technology / Sporting, recreational and children's goods / Stone quarries / Telecom / Textiles / Tobacco / Tourism and hospitality / Transportation and logistics	3. Eco	Construction, Construction materials, Oil and Gas Power generation and transmission
		4. Mobile	Telecom, IT
		5. Experience	Entertainment Tourism and Hospitality
		6. Mobility	Aerospace, Automotive Transportation and Logistics

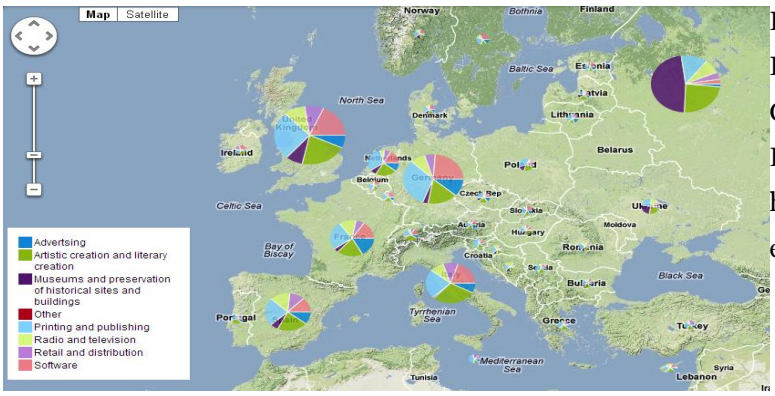
These two tables illustrate how, starting from the ECO, we would disaggregate and re-aggregate the sectors, to somehow match the classification we have done for emerging industries. It has to be considered that, however, even if the aggregation we propose results to be more pertinent to the scope we are aiming at, the ECO's data sources are mainly composed by official statistics. Therefore, we expect the data related to the number of companies, and to the number of employees to reflect the situation of a mature market, whichever aggregation is used to match the perimeter of the newly emerging industries.

For cluster organisations and science parks, we would expect them to act as catalysts for the newly emerging industries and SMEs, as poles for geographical localisation. We will therefore present, for every perimeter corresponding to the key emerging industries, the following pictures: the geographical localisation of the employees and of the companies (2009 EUROSAT and OECD data, coming from the ECO), the geographical localisation of clusters and of science parks (ECO data), and the geographical localisations of the companies, which raise funds (2005-2010, PwC classification). For measuring the deal intensity for a given emerging industry on a specific geographical location, an ad-hoc software has been used (Corto software, produced by the Spallian Group, a company operating within the mobile industries emerging sector).

There is no information in the ECO database in cluster mapping about Eco sector, consequently we disaggregated some of the standard sectors, and re-aggregated them following the perimeters we defined in our methodology, as much as we could. This aggregation is far to be extensive, however we think it could be relevant for the kind of exercise we are trying to do, in terms of geographical localisation.

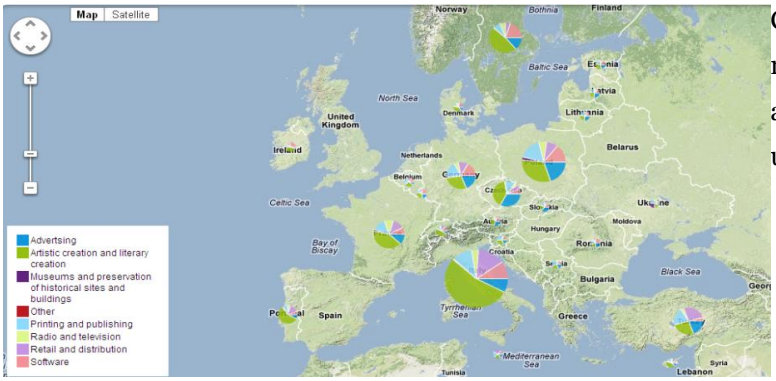
Figure 49: Creative industries: geographical localisation based on data from the European Cluster Observatory website

Number of Employees



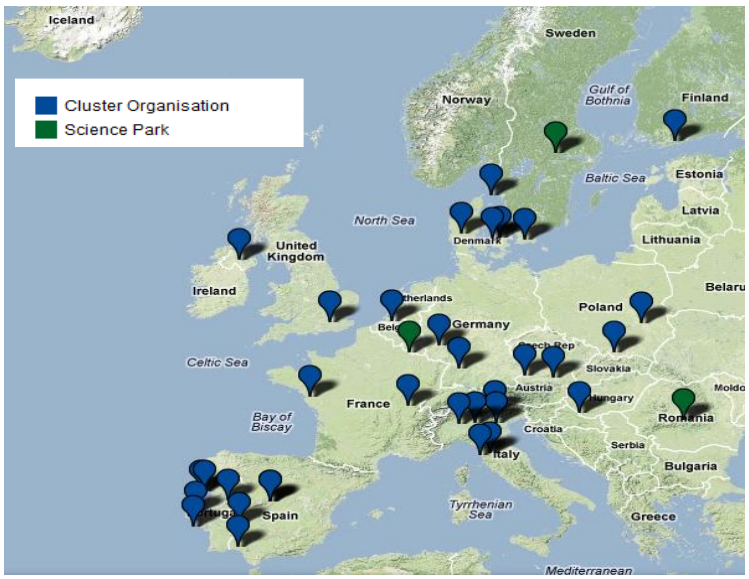
Employees concentrate mainly in the EU-15, and especially in UK, Germany, France, Spain and Italy. Russia is also shown in the figure to have a strong concentration of employees.

Number of Enterprises (no UK data)



Concentration of companies is mainly in Italy, Germany, France, and Poland. Data for UK are unfortunately not available

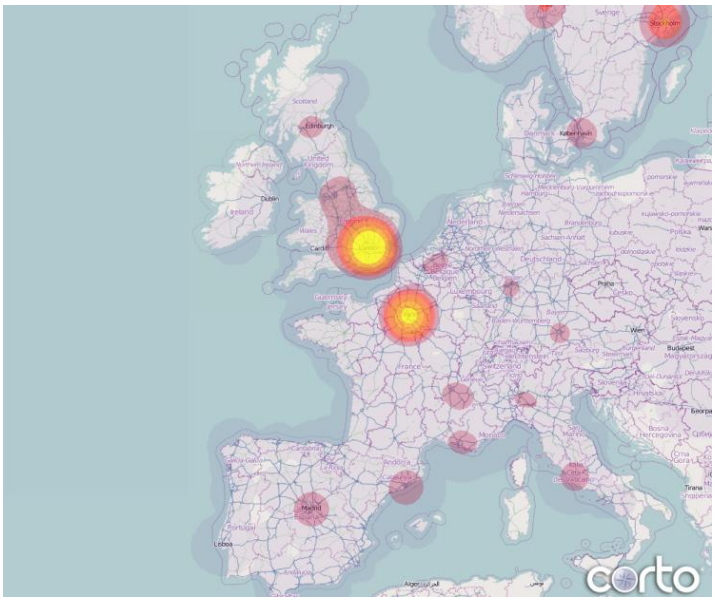
Cluster organizations and Science Parks



In the 'Creative and Cultural' sector cluster organisations are spread around Europe, focusing in Northern Italy and Spain/Portugal.

Figure 50: Creative industries: European and international localisations of companies raising funds, measured in terms of deal intensity

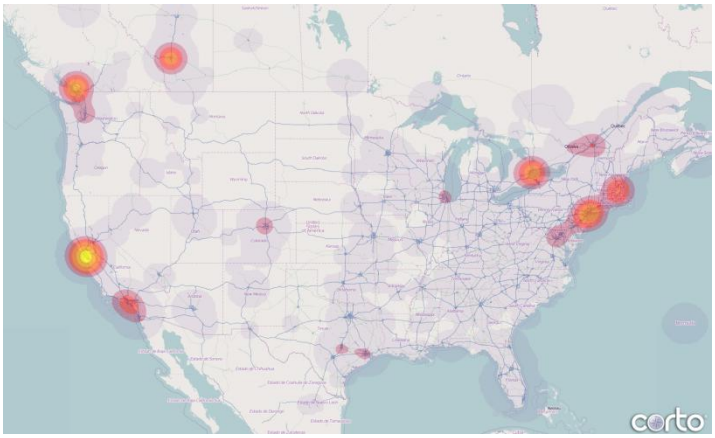
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK (whole southern region)
- Ile de France
- Stockholm (Sweden)
- Oslo (Norway)

Intensity of fundraising in US and Canada



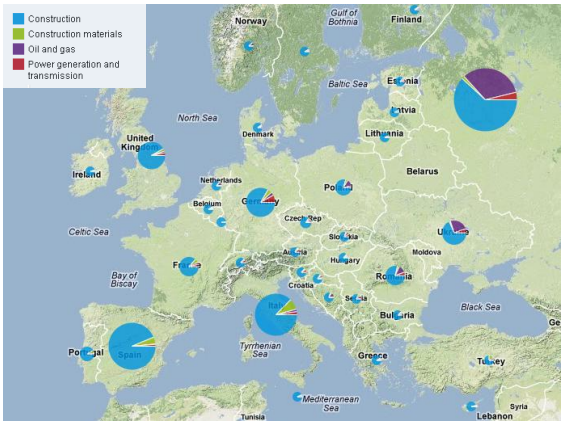
Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New Jersey, LA, S. Francisco, Chicago, Seattle, Colorado, Huston, and Austin.

  In Canada: Vancouver, Calgary, Toronto, Ottawa

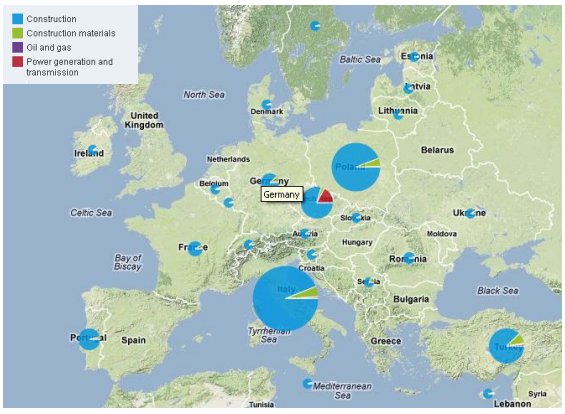
Figure 51: Eco industries: geographical localisation based on data from the European Cluster Observatory website

Number of Employees



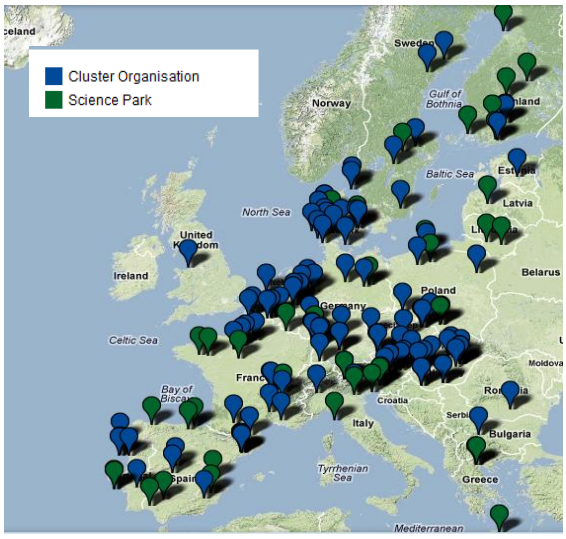
Employees concentrate mainly in the UK, Germany, Spain, and Italy. Russia is also shown to have a high concentration of employees.

Number of Enterprises (no UK data)



Concentration of companies is mainly in Italy, Germany, France, Poland, Czech Republic, and Turkey. Data for UK are unfortunately not available.

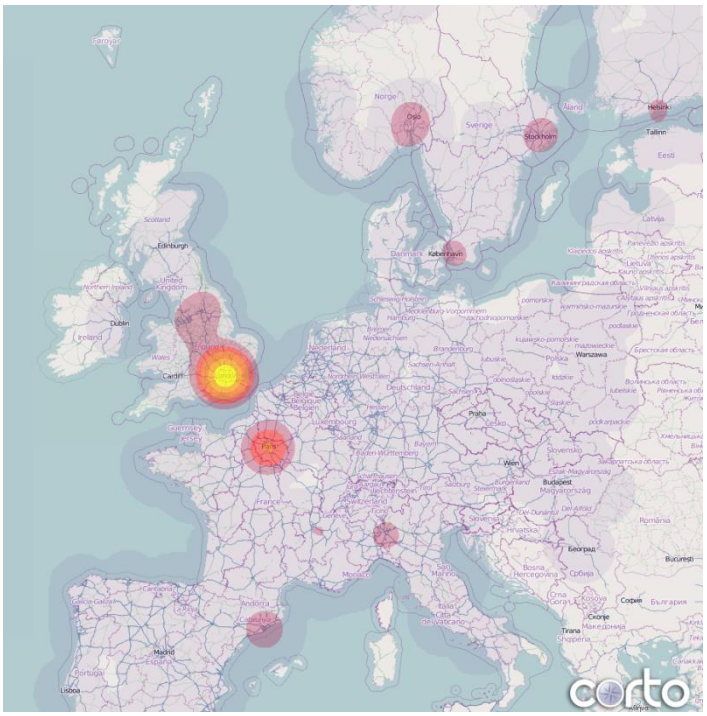
Cluster Organisations and Science Parks



Cluster organisations and Science parks are spread all around Europe, and reach the highest critical mass in Belgium, NL, Hungary, and Czech Republic.

