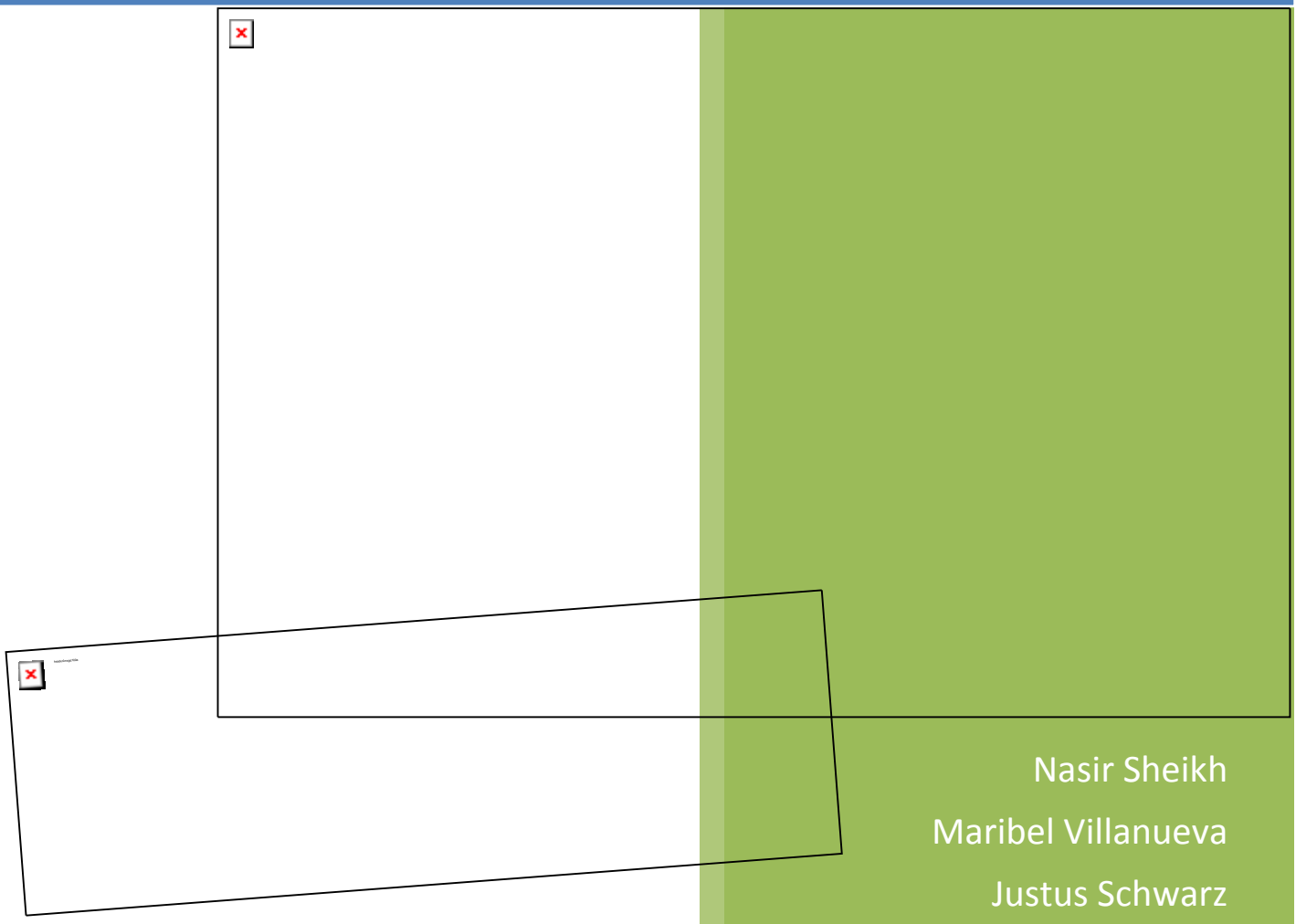
Portland State UNIVERSITY

Team 4

Europe – Can It Keep Up With Creativity & Innovation?



Nasir Sheikh
Maribel Villanueva
Justus Schwarz
Nadja Wolfangel
Durai Devadoss
Mosaab Algain

ETM 520/620 – Team 4

Team 4 Project

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Nasir Sheikh, Maribel Villanueva, Justus Schwarz, Nadja Wolfangel, Durai Devadoss, Mosaab Algain

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Abstract

Innovation in Europe is of great interest to the world since a major portion of the world GDP relies on its goods and services which in turn are dependent on technology and innovation to stay competitive and remain relevant. This paper addresses Europe's position in the world innovation and creativity stage by analyzing its trends—barriers and drivers—and compares its innovation-related performance metrics to those of the United States and Japan. The drivers indicate that the top European countries have motivated employees. A quantitative analysis indicates that countries like Sweden, Switzerland, and Finland, Europe are still ranked highest on the Global Innovation Scoreboard (GIS). A qualitative analysis indicates that EU is well-positioned in innovation because it's simplified and standardized laws that help commercialization and strong support for local students to excel to graduate studies and R&D. Technology and industrial clusters provide a strong base for innovation and directed technological advances. Germany and Northern European countries (Sweden, Denmark, and Finland) have well-established diversified industrial clusters that are supported by both industries and government policies. In conclusion, Europe is still strong in innovation due to its diversified and established infrastructure and skilled and motivated talent. The authors recommend that Europe should focus on the strengths of each country, region, and technology cluster to continue to develop its innovation leadership.