Figure 52: Eco industries: European and international localisations of companies raising funds, measured in terms of deal intensity

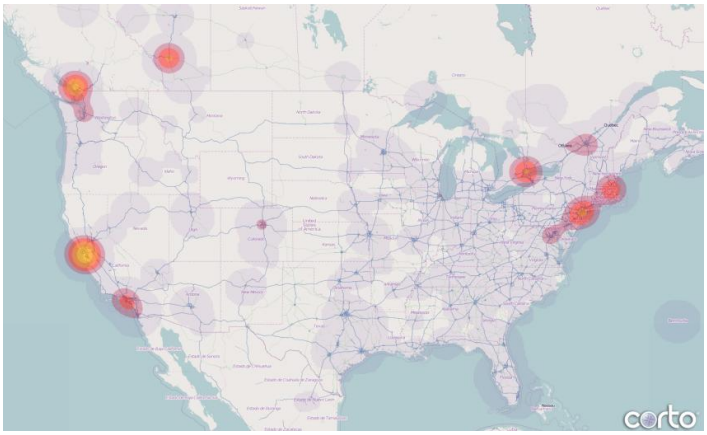
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK
- Ile de France
- Lombardia (I)
- Oslo (Norway)
- Catalunya (Spain)
- Stockholm (Sweden)
- Oslo (Norway)
- Copenhagen (DK)
- Helsinki (Fi)

Intensity of fundraising in US and Canada



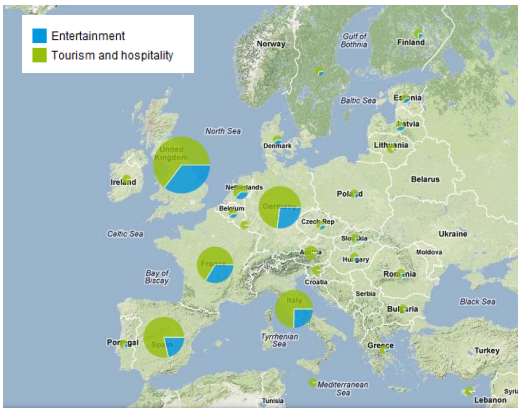
Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New Jersey, Washington DC, LA, S. Francisco, Colorado, and Seattle.

  In Canada: Vancouver, Calgary, Toronto, Ottawa

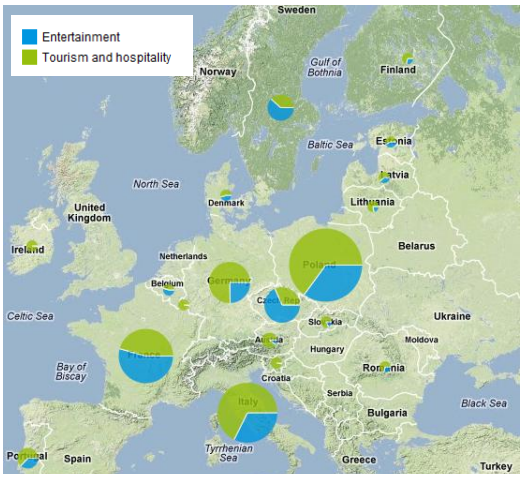
Figure 53: Experience industries: geographical localisation based on data from the European Cluster Observatory website

Number of Employees



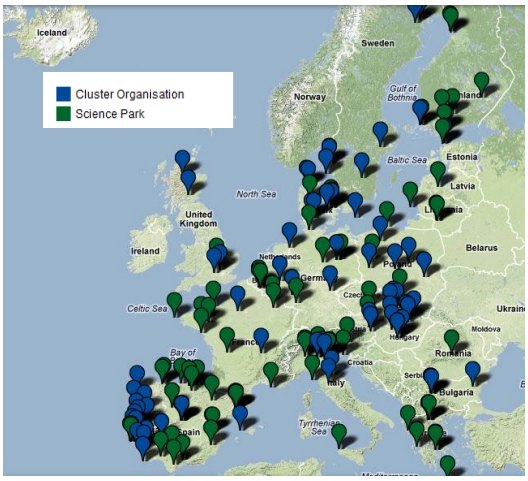
Employees concentrate mainly in the UK, Germany, France, Spain and Italy.

Number of Enterprises (no UK data)



Concentration of companies is mainly in Italy, Germany, France, Czech Republic, and Poland. Data for UK are unfortunately not available

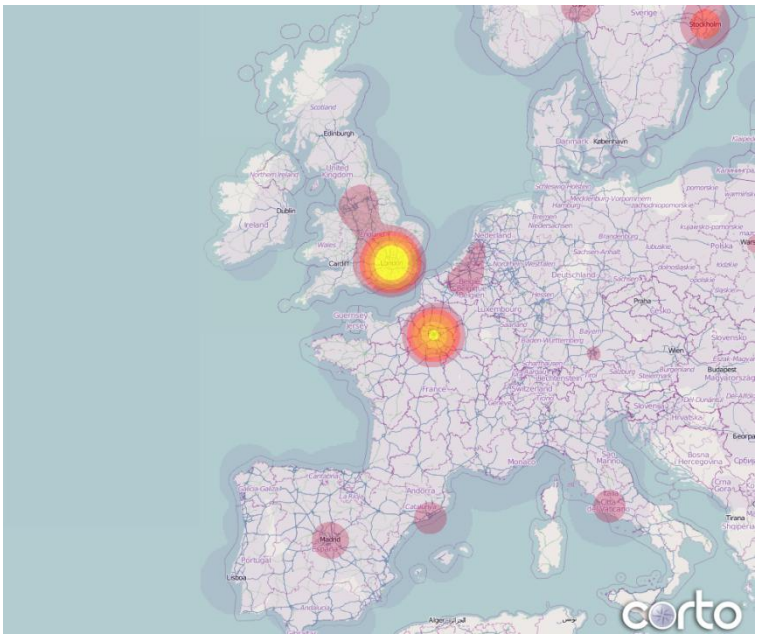
Cluster Organisations and Science Parks



Cluster organisations and Science parks are spread all around Europe, and reach the highest critical mass in Italy and in Portugal

Figure 54: Experience industries: European and International localisations of companies raising funds, measured in terms of deal intensity

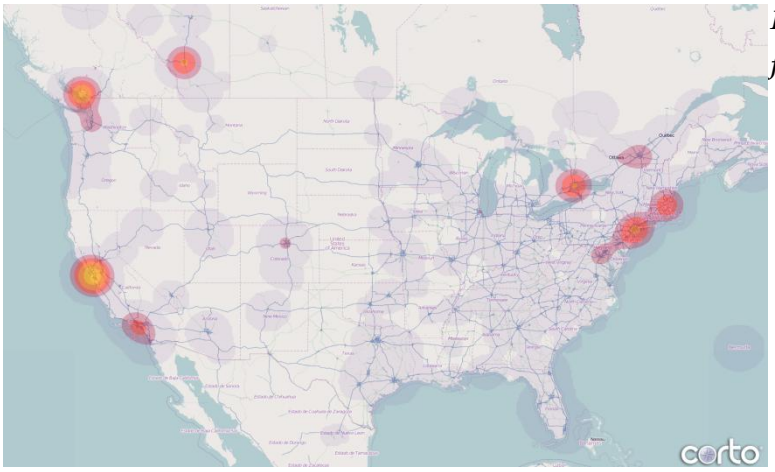
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK (whole southern region)
- Ile de France
- Stockholm (Sweden)
- Oslo (Norway)
- NL
- Lazio (I)
- Catalunia, Madrid (ES)

Intensity of fundraising in US and Canada



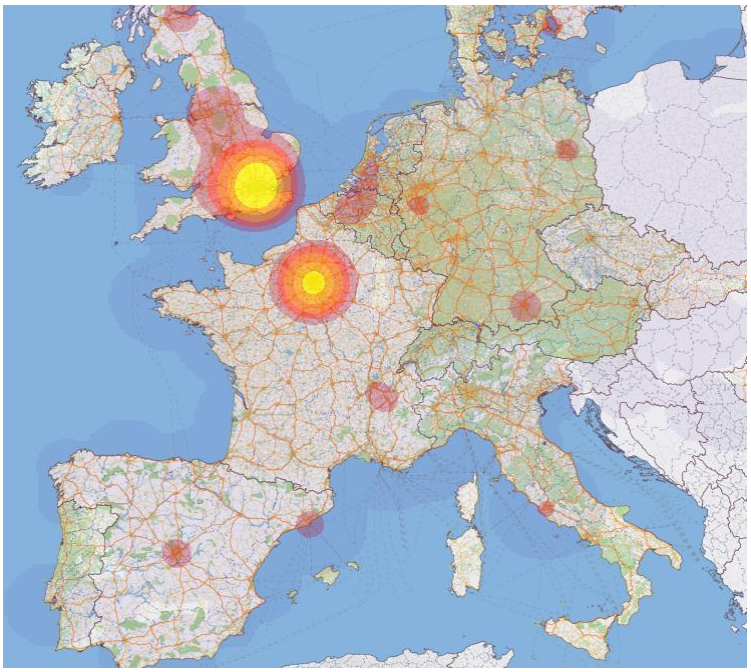
Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New Jersey, Washington DC, LA, S. Francisco, Chicago, Seattle.

  In Canada: Vancouver, Calgary, Toronto, Ottawa

Figure 55: Maritime industries: European and International localisations of companies raising funds, measured in terms of deal intensity

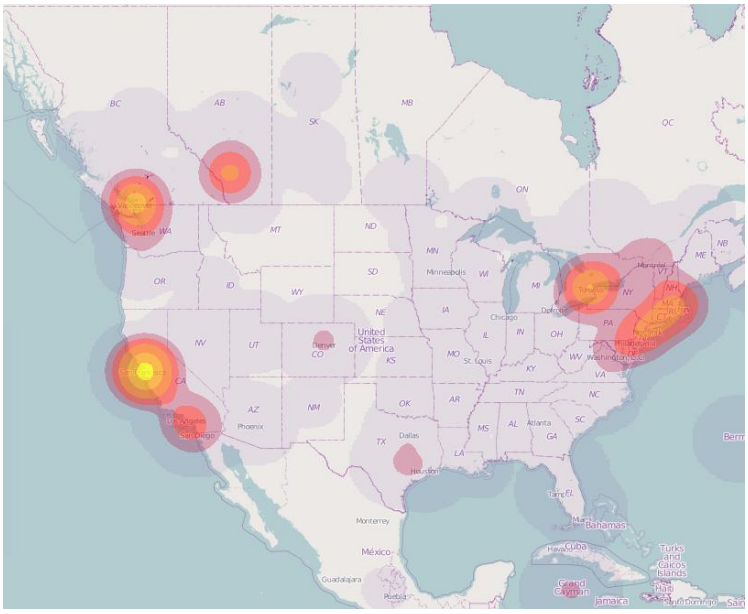
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK: southern region and Scotland
- Ile de France and Lyon
- Netherlands and Flanders
- Copenhagen (DK)
- Catalunia, Madrid (ES)
- Berlin, Munich, Cologne (DE)
- Rome (IT)

Intensity of fundraising in US and Canada



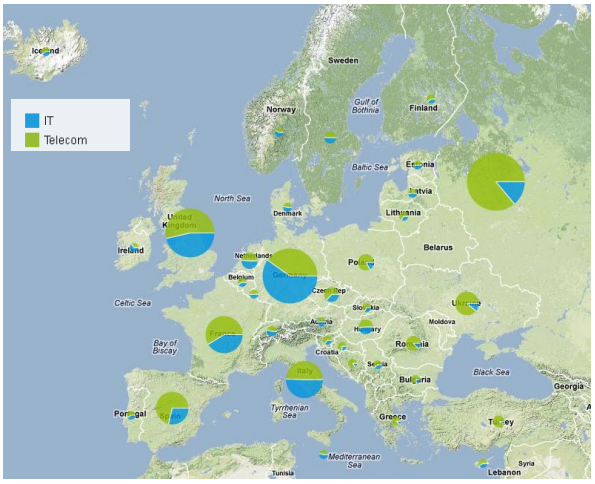
Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New Jersey, Los Angeles, San Francisco.

  In Canada: Vancouver, Calgary, Toronto

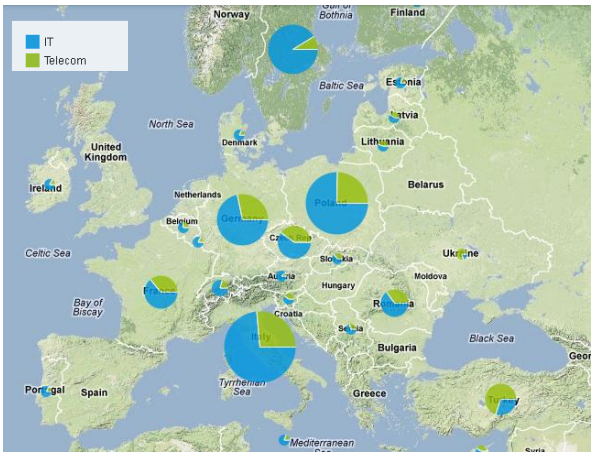
Figure 56: Mobile services industries: geographical localisation based on data from the European Cluster Observatory website

Number of Employees



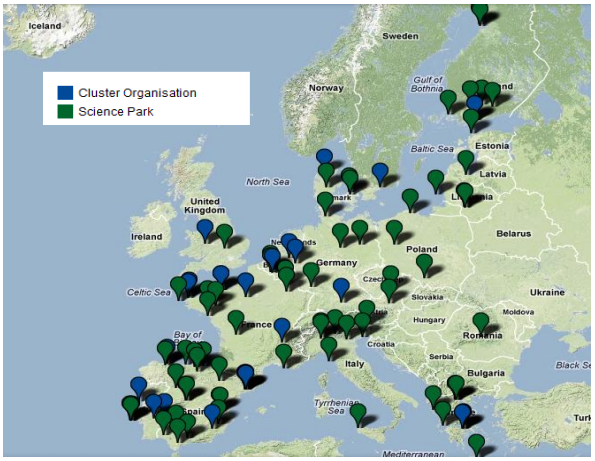
Employees concentrate mainly in UK, Germany, France, Spain and Italy. Ukraine and Russia are also shown in the figure to have a strong concentration of employees.

Number of Enterprises (no UK data)



Concentration of companies is mainly in Italy, Germany, France, Czech Republic, and Poland. Data for UK are unfortunately not available

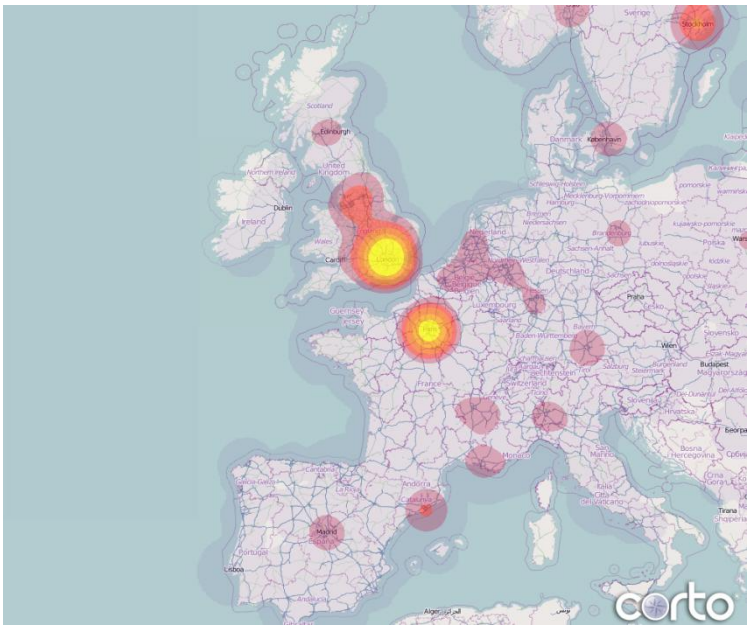
Cluster Organisations and Science Parks



In the 'Mobile' sector cluster organisations are spread all around Western Europe. Eastern countries look like being mostly uncovered.

Figure 57: Mobile services industries: European and international localisations of companies raising funds, measured in terms of deal intensity

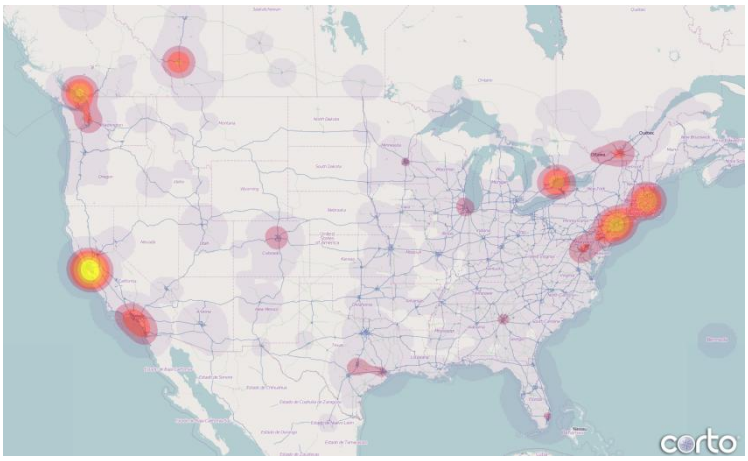
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK (whole southern region)
- Ile de France, Lyon (F)
- Stockholm (Sweden)
- Oslo (Norway)
- Copenhagen (DK)
- NL
- Flanders (B)
- Northern Westfalia, Brandenbourg, Hessern, Bayern
- Warszavia (Poland)
- Lombardia (I)
- Catalunia, Madrid (ES)

Intensity of fundraising in US and Canada



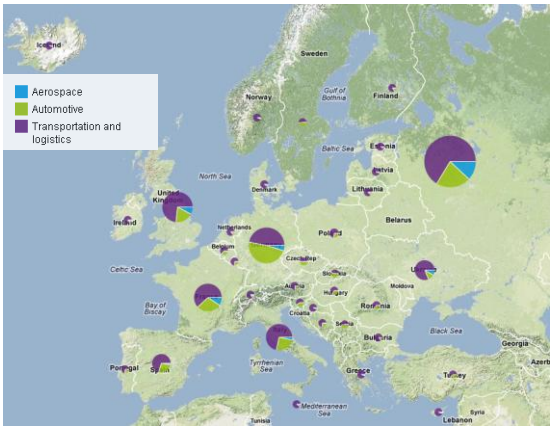
Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New Jersey, LA, S. Francisco, Chicago, Seattle, Colorado, Huston, and Austin.

  In Canada: Vancouver, Calgary, Toronto, Ottawa

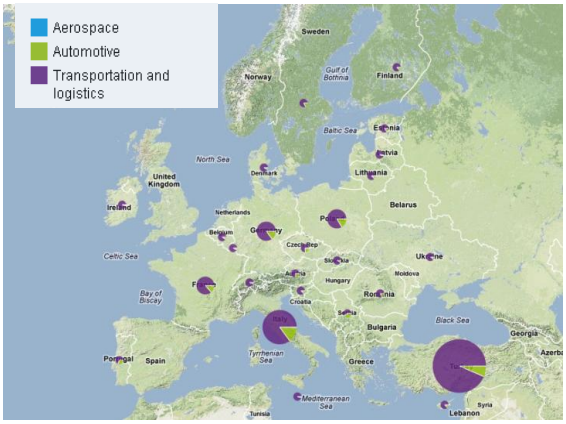
Figure 58: Mobility industries: geographical localisation based on data from the European Cluster Observatory website

Number of Employees



Employees concentrate mainly in the UK, Germany, France, and Italy. Russia is also shown to have a high concentration of employees.

Number of Enterprises (no UK data)



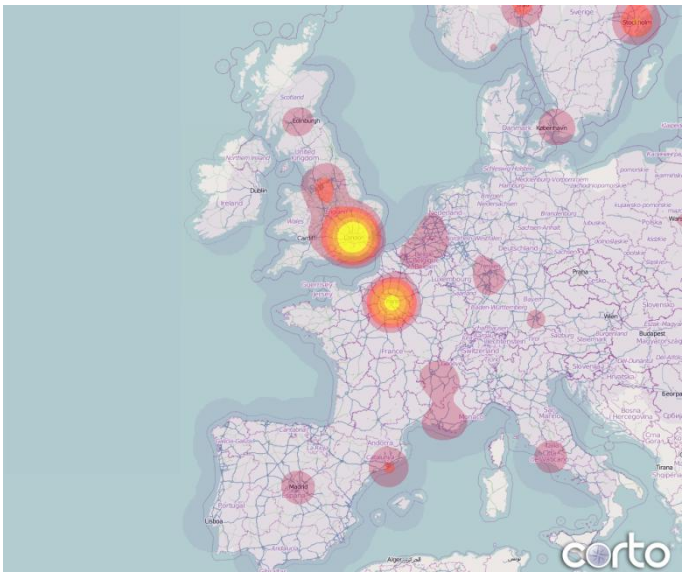
Concentration of companies is mainly in Italy, Germany, France, Poland and Turkey. Data for UK are unfortunately not available.

Cluster Organisations and Science Parks

Cluster organisations and Science parks are spread all around Europe, and reach the highest critical mass in Italy, Hungary, Belgium, NL and Northern Germany.

Figure 59: Mobility industries: European and International localisations of companies raising funds, measured in terms of deal intensity

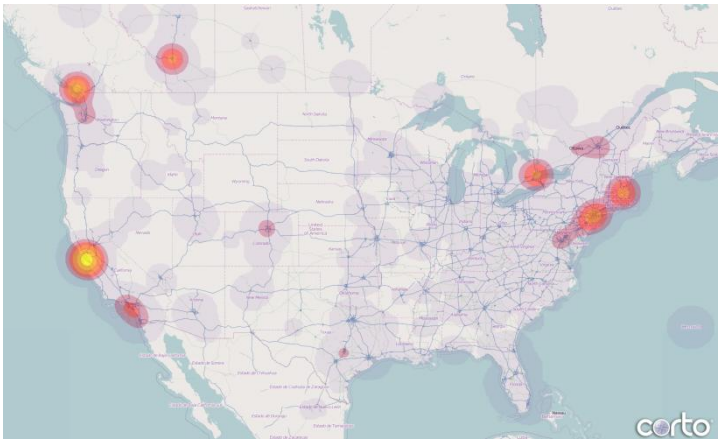
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK (whole southern region)
- Ile de France, Lyon, Cote d'Azur (F)
- Lazio (I)
- Oslo (Norway)
- NL
- Bayers, Hessen (Germany)
- Madrid, Catalunya (Spain)
- Stockholm (Sweden)
- Oslo (Norway)
- Copenhagen (DK)

Intensity of fundraising in US and Canada



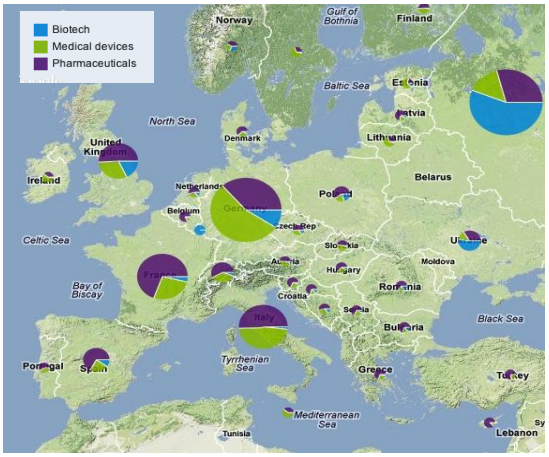
Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New Jersey, Washington DC, LA, S. Francisco, Colorado, and Seattle.

  In Canada: Vancouver, Calgary, Toronto, Ottawa

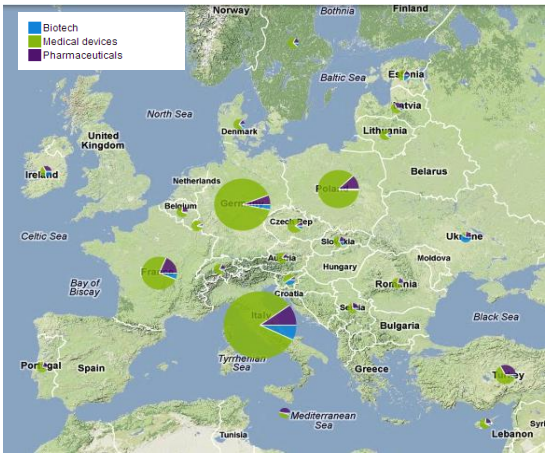
Figure 60: Personalised medicine industries: geographical localisation based on data from the European Cluster Observatory website

Number of employees



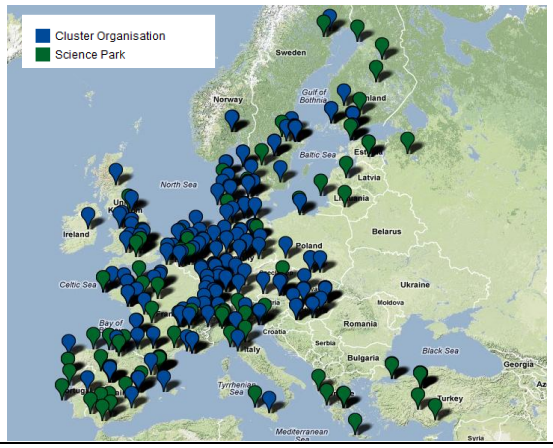
Employees are concentrated in Germany (EU-15), Italy, France, and in the UK, but also in the new MS (EU-12), such as Poland, and Hungary. Ukraine and Russia result with a high density of employees.

Number of enterprises (no UK data)



Companies are highly concentrated in Italy and Germany, France and Poland. Unfortunately, no UK data is available.

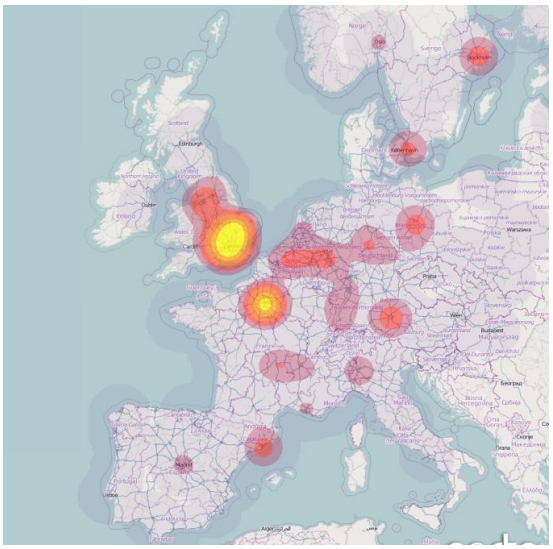
Cluster Organisations and Science Parks



In 'E-Health & Personalised Medicine' sector cluster organisations and Science Parks reach a critical mass in western Europe only.

Figure 61: Personalised medicine industries: European and international localisations of companies raising funds, measured in terms of deal intensity

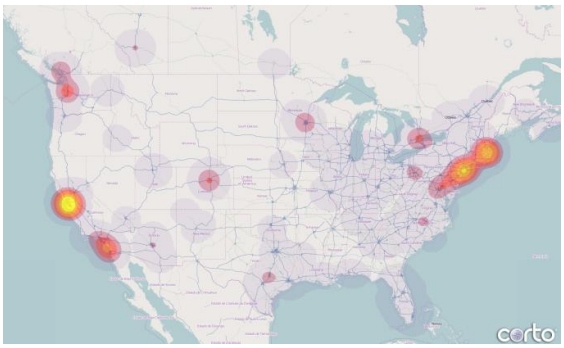
Intensity of fundraising in Western Europe



Fundraising activities occur in the following main cities and regions:

- UK (whole southern region)
- Ile de France
- NL
- Flanders (B)
- Bavaria, Saxonia, and Westfalia for Germany
- Stockholm (Sweden)
- Oslo (Norway)
- Copenhagen (Denmark)

Intensity of fundraising in US and Canada



Fundraising activities occur in the following main cities and regions:

- In the US: Massachusetts, New jersey, LA, S. Francisco, Pennsylvania (Pittsburgh), Minnesota (Minneapolis), Washington (Seattle) and Colorado.

  In Canada: Toronto and Vancouver

From our analysis it is clear that, in most of the cases, the companies which are most successful in raising funds are located in strategic European regions, where the VC industry is active. For all industry sectors most of the companies are located in Paris or London. Nearly all sectors also present companies with an intense fundraising activity in the Nordic countries (Stockholm, Copenhagen, and Oslo).

The results of the analysis in terms of hot spots do not vary widely from one emerging industry to another; a detailed look can however provide some relevant information: for personalised medicine the North of Germany, the Netherlands and Belgium seem to be critical locations. For creative industries and experience industries, companies located in Italy and Spain also show to have some fundraising activity. For mobility, the Netherlands, northern Germany, and Belgium seem to be interesting locations.

While, for the eco industries, Germany doesn't result to have a critical mass of companies developing through the risk capital financing process. Such a lack of critical mass for the eco emerging industry in this country looks to be more related to the fact that this market is overall underdeveloped in Europe. Moreover, Germany has a quite unique best practice of providing

consistent seed funds through state aids, and of providing financing to SMEs through University, TTOs, or corporate funds (e.g. Siemens).