Executive Summary

Europe is an enigma when it comes to innovation and creativity. Historically recognized as a foundation for modern technology, innovation, and creativity yet it lags behind the United States and Japan in patents and inventions. Also, in terms of growth in this area, developing countries like China, Korea, India, and others appear to be growing faster.

This may be due to several factors such as Europe is not one "technology country" but a mix of countries and regions producing goods and services that are based on the best of technology and innovation. The aggregate of this effort may not produce leadership in every field but still makes Europe an overall contender for the top percentile in innovation.

To better manage the question, "Europe – Can It keep up with creativity and innovation?" and bound the scope of the problem, the authors decided to focus on the top European Union (EU) countries with inclusion of Switzerland since these are the dominant and most technologically advanced economies in Europe. Currently, the EU consists of 27 countries with the innovation leaders being Denmark, Finland, Germany, Sweden, and the United Kingdom. [Switzerland opted out of the EU but is an important European country.]

Even though there has been strong progress in innovation in Europe, there are still barriers that need to be overcome to become the leaders in innovation. These include: *Risk Avoidance* which needs to be better balanced with risk-taking; *"Silos"* of research and development (R&D) and commercialization within countries and regions which results in the lack of smooth flow of information and knowledge; *Employment Policies* which favor employee entitlements and permanency; and *High costs* of innovation and commercialization.

Notwithstanding the barriers, the innovation drivers provide a strong impetus to European progress and include best practices in human resources (HR) including: *Nurturing talent* and providing motivation; *Innovative Managers* that provide proper mentoring to employees; and *Employee Relationships* providing job satisfaction and motivation.

A comparative analysis of Europe, Japan, and the United States (US) was performed. This consisted of both a quantitative and qualitative assessment. The quantitative analysis was based on innovation performance metrics such as innovation enablers, firm activities, and innovation outputs. This indicated that, in general, every year EU (representing Europe) is reducing the gap between it and US and Japan. For example, in 2004 the EU-US gap was 41% and reduced to 28% in 2008. Similarly, in 2004 the EU-Japan gap was 42% and reduced to 38% in 2008. Also, most of the key innovation performance metrics show faster growth year-over-year than the US and Japan (as shown in chapter 6). A qualitative analysis also indicates that EU is well-positioned in innovation because of its simplified and standardized laws that help commercialization and the strong support for local students to excel to graduate studies and R&D. Although EU has a risk-averse mindset which may impede extreme innovation it helps in protecting against financial crisis such as those experienced by technology bubbles.

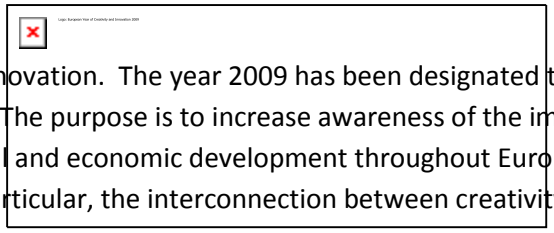
Technology and industrial clusters provide a strong base for innovation and directed technological advances. Germany and Northern European countries (Sweden, Denmark, and Finland) have well-established diversified industrial clusters that are supported by both industries and government policies.

Overall top rankings are given to Sweden, Switzerland, and Finland—above US and Japan—by the European Commission's Global Innovation Scoreboard based on innovation performance metrics.

In conclusion, Europe is still strong in innovation due to its diversified and established infrastructure and skilled and motivated talent. The authors recommend that Europe should focus on the strengths of each country, region, and technology cluster to continue to develop its innovation leadership.

Europe has been keeping up for the last century—in fact has achieved top ranking in multiple aspects of innovation—and there appears to be no reason that it not continue "keeping up".

Introduction



Europe is on a drive to gain leadership in innovation. The year 2009 has been designated the *European Year of Creativity and Innovation (EYCI)* [1]. The purpose is to increase awareness of the importance of creativity and innovation for personal, social and economic development throughout Europe and especially in the European Union (EU). In particular, the interconnection between creativity, the

innovation process and entrepreneurial attitude is highlighted as a crucial component of maintaining prosperity and finding paths to sustainable development. The relevance of encouraging enterprises to invest more in creativity, in general, and design, more specifically, has been underlined by research done in the UK which shows that firms with higher design intensity have a greater probability of carrying out product innovation and that design expenditure has a positive association with firm productivity growth [2].