One of the main findings of this exercise, is the fact that localisation of companies showing the highest deal activity doesn’t seem to be related to cluster locations. This would bring forward the fact that one of the main components characterising the success of the SMEs is the availability of funds. Therefore, one of the main reflections these results would need to generate from us is how to increase the critical mass of entities providing funds within the clusters, and how to measure the economic activity of the SMEs included in their perimeter. Some critical factors should therefore be the object of a deep study, namely the framework conditions present in the most popular locations, along with essential support structures, such as incubators, accelerators, TTOs, and large scale demonstrators.

5 *Conclusions*

The purpose of this assignment (ECO-III project, *Work package 3*) is to further improve cluster analysis in Europe by complementing the statistical work performed by the European Cluster Observatory (ECO) through developing a "European Cluster Excellence Scoreboard". To reach our objective we first introduce in this report the methodology for establishing a classification scheme and measuring clusters in emerging industries.

To map new emerging industries we used NACE Rev.2 codes (an industry classification scheme), which allows the identification of company sectors in most of the commercially available databases. The major limitation of this classification scheme is that NACE Rev.2 is not separating traditional versus emerging sectors. Based on the NACE Rev.2 classification scheme seven final emerging industries were selected: creative industries, eco industries, experience industries, maritime industries, mobile service industries, mobility industries and personalised medicine industries

Based on our understanding of the development of emerging industries and a review of different approaches for identifying and determining the scope of emerging industries, we concluded that no single approach is sufficient to identify and classify emerging industries. We used a combination of different approaches to ensure the reliability and accuracy of the classification system. These approaches were based on the following assumptions and types of data:

- **Approach 1**: Firms in emerging industries attract risk capital (Classification based on firm capital raising data);
- **Approach 2:** Firms in emerging industries attract interest from companies from previously un-related sectors (Classification based on cross-sector deal data)
- **Approach 3:** Firms in emerging industries are highly innovative (Classification based on firm patenting data);
- **Approach 4:** Firms in emerging industries grow fast (Classification based on sector growth potential);

The first two approaches formed the basis of our database (classification based on a firm capital raising data and on cross-sector combinations). We compiled data from *Zephyr (*comprehensive M&A data with integrated detailed company information) and from *Europe Unlimited* (companies in the process of raising funds or still looking for investors). Approaches 1 & 2 enabled us to collect data using the NACE code classification system to construct the database.

We propose to use these two approaches in combination to provide insight into the activities of firms raising capital to finance their development (equity raising) and engaging in M&As. Particular interest has been shown in cross-sector spillovers and a variety of combinations that give rise to emerging industries.

Our study is based on the hypothesis that structural changes in the market are driven by changes in relations between different industry sectors. These changes are mostly related to mergers and acquisitions, and to the capability of new companies to raise funds through VC rounds. Our methodology shows major relations or "linkages" between different NACE codes. We also assessed which codes have the highest activity in the market in terms of M&A and equity raising.

We used our M&A and equity data to build up a metrical approach in order to better segment every emerging industry, and to investigate which were the most active NACE Rev.2 4 digit codes, and which the less attractive from an investment stand point. This metrical approach was carried out through scatter charts representing NACE Rev.2 classes in which the M&A deals, and the numbers of companies raising equity were used as variables.

Our classification methodology proceeded as follows. We analysed the deal flow of M&A to understand the degree of interlinkages between different NACE codes. This approach allowed us to determine the perimeter of each new emerging industry and to identify the possible codes to be included in each new emerging industry. We then conducted an analysis of the full picture of the

investments (number of equity companies versus number of M&A deals) through scattered charts. We segmented the emerging industries into 7 categories.

In a second stage, we complemented the data on equity investments and M&A by patent data (approach 3) and by sector growth data (approach 4). The collection of data used in approaches 3 and 4 was based first of all on European Patent Office (EPO) data. Companies' patenting data captures companies' activities still in their early stages of emergence (sometimes even only engaged in research and development, rather than companies that are already selling products and services and which have an impact on the market).

We also took more 'qualitative' aspects into account to ensure that the proposed classification scheme integrates all relevant knowledge and practical insights. As such, several experts were consulted based on their knowledge and practical know-how of the selected industries and companies involved. This external expertise was essential to ensure that the proposed system is complete and reflects the emerging market reality in an accurate and reliable way.

In order to complement our analysis, we also looked at the geographical localisation of companies and their corresponding employment rates (based on EUROSTAT and OECD data from the European Cluster Observatory); companies raising funds (based on the PwC classification); and clusters and science parks (ECO data). To measure the deal intensity for a given emerging industry on a specific geographical location the software of Corto (produced by the Spallian Group) was used to produce heat maps.

The analysis we have performed with this report has allowed us to highlight some interesting points. First, current statistics cannot provide adequate tools for classifying emerging industries. Even if the methodological approach we propose could be further refined in the future, we think that it can provide a valuable tool for this purpose. Further, the classification we have developed, along with the analysis based on EUROSTAT and patent data, has allowed up to draw some conclusions about the different emerging industries:

- Industries such as personalised medicine and the eco industries look like having a lower degree of maturity. This is probably due to the fact that these are heavily regulated in terms of the prerequisites that the products and technologies need for accessing the market. There is an urgent need to be addressed for a better understanding of the potential of these emerging industries, and of tailored framework conditions, regulations, and financing mechanisms. Policy makers, investors, cluster managers and entrepreneurs should be involved and actively contribute to address this matter.

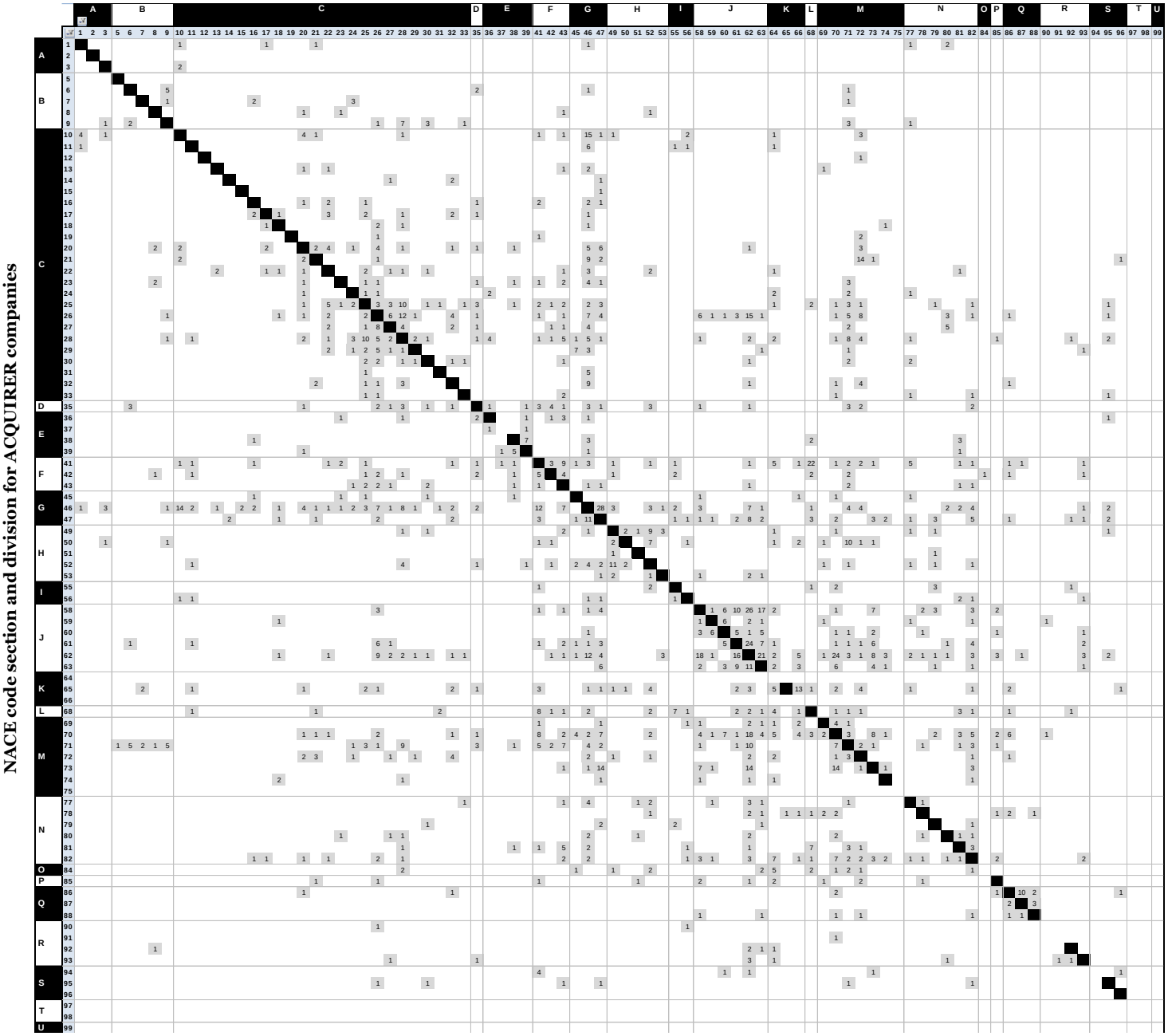
- Emerging industries such as experience, creative, and mobile services, share quite a few codes in common. This is due to the fact that, probably, they all leverage to a great extent on ICT and web related codes.

- The segments presenting high deal activity for each emerging industry are related to ICT, or to technical and business consulting services. This fact underlines the importance of these sectors and their role for fostering the growth of all emerging industries. We hypothesize that the same results could be found in other emerging industries, which have not yet been investigated.

The analysis we have performed on the geographical locations of the companies provides the powerful insight that the presence and proximity of funding entities is an essential element for the development and success of SMEs. Further analysis is needed to better understand how to increment the presence of risk capital entities within clusters, and to increase the attractiveness of these clusters in this regard.

6 Appendix A: Data on cross-sectoral mergers and acquisitions (M&As)

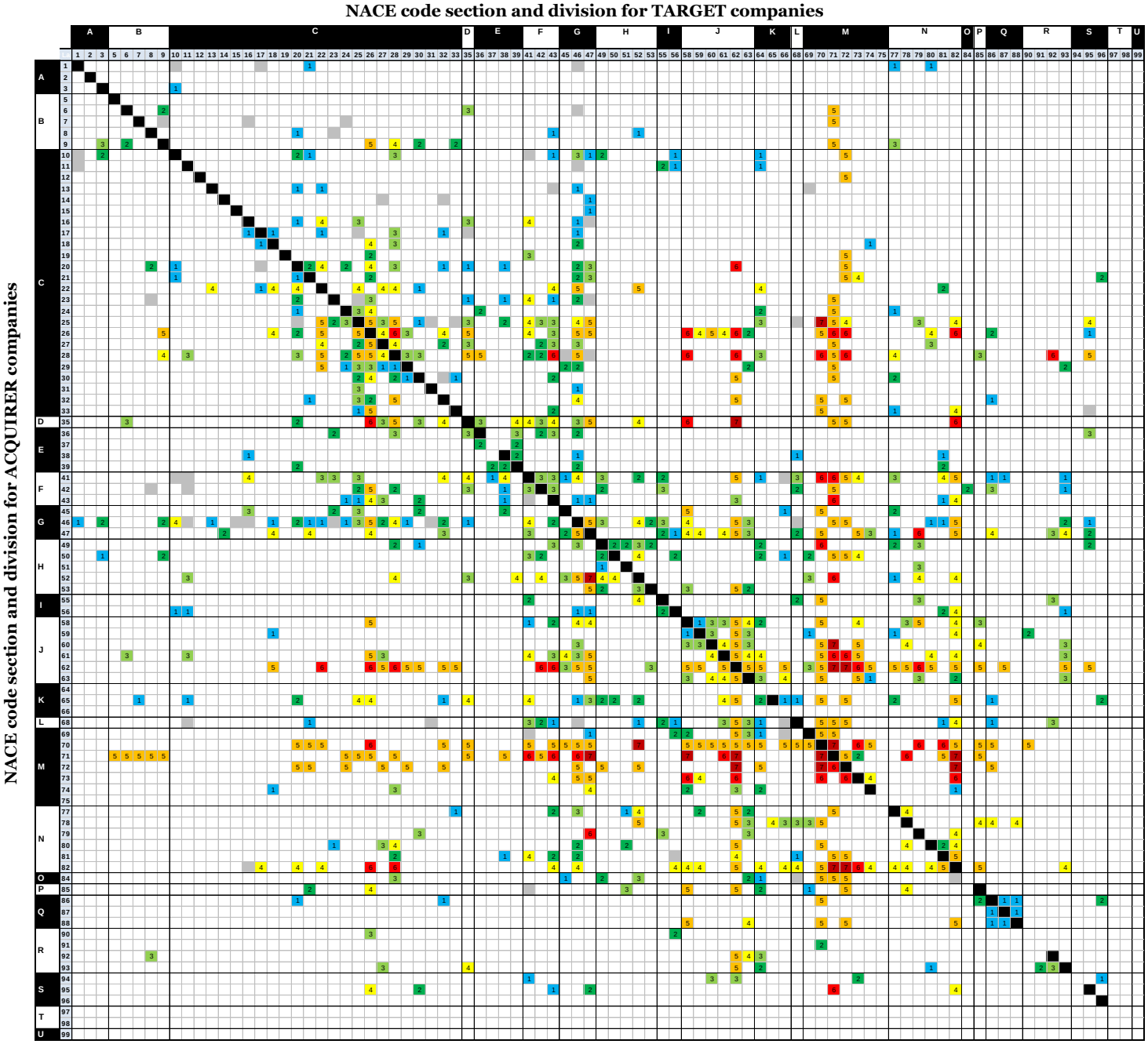
6.1 All industries: number of M&A deals between targets and acquirers by NACE code division



NACE Rev. 2 classification: Section – Title (Divisions)

A – Agriculture, forestry and fishing (01-03); B – Mining and quarrying (05-09); C – Manufacturing (10-33); D – Electricity, gas, steam and air conditioning supply (35); E – Water supply; sewerage, waste management and remediation activities (36-39); F – Construction (41-43); G – Wholesale and retail trade; repair of motor vehicles and motorcycles (45-47); H – Transportation and storage (49-53); I – Accommodation and food service activities (55-56); J – Information and communication (58-63); K – Financial and insurance activities (64-66); L – Real estate activities (68); M – Professional, scientific and technical activities (69-75); N – Administrative and support service activities (77-82); O – Public administration and defence; compulsory social security (84); P – Education (85); Q – Human health and social work activities (86-88); R – Arts, entertainment and recreation (90-93); S – Other service activities (94 -96); T – Activities of households as employers; u0ndifferentiated goods- and services-producing activities of households for own use (97-98); U – Activities of extraterritorial organisations and bodies (99)

6.2 *All 7 key emerging industries and cross-sectoral interlinkages based on M&A deals: number of emerging industries assigned to by NACE code division*

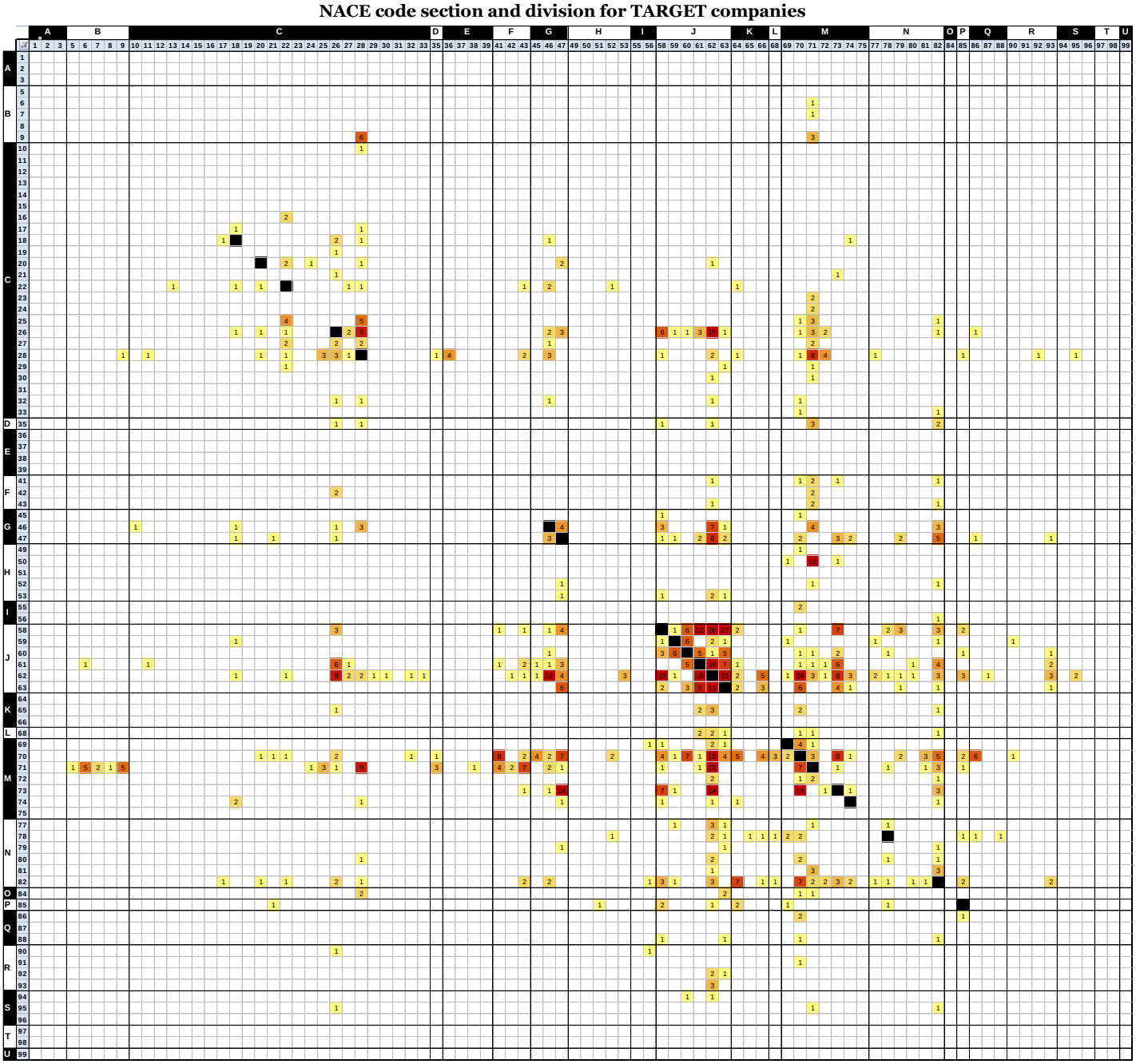


Interlinkage not assigned to any emerging industry
Interlinkage assigned to 1 emerging industry
Interlinkage assigned to 2 emerging industries
Interlinkage assigned to 3 emerging industries
Interlinkage assigned to 4 emerging industries
Interlinkage assigned to 5 emerging industries
Interlinkage assigned to 6 emerging industries
Interlinkage assigned to 7 emerging industries

NACE Rev. 2 classification: Section – Title (Divisions)

A – Agriculture, forestry and fishing (01-03); B – Mining and quarrying (05-09); C – Manufacturing (10-33); D – Electricity, gas, steam and air conditioning supply (35); E – Water supply, sewerage, waste management and remediation activities (36-39); F – Construction (41-43); G – Wholesale and retail trade; repair of motor vehicles and motorcycles (45-47); H – Transportation and storage (49-53); I – Accommodation and food service activities (55-56); J – Information and communication (58-63); K – Financial and insurance activities (64-66); L – Real estate activities (68); M – Professional, scientific and technical activities (69-75); N – Administrative and support service activities (77-82); O – Public administration and defence; compulsory social security (84); P – Education (85); Q – Human health and social work activities (86-88); R – Arts, entertainment and recreation (90-93); S – Other service activities (94 -96); T – Activities of households as employers; uondifferentiated goods- and services-producing activities of households for own use (97-98); U – Activities of extraterritorial organisations and bodies (99)

6.3 *Creative industries: number of M&A deals between targets and acquirers by NACE code division*



NACE Rev. 2 classification: Section – Title (Divisions)

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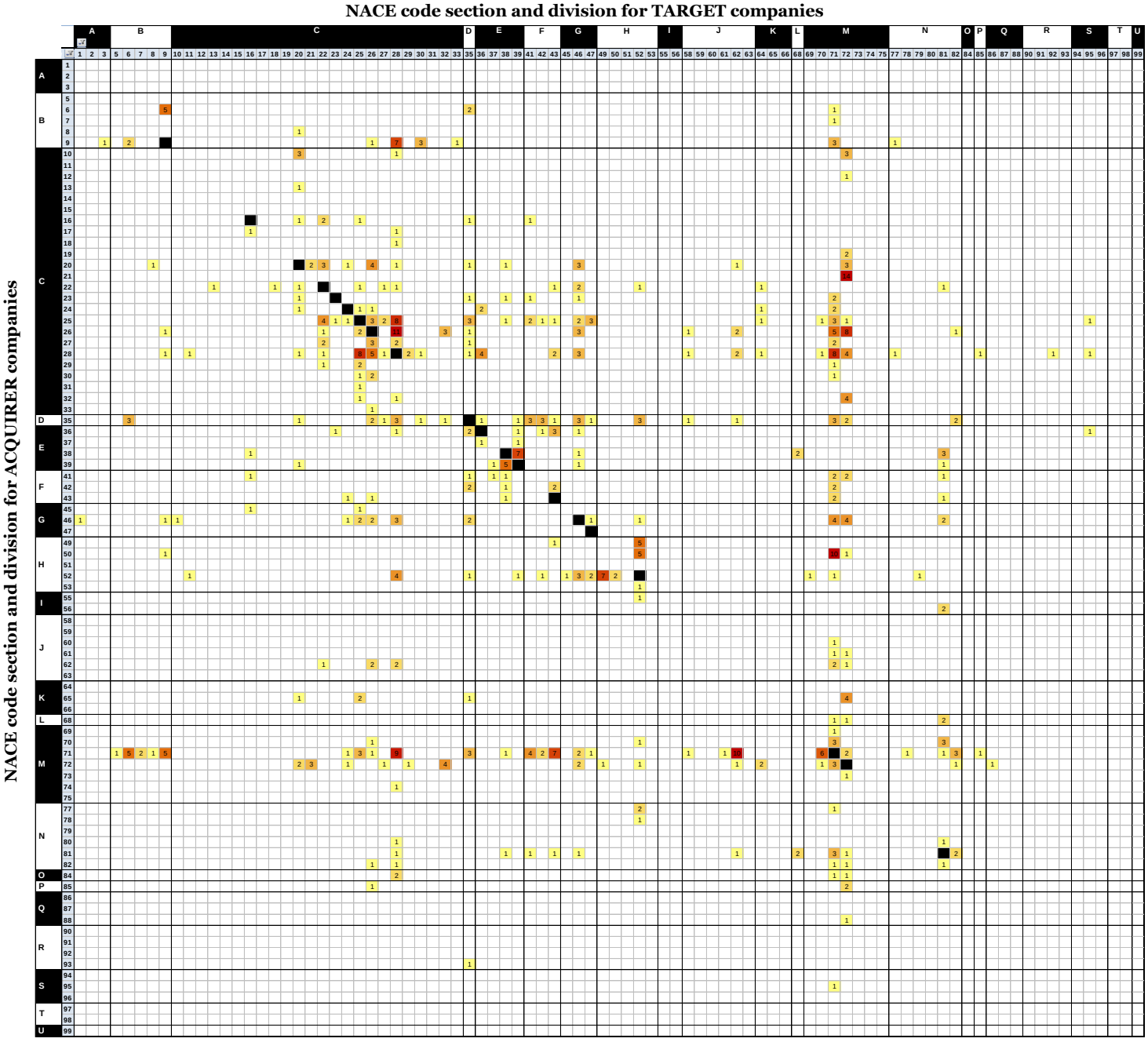
6.4 Eco industries: number of M&A deals between targets and acquirers by NACE code division



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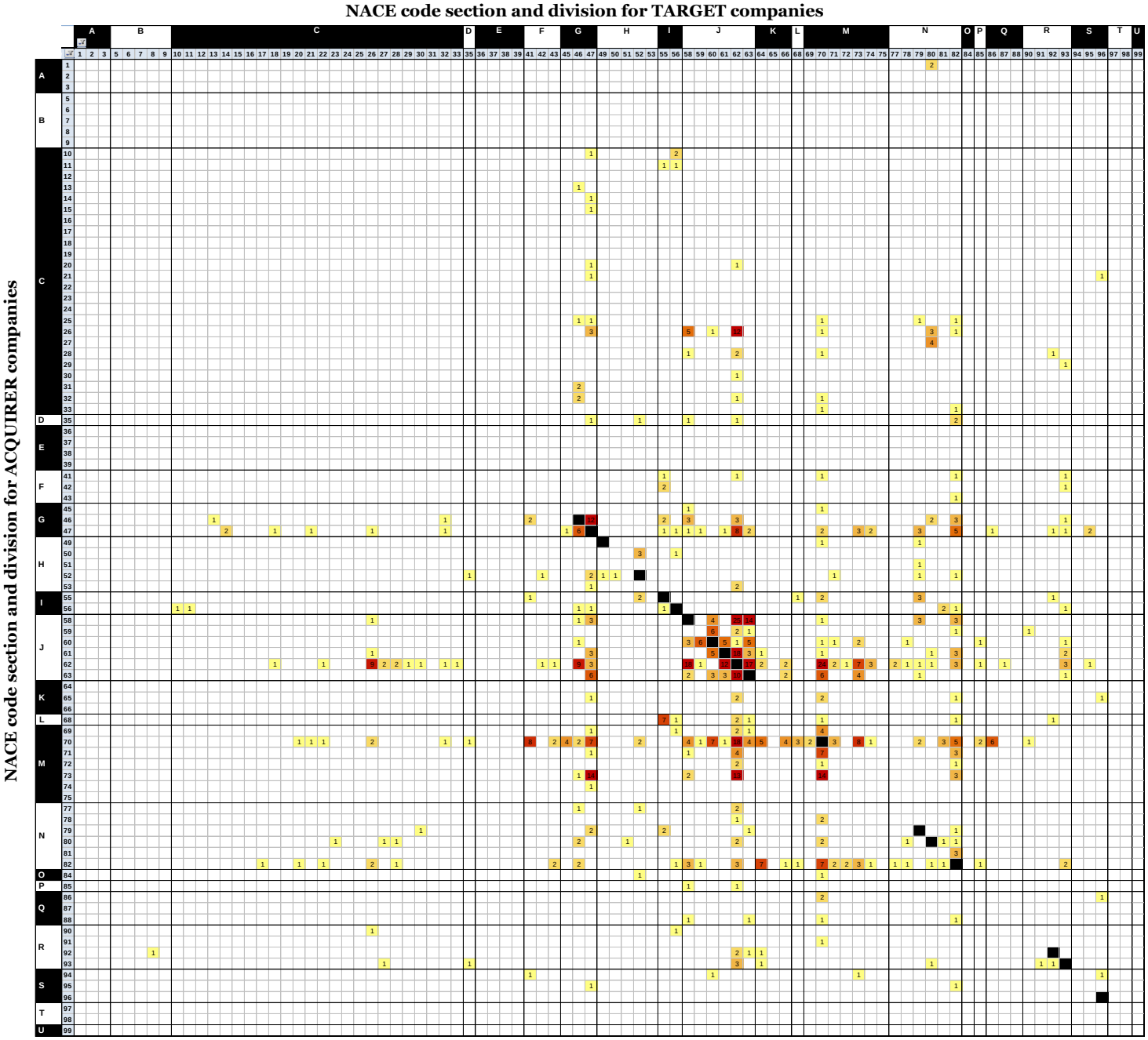
6.5 *Experience industries: number of M&A deals between targets and acquirers by NACE code division*



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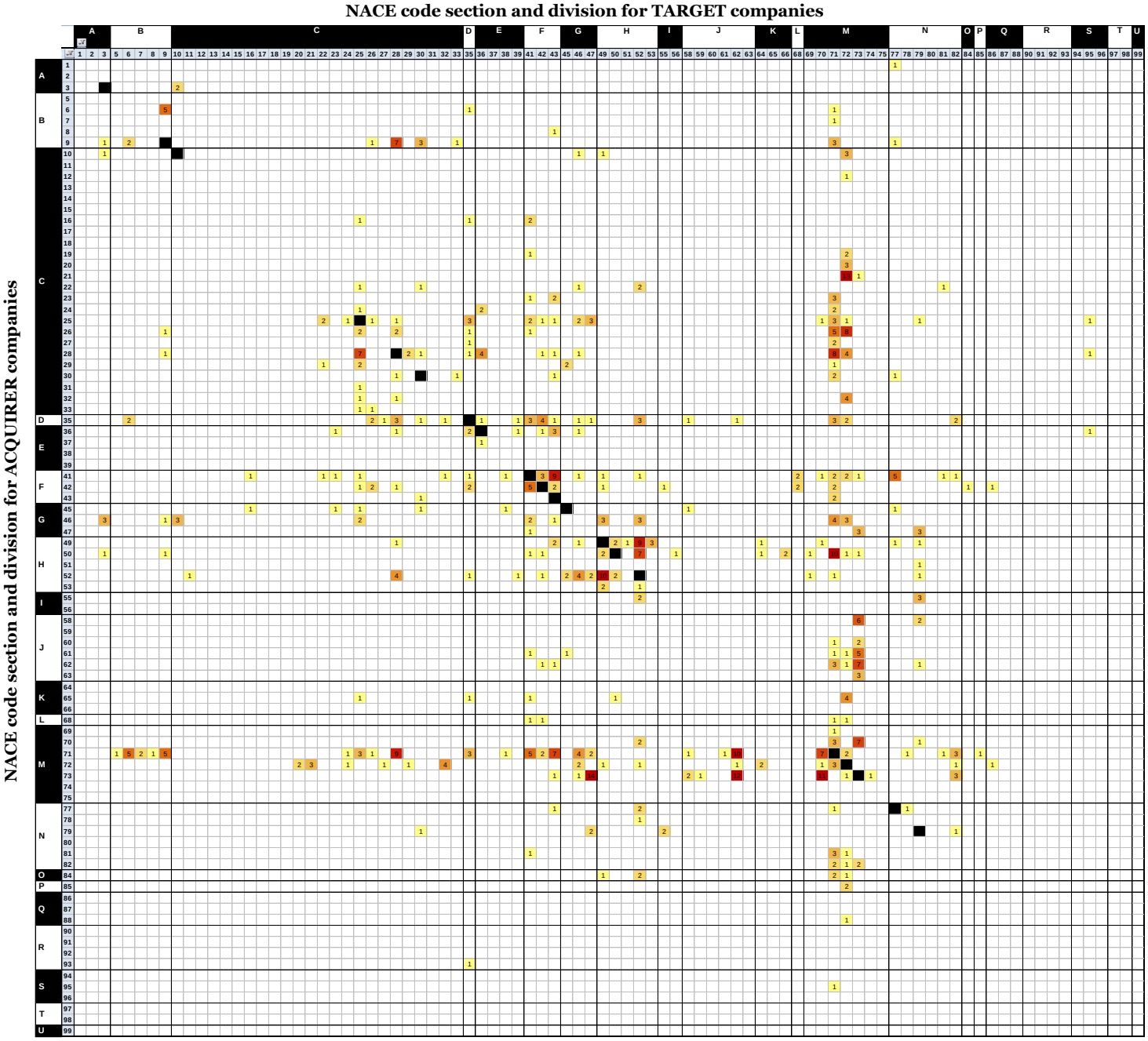
6.6 *Maritime industries: number of M&A deals between targets and acquirers by NACE code division*



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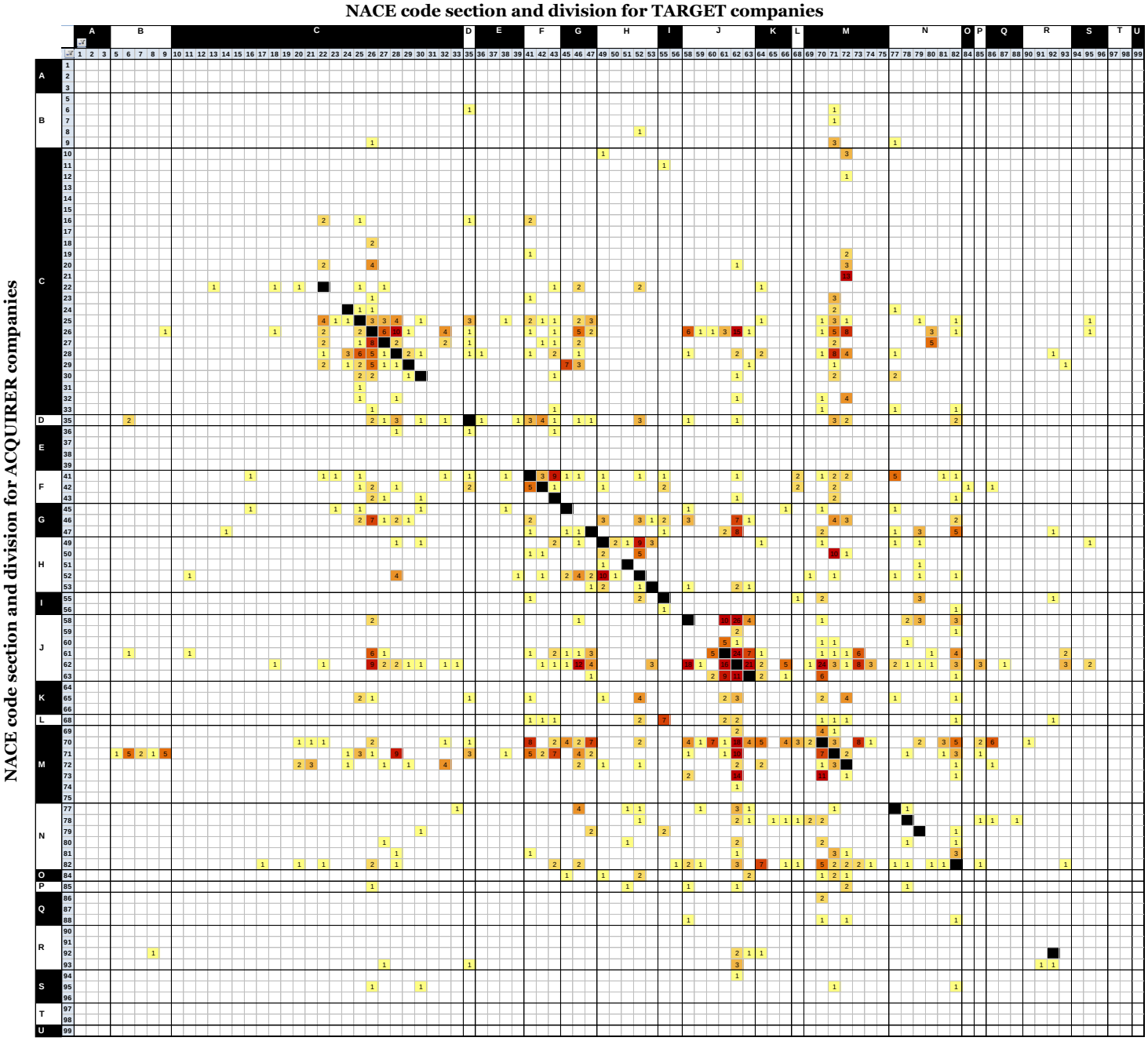
6.7 *Mobility industries: number of M&A deals between targets and acquirers by NACE code division*



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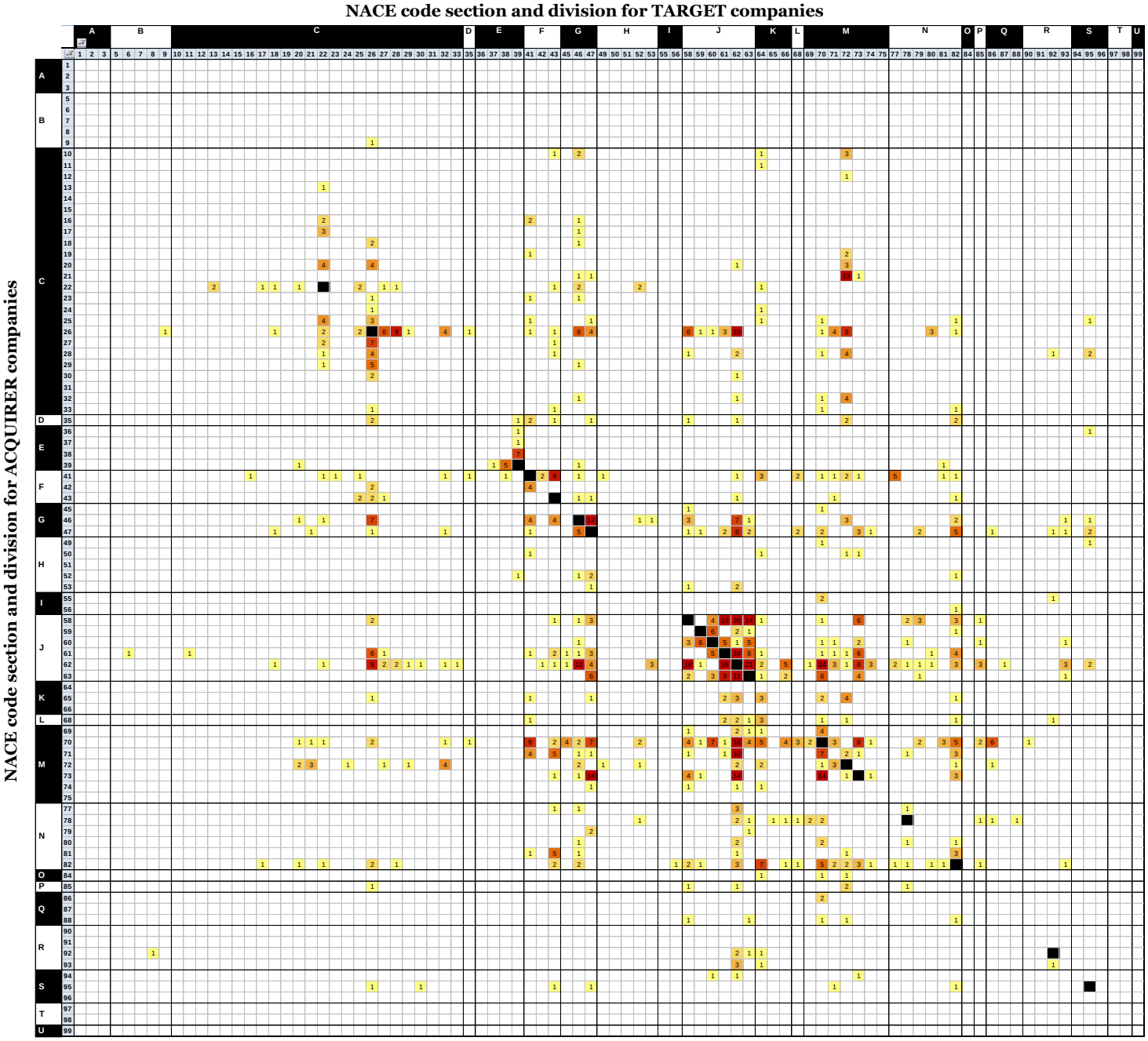
6.8 *Mobile services: number of M&A deals between targets and acquirers by NACE code division*



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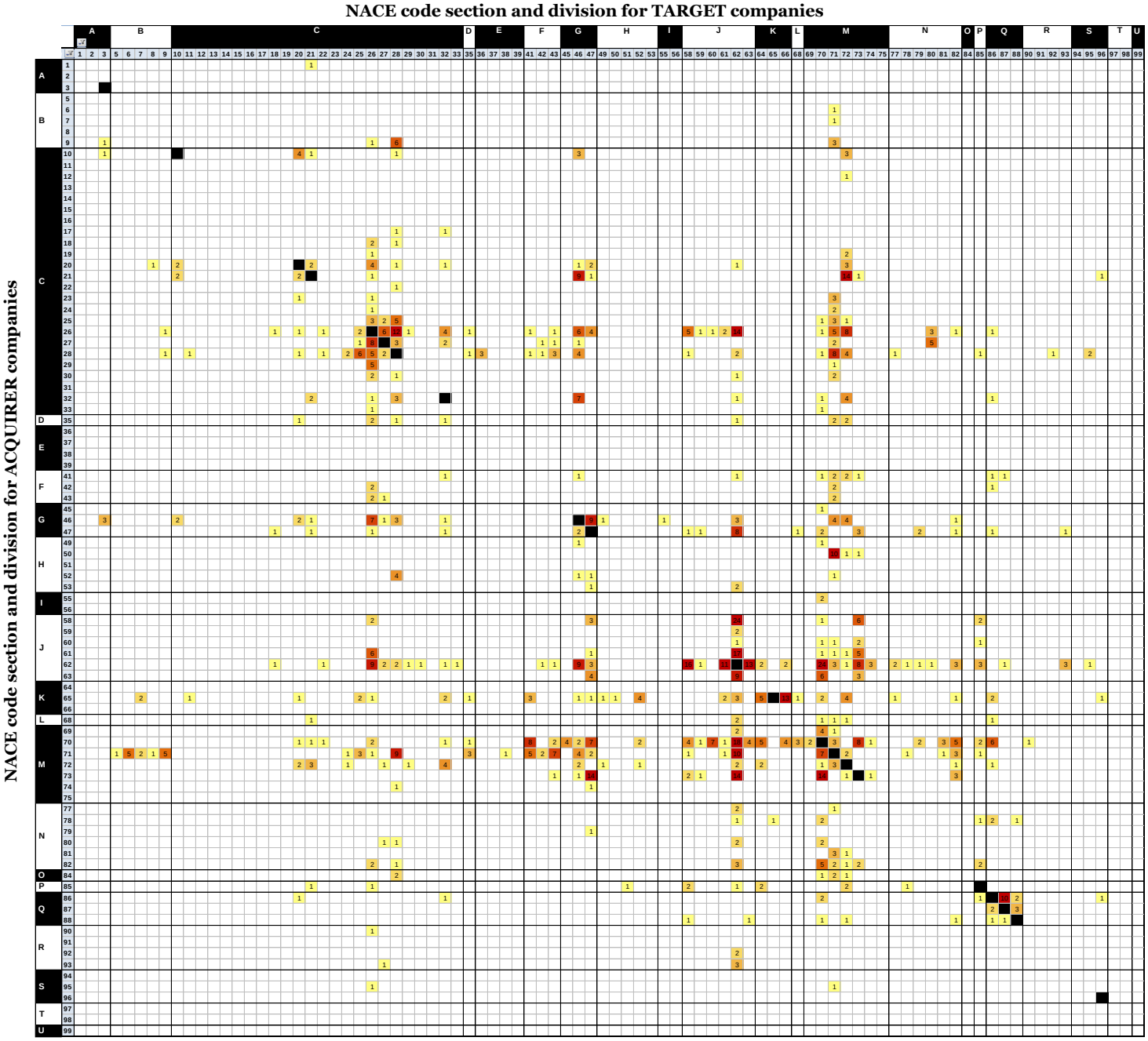
6.9 *Personalised medicine: number of M&A deals between targets and acquirers by NACE code division*



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7 Appendix B: Key emerging industries NACE codes

7.1 Creative industries

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
1811	Printing of daily newspapers	1	2	4,474	1,755	296
1812	Other printing	15	11	69,342	24,422	6,164
1813	Pre-press and pre-media services	3	3	9,898	4,234	1,126
1814	Bookbinding industry	0	0	3,961	1,817	610
1820	Reproduction of recorded media	0	3	5,000	-	-
2012	Manufacture of dyes and pigments	0	1	8,549	1,983	329
2229	Manufacture of other plastic products	37	33	62,901	20,599	5,293
2630	Manufacture of communication equipment	159	43	-	-	2,259
2640	Manufacture of consumer electronics	154	12	27,502	4,075	844
2670	Manufacture of optical instruments and photographic equipment	34	16	6,210	2,433	451
2680	Manufacture of magnetic and optical media	0	2	282	75	21
2732	Manufacture of other electronic and electric wires and cables	6	4	20,000	4,000	981
2829	Manufacture of other general-purpose machinery n.e.c.	11	7	52,327	17,228	3,159
2899	Manufacture of other special-purpose machinery n.e.c.	148	94	39,962	12,542	2,610
3220	Industry of musical instruments	2	0	-	-	200
4618	Agents specialised in the sale of other particular products	2	2	25,816	7,502	2,005
4666	Wholesale of other office machinery and equipment	0	9	24,403	5,350	1,025
4761	Retail sale of books in specialised stores	1	7	15,751	3,291	1,475
4762	Retail sale of newspapers and stationery in specialised stores	0	1	21,590	4,118	2,458
4763	Retail sale of music and video recordings in specialised stores	0	1	3,608	579	247
4791	Retail sale via mail order houses or via Internet	115	90	68,326	11,352	2,635
5811	Book publishing	15	13	29,075	9,888	1,674
5812	Publishing of directories and mailing lists	0	0	3,900	2,069	-
5813	Publishing of newspapers	19	22	41,961	15,747	3,127
5814	Publishing of journals and periodicals	41	43	36,159	14,513	2,333
5819	Other publishing activities	32	12	6,233	2,427	790
5821	Publisher of computer games	0	0	2,025	-	91
5829	Other software publishing	93	54	-	12,083	1,340
5911	Motion picture, video and television programme production activities	52	33	30,053	9,572	2,237
5912	Motion picture, video and television programme post-production activities	2	1	5,225	2,292	396
5913	Motion picture, video and television programme distribution activities	12	16	12,625	4,520	-
5914	Motion picture projection activities	3	3	7,267	2,374	885
5920	Sound recording and music publishing activities	13	3	5,740	1,864	-
6010	Radio broadcasting	5	6	-	-	-
6020	Television programming and broadcasting activities	121	72	45,068	20,821	1,831
6110	Wired telecommunications activities	18	10	165,925	82,650	5,963
6120	Wireless telecommunications activities	36	12	137,467	53,956	2,037
6190	Other telecommunications activities	229	217	103,011	39,734	3,463

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover **(m EUR)**	Value-added **(m EUR)**	Employment **(million)**
6201	Computer programming activities	1448	315	129,748	62,496	9,605
6202	Computer consultancy activities	120	114	129,092	66,247	9,829
6209	Other information technology and computer service activities	241	144	48,803	23,471	3,624
6311	Data processing, hosting and related activities	278	36	35,029	17,572	3,507
6312	Web portals	204	86	14,260	3,131	387
6391	News agency activities	4	5	6,545	3,997	382
6910	Legal activities	45	20	112,835	77,671	13,884
7021	Public relations and communication activities	7	20	-	-	-
7022	Business and other management consultancy activities	194	179	155,084	79,990	14,022
7111	Architect's office	6	6	41,603	23,598	5,982
7112	Engineering activities and related technical consultancy	1029	174	214,371	99,681	19,189
7311	Advertising agencies	137	122	89,379	27,638	7,999
7312	Media representation	0	1	44,212	8,805	1,479
7410	Specialised design activities	3	5	15,091	6,927	1,829
7420	Photographic activities	16	6	9,000	3,800	-
7430	Translation and interpretation activities	4	7	3,951	2,029	822
7722	Renting of video tapes and disks	0	0	2,193	600	418
7810	Activities of employment placement agencies	28	69	19,011	12,627	4,447
8230	Organisation of conventions and trade shows	1	5	18,273	5,481	1,400
8299	Other business support service activities n.e.c.	104	107	98,493	37,180	8,990
8552	Cultural education	0	0	-	-	-
8559	Other education n.e.c.	50	42	-	-	-
9001	Performing artists and producers of artistics and literary work	0	0	-	-	-
9002	Support activities to performing arts	0	6	-	-	-
9003	Artists, writers, journalists and others	0	0	-	-	-
9004	Theatre and concert hall companies etc.	4	0	-	-	-
9101	Libraries and archives	0	0	-	-	-
9102	Museums	1	0	-	-	-
9103	Institutions for the preservation of historical sites and buildings and similar visitor attractions	0	0	-	-	-

7.2 Eco industries

NACE code	**Level 4 NACE description**	**# ER deals**	**# M&A deals**	**Turnover** (m EUR)	**Value-added** (m EUR)	**Employment** (million)
1621	Manufacture of veneer sheets and wood-based panels	3	0	20,547	4,051	1,085
1629	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials	12	8	9,675	2,591	1,181
1722	Manufacture of household and sanitary goods and of toilet requisites	2	0	23,808	4,971	789
2014	Manufacture of other organic basic chemicals	28	6	96,721	17,298	1,600
2015	Manufacture of fertilisers and nitrogen compounds	10	5	16,224	2,487	554
2016	Manufacture of plastics in primary forms	28	17	84,032	15,651	1,733
2059	Manufacture of other chemical products n.e.c.	79	27	45,477	10,177	1,299
2229	Manufacture of other plastic products	37	33	62,901	20,599	5,293
2349	Manufacture of other ceramic products	4	2	585	247	80

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
2351	Manufacture of cement	1	4	18,503	7,373	570
2410	Manufacture of basic iron and steel and of ferro-alloys	10	10	-	15,000	3,673
2521	Manufacture of central heating radiators and boilers	17	9	10,204	2,824	590
2530	Manufacture of steam generators, except central heating hot water boilers	0	0	5,815	1,766	353
2599	Manufacture of other fabricated metal products n.e.c.	56	51	41,235	13,210	3,797
2651	Manufacture of instruments and appliances for measuring, testing and navigation	207	55	54,312	20,189	3,432
2811	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	20	7	71,315	17,860	2,522
2829	Manufacture of other general-purpose machinery n.e.c.	11	7	52,327	17,228	3,159
2899	Manufacture of other special-purpose machinery n.e.c.	148	94	39,962	12,542	2,610
3511	Production of electricity	132	92	285,587	86,846	4,205
3513	Distribution of electricity	10	9	199,708	49,097	3,205
3514	Trade of electricity	1	1	342,852	20,425	930
3521	Manufacture of gas	2	1	-	-	-
3522	Distribution of gaseous fuels through mains	9	21	62,606	18,622	1,046
3600	Water collection, treatment and supply	23	21	56,824	-	-
3700	Sewerage	0	2	21,354	12,646	1,396
3811	Collection of non-hazardous waste	14	12	39,131	16,327	4,012
3812	Collection of hazardous waste	0	1	-	665	-
3821	Treatment and disposal of non-hazardous waste	0	1	23,772	9,457	1,284
3822	Treatment and disposal of hazardous waste	0	2	-	2,046	-
3832	Recovery of sorted materials	11	10	34,789	6,803	1,437
3900	Remediation activities and other waste management services	53	25	4,000	1,637	382
4312	Site preparation	1	5	36,473	13,554	3,339
4621	Wholesale of grain, unmanufactured tobacco, seeds and animal feeds	0	3	153,477	10,608	2,250
4622	Wholesale of flowers and plants	2	1	23,390	3,299	860
4677	Wholesale of waste and scrap	0	3	39,200	4,983	1,386
4776	Retail sale of flowers, plants, seeds, fertilisers, pet animals and pet food in specialised stores	3	2	32,654	8,238	4,325
4950	Transport via pipeline	0	1	11,839	7,427	229
5222	Service activities incidental to water transportation	5	10	-	-	-
5229	Other transportation support activities	10	35	198,144	43,175	9,184
7112	Engineering activities and related technical consultancy	1029	174	214,371	99,681	19,189
7211	Research and experimental development on biotechnology	444	22	-	-	465
7219	Other research and experimental development on natural sciences and engineering	916	287	42,193	19,003	3,982
8122	Other building and industrial cleaning activities	12	34	10,289	6,186	2,741
0620	Extraction of natural gas	1040	312	71,214	14,505	253
0910	Support activities for petroleum and natural gas extraction	127	30	12,514	5,036	391

7.3 Experience industries

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
4618	Agents specialised in the sale of other particular products	2	2	25,816	7,502	2,005

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
4642	Wholesale of clothing and footwear	7	10	120,215	22,331	4,152
4649	Wholesale of other household goods	5	13	164,490	26,546	5,844
4719	Other retail sale in non-specialised stores	2	3	115,877	22,672	10,068
4764	Retail sale of sporting equipment in specialised stores	0	1	40,402	8,342	3,256
4765	Retail sale of games and toys in specialised stores	0	2	11,797	2,202	1,030
4771	Retail sale of clothing in specialised stores	27	24	178,426	44,535	18,980
4772	Retail sale of footwear and leather goods in specialised stores	5	4	39,698	9,640	4,370
4778	Other retail sale of new goods in specialised stores	68	77	77,609	18,837	8,531
4791	Retail sale via mail order houses or via Internet	115	90	68,326	11,352	2,635
4799	Other retail sale not in stores, stalls or markets	9	4	30,000	6,000	2,575
4939	Other passenger land transport n.e.c.	4	1	31,572	17,274	5,409
5222	Service activities incidental to water transportation	5	10	-	-	-
5223	Service activities incidental to air transportation	7	10	34,494	20,107	2,595
5510	Hotels and similar accommodation	65	51	107,981	52,099	19,437
5520	Holiday and other short-stay accommodation	0	0	13,146	5,370	2,410
5530	Camping grounds, recreational vehicle parks and trailer parks	5	3	7,129	3,336	859
5590	Other accommodation	8	3	2,069	1,000	404
5610	Restaurants and mobile food service activities	58	36	191,569	76,600	45,562
5621	Event catering activities	3	8	15,941	7,021	3,936
5630	Beverage serving activities	1	7	79,752	28,124	20,837
5829	Other software publishing	93	54	-	12,083	1,340
6020	Television programming and broadcasting activities	121	72	45,068	20,821	1,831
6110	Wired telecommunications activities	18	10	165,925	82,650	5,963
6201	Computer programming activities	1448	315	129,748	62,496	9,605
6209	Other information technology and computer service activities	241	144	48,803	23,471	3,624
6312	Web portals	204	86	14,260	3,131	387
7021	Public relations and communication activities	7	20	-	-	-
7022	Business and other management consultancy activities	194	179	155,084	79,990	14,022
7911	Travel agency activities	35	49	70,837	11,496	2,813
7912	Tour operator activities	4	3	-	7,000	-
7990	Other reservation service and related activities	0	1	7,504	2,251	545
8020	Security systems service activities	62	34	5,872	3,257	1,479
8230	Organisation of conventions and trade shows	1	5	18,273	5,481	1,400
8299	Other business support service activities n.e.c.	104	107	98,493	37,180	8,990
9004	Operation of arts facilities	4	0	-	-	-
9102	Museums activities	1	0	-	-	-
9103	Operation of historical sites and buildings and similar visitor attractions	0	0	-	-	-
9104	Botanical and zoological gardens and nature reserves activities	1	1	-	-	-
9200	Gambling and betting activities	35	46	-	-	-
9311	Operation of sports facilities	11	11	-	-	-
9312	Activities of sports clubs	9	4	-	-	-
9313	Fitness Facilities	0	0	-	-	-
9319	Other sports activities	14	9	-	-	-

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
9321	Activities of amusement parks and theme parks	4	0	-	-	-
9329	Other amusement and recreation activities	22	19	-	-	-
9499	Activities of other membership organisations n.e.c.	34	1	-	-	-
9602	Hairdressing and other beauty treatment	2	2	-	-	-
9604	Physical well-being activities	15	5	-	-	-
9609	Other personal service activities n.e.c.	6	1	-	-	-
5030	Inland passenger water transport	0	0	-	-	-
5040	Inland freight water transport	1	0	-	-	-
9001	Performing arts	0	0	-	-	-
9002	Support activities to performing arts	0	6	-	-	-
9003	Artistic creation	0	0	-	-	-

7.4 Maritime industries

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
1020	Processing and preserving of fish, crustaceans and molluscs	11	10	21,795	3,917	4,844
2219	Manufacture of other rubber products	6	9	-	8,090	2,142
2599	Manufacture of other fabricated metal products n.e.c.	56	51	41,235	13,210	3,797
2811	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	20	7	71,315	17,860	2,522
2822	Manufacture of lifting and handling equipment	6	15	46,444	13,818	2,711
3011	Building of ships and floating structures	26	22	27,622	5,903	1,544
3012	Building of pleasure and sporting boats	9	8	8,898	1,949	528
3320	Installation of industrial machinery and equipment	3	2	50,000	17,000	-
3511	Production of electricity	132	92	285,587	86,846	4,205
3600	Water collection, treatment and supply	23	21	56,824	-	-
4120	Construction of residential and non-residential buildings	83	50	495,751	133,469	39,326
4213	Construction of bridges and tunnels	0	0	12,198	2,984	-
4221	Construction of utility projects for fluids	0	2	26,807	8,600	2,421
4291	Construction of water projects	0	1	15,413	5,433	959
4299	Construction of other civil engineering projects n.e.c.	28	25	56,577	13,762	3,341
4313	Test drilling and boring	2	3	6,733	1,706	292
4399	Other specialised construction activities n.e.c.	11	13	103,494	39,601	12,353
4519	Sale of other motor vehicles	12	20	44,446	5,350	1,212
4614	Agents involved in the sale of machinery, industrial equipment, ships and aircraft	0	0	15,790	5,998	1,049
4931	Urban and suburban passenger land transport	6	11	49,659	30,841	8,438
4941	Freight transport by road	37	47	264,631	93,774	28,778
5210	Warehousing and storage	21	18	50,000	-	-
5222	Service activities incidental to water transportation	5	10	-	-	-
5223	Service activities incidental to air transportation	7	10	34,494	20,107	2,595
5224	Cargo handling	8	6	22,724	10,725	2,599
5229	Other transportation support activities	10	35	198,144	43,175	9,184
7112	Engineering activities and related technical consultancy	1029	174	214,371	99,681	19,189
7120	Technical testing and analysis	25	24	32,467	18,805	3,892

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
7219	Other research and experimental development on natural sciences and engineering	916	287	42,193	19,003	3,982
7311	Advertising agencies	137	122	89,379	27,638	7,999
7732	Rental and leasing of construction and civil engineering machinery and equipment	16	10	19,257	9,175	1,433
7734	Rental and leasing of water transport equipment	0	0	3,445	1,800	110
7911	Travel agency activities	35	49	70,837	11,496	2,813
0311	Marine fishing	5	1	-	-	-
0312	Freshwater fishing	0	0	-	-	-
0321	Marine aquaculture	9	23	-	-	-
0322	Freshwater aquaculture	0	0	-	-	-
0910	Support activities for petroleum and natural gas extraction	127	30	12,514	5,036	391
5010	Sea and coastal passenger water transport	0	0	-	-	-
5020	Sea and coastal freight water transport	34	35	-	-	-
5030	Inland passenger water transport	0	0	-	-	-
5040	Inland freight water transport	1	0	-	-	-

7.5 Mobile services industries

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
2221	Manufacture of plastic plates, sheets, tubes and profiles	6	4	51,182	13,779	2,697
2222	Manufacture of plastic packing goods	10	17	39,449	11,324	2,406
2223	Manufacture of buildersâ€™ ware of plastic	7	3	29,384	8,918	2,468
2229	Manufacture of other plastic products	37	33	62,901	20,599	5,293
2611	Manufacture of electronic components	430	87	43,795	11,151	2,229
2630	Manufacture of communication equipment	159	43	-	-	2,259
2651	Manufacture of instruments and appliances for measuring, testing and navigation	207	55	54,312	20,189	3,432
3900	Remediation activities and other waste management services	53	25	4,000	1,637	382
4120	Construction of residential and non-residential buildings	83	50	495,751	133,469	39,326
4321	Electrical installation	24	38	145,989	56,907	16,087
4651	Wholesale of computers, computer peripheral equipment and software	21	39	208,810	27,854	3,516
4690	Non-specialised wholesale trade	20	27	219,775	28,220	6,856
4754	Retail sale of electrical household appliances in specialised stores	11	12	44,953	6,612	2,898
4778	Other retail sale of new goods in specialised stores	68	77	77,609	18,837	8,531
4779	Retail sale of second-hand goods in stores	1	0	7,186	1,817	1,148
4791	Retail sale via mail order houses or via Internet	115	90	68,326	11,352	2,635
5819	Other publishing activities	32	12	6,233	2,427	790
5829	Other software publishing	93	54	-	12,083	1,340
5914	Motion picture projection activities	3	3	7,267	2,374	885
6020	Television programming and broadcasting activities	121	72	45,068	20,821	1,831
6120	Wireless telecommunications activities	36	12	137,467	53,956	2,037
6130	Satellite telecommunications activities	0	0	-	-	-
6190	Other telecommunications activities	229	217	103,011	39,734	3,463
6201	Computer programming activities	1448	315	129,748	62,496	9,605

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
6202	Computer consultancy activities	120	114	129,092	66,247	9,829
6203	Computer facilities management activities	4	5	28,462	12,276	1,569
6209	Other information technology and computer service activities	241	144	48,803	23,471	3,624
6312	Web portals	204	86	14,260	3,131	387
6499	Other financial service activities, except insurance and pension funding n.e.c.	720	210	-	-	-
7022	Business and other management consultancy activities	194	179	155,084	79,990	14,022
7219	Other research and experimental development on natural sciences and engineering	916	287	42,193	19,003	3,982
7311	Advertising agencies	137	122	89,379	27,638	7,999
7320	Market research and public opinion polling	11	18	17,000	8,000	2,000
7810	Activities of employment placement agencies	28	69	19,011	12,627	4,447
8299	Other business support service activities n.e.c.	104	107	98,493	37,180	8,990
9200	Gambling and betting activities	35	46	-	-	-
9512	Repair of communication equipment	0	1	3,000	1,053	347
9529	Repair of other personal and household goods	32	11	2,497	1,078	625

7.6 Mobility industries

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
2229	Manufacture of other plastic products	37	33	62,901	20,599	5,293
2453	Casting of light metals	0	6	9,183	2,972	798
2521	Manufacture of central heating radiators and boilers	17	9	10,204	2,824	590
2594	Manufacture of fasteners and screw machine products	3	2	-	-	642
2599	Manufacture of other fabricated metal products n.e.c.	56	51	41,235	13,210	3,797
2611	Manufacture of electronic components	430	87	43,795	11,151	2,229
2612	manufacture of loaded electronic boards	0	0	10,000	-	-
2620	Manufacture of computers and peripheral equipment	115	8	37,406	5,452	947
2630	Manufacture of communication equipment	159	43	-	-	2,259
2651	Manufacture of instruments and appliances for measuring, testing and navigation	207	55	54,312	20,189	3,432
2731	Manufacture of fibre optic cables	0	0	3,167	614	-
2732	Manufacture of other electronic and electric wires and cables	6	4	20,000	4,000	981
2790	Manufacture of other electrical equipment	45	32	26,392	9,002	1,865
2811	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	20	7	71,315	17,860	2,522
2813	Manufacture of other pumps and compressors	5	8	27,896	9,014	1,483
2814	Manufacture of other taps and valves	3	8	23,967	8,187	1,319
2823	Manufacture of office machinery and equipment (except computers and peripheral equipment)	0	0	4,413	1,464	286
2825	Manufacture of non-domestic cooling and ventilation equipment	29	14	39,901	11,440	2,345
2829	Manufacture of other general-purpose machinery n.e.c.	11	7	52,327	17,228	3,159
2910	Manufacture of motor vehicles	24	5	-	57,228	10,345
2920	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	4	0	24,934	6,303	1,700
2932	Manufacture of other parts and accessories for motor vehicles	49	29	132,282	30,685	8,119
3020	Manufacture of railway locomotives and rolling stock	0	4	21,435	6,136	1,095

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
3030	Manufacture of air and spacecraft and related machinery	49	4	86,670	25,929	3,552
3040	Manufacture of military fighting vehicles	0	0	3,616	841	114
3091	Manufacture of motorcycles	5	0	5,483	1,070	254
3099	Manufacture of other transport equipment n.e.c.	0	0	644	201	63
3316	Repair and maintenance of aircraft and spacecraft	1	1	15,896	5,423	697
3511	Production of electricity	132	92	285,587	86,846	4,205
4120	Construction of residential and non-residential buildings	83	50	495,751	133,469	39,326
4299	Construction of other civil engineering projects n.e.c.	28	25	56,577	13,762	3,341
4329	Other construction installation	6	7	38,867	14,630	4,012
4511	Sale of cars and light motor vehicles	3	6	668,541	59,593	15,537
4519	Sale of other motor vehicles	12	20	44,446	5,350	1,212
4520	Maintenance and repair of motor vehicles	9	17	118,963	37,424	15,236
4719	Other retail sale in non-specialised stores	2	3	115,877	22,672	10,068
4910	Passenger rail transport, interurban	0	0	55,820	24,000	5,471
4920	Freight rail transport	6	14	14,461	-	1,653
4931	Urban and suburban passenger land transport	6	11	49,659	30,841	8,438
4932	Taxi operation	4	2	17,252	10,770	7,258
4939	Other passenger land transport n.e.c.	4	1	31,572	17,274	5,409
4941	Freight transport by road	37	47	264,631	93,774	28,778
5110	Passenger air transport	36	12	102,512	21,647	3,599
5121	Freight air transport	0	1	-	1,318	-
5210	Warehousing and storage	21	18	50,000	-	-
5221	Service activities incidental to land transportation	40	41	61,302	38,860	4,819
5223	Service activities incidental to air transportation	7	10	34,494	20,107	2,595
5224	Cargo handling	8	6	22,724	10,725	2,599
5229	Other transportation support activities	10	35	198,144	43,175	9,184
5320	Other postal and courier activities	9	14	44,937	20,473	6,751
5510	Hotels and similar accommodation	65	51	107,981	52,099	19,437
5520	Holiday and other short-stay accommodation	0	0	13,146	5,370	2,410
5530	Camping grounds, recreational vehicle parks and trailer parks	5	3	7,129	3,336	859
5590	Other accommodation	8	3	2,069	1,000	404
5821	Publishing of computer games	0	0	2,025	-	91
5829	Other software publishing	93	54	-	12,083	1,340
6110	Wired telecommunications activities	18	10	165,925	82,650	5,963
6120	Wireless telecommunications activities	36	12	137,467	53,956	2,037
6130	Satellite telecommunications activities	0	0	-	-	-
6190	Other telecommunications activities	229	217	103,011	39,734	3,463
6201	Computer programming activities	1448	315	129,748	62,496	9,605
6202	Computer consultancy activities	120	114	129,092	66,247	9,829
6209	Other information technology and computer service activities	241	144	48,803	23,471	3,624
6311	Data processing, hosting and related activities	278	36	35,029	17,572	3,507
7022	Business and other management consultancy activities	194	179	155,084	79,990	14,022
7112	Engineering activities and related technical consultancy	1029	174	214,371	99,681	19,189

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
7120	Technical testing and analysis	25	24	32,467	18,805	3,892
7219	Other research and experimental development on natural sciences and engineering	916	287	42,193	19,003	3,982
7711	Rental and leasing of cars and light motor vehicles	11	11	43,777	20,417	1,414
7712	Rental and leasing of trucks	3	0	-	-	-
7735	Rental and leasing of air transport equipment	0	0	4,718	2,375	48
7739	Rental and leasing of other machinery, equipment and tangible goods n.e.c.	25	22	30,795	15,874	1,340
7810	Activities of employment placement agencies	28	69	19,011	12,627	4,447
7911	Travel agency activities	35	49	70,837	11,496	2,813
8299	Other business support service activities n.e.c.	104	107	98,493	37,180	8,990
9200	Gambling and betting activities	35	46	-	-	-
9321	Activities of amusement parks and theme parks	4	0	-	-	-

7.7 Personalised medicine industries

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
1041	Manufacture of oils and fats	10	4	38,637	3,300	532
1089	Manufacture of other food products n.e.c.	25	25	42,451	10,373	1,652
2042	Manufacture of perfumes and toilet preparations	38	38	29,428	7,809	1,322
2059	Manufacture of other chemical products n.e.c.	79	27	45,477	10,177	1,299
2120	Manufacture of pharmaceutical preparations	251	96	192,230	68,678	4,811
2611	Manufacture of electronic components	430	87	43,795	11,151	2,229
2630	Manufacture of communication equipment	159	43	-	-	2,259
2651	Manufacture of instruments and appliances for measuring, testing and navigation	207	55	54,312	20,189	3,432
2670	Manufacture of optical instruments and photographic equipment	34	16	6,210	2,433	451
2790	Manufacture of other electrical equipment	45	32	26,392	9,002	1,865
2813	Manufacture of other pumps and compressors	5	8	27,896	9,014	1,483
2822	Manufacture of lifting and handling equipment	6	15	46,444	13,818	2,711
2899	Manufacture of other special-purpose machinery n.e.c.	148	94	39,962	12,542	2,610
3250	Manufacture of medical and dental instruments and supplies	292	54	57,178	24,066	4,545
4646	Wholesale of pharmaceutical goods	19	36	372,501	56,595	5,895
4773	Dispensing chemist in specialised stores	12	24	167,083	33,812	8,947
4791	Retail sale via mail order houses or via Internet	115	90	68,326	11,352	2,635
6201	Computer programming activities	1448	315	129,748	62,496	9,605
6209	Other information technology and computer service activities	241	144	48,803	23,471	3,624
6511	Life insurance	19	3	-	-	-
6512	Non-life insurance	43	9	-	-	-
7022	Business and other management consultancy activities	194	179	155,084	79,990	14,022
7112	Engineering activities and related technical consultancy	1029	174	214,371	99,681	19,189
7120	Technical testing and analysis	25	24	32,467	18,805	3,892
7211	Research and experimental development on biotechnology	444	22	-	-	465
7219	Other research and experimental development on natural sciences and engineering	916	287	42,193	19,003	3,982
7311	Advertising agencies	137	122	89,379	27,638	7,999

NACE code	Level 4 NACE description	# ER deals	# M&A deals	Turnover (m EUR)	Value-added (m EUR)	Employment (million)
8559	Other education n.e.c.	50	42	-	-	-
8610	Hospital activities	28	22	-	-	-
8621	General medical practice activities	18	12	-	-	-
8622	Specialist medical practice activities	2	6	-	-	-
8623	Dental practice activities	12	7	-	-	-
8690	Other human health activities	67	46	-	-	-
8730	Residential care activities for the elderly and disabled	4	4	-	-	-
8790	Other residential care activities	9	16	-	-	-
8810	Social work activities without accommodation for the elderly and disabled	0	7	-	-	-
8899	Other social work activities without accommodation n.e.c.	0	6	-	-	-
9602	Hairdressing and other beauty treatment	2	2	-	-	-
9604	Physical well-being activities	15	5	-	-	-
0321	Marine aquaculture	9	23	-	-	-