Europe is an enigma when it comes to innovation and creativity. Historically recognized as a foundation for modern technology, innovation, and creativity yet lags behind the United States and Japan in patents and inventions. Also, in terms of growth in this area, developing countries like China, Korea, India, and others [3].

This may be due to several facts such as Europe is not one "technology country" but a mix of countries and regions producing goods and services that are based on the best of technology and innovation. The aggregate of this effort may not produce leadership in every field but still makes Europe an overall contender for the top percentile in innovation.

Of the top 10 countries by gross domestic product (GDP), 5 are European countries and make up a significant portion of the world economy [Figure 3-1].

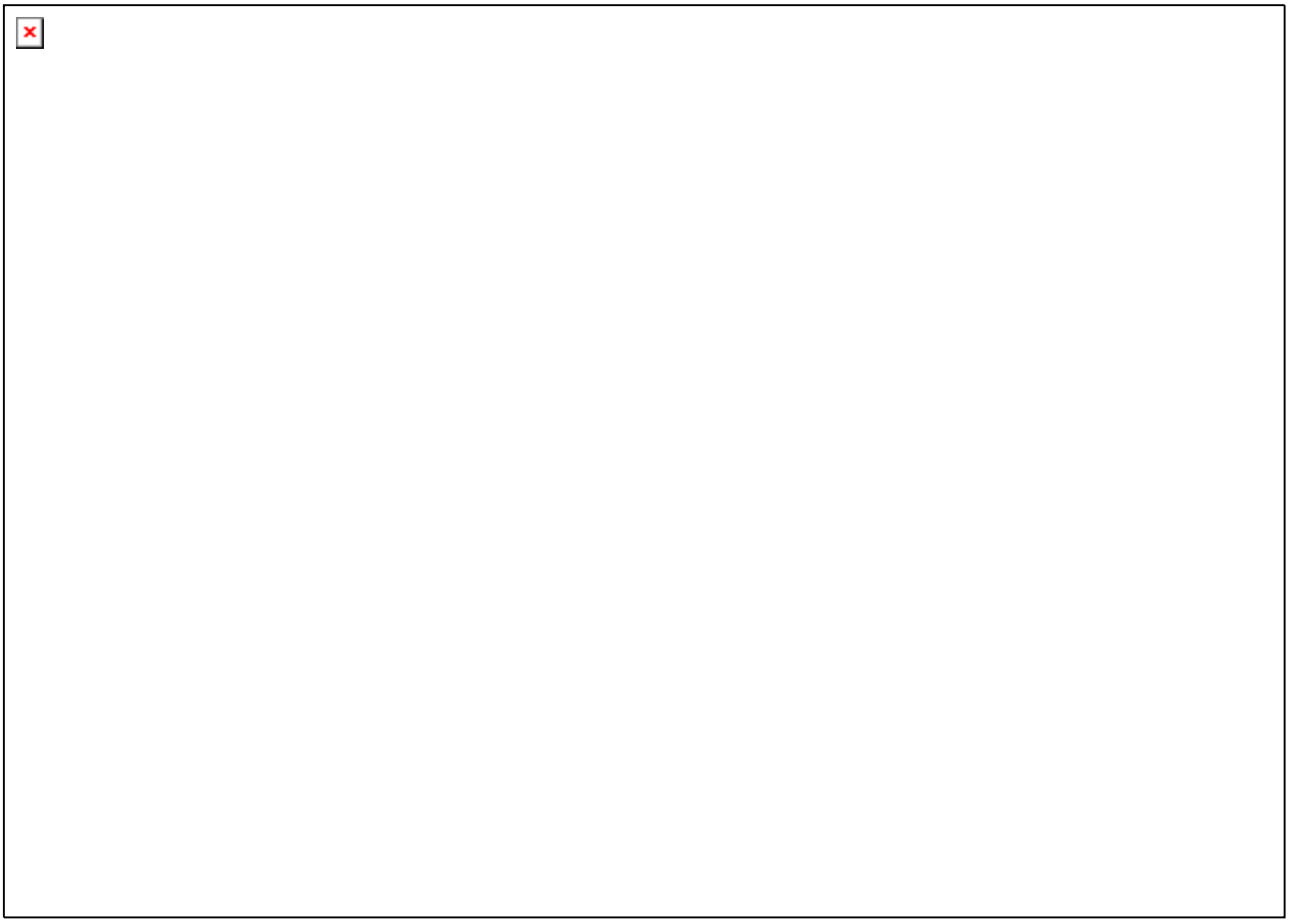


Figure **Error! No text of specified style in document.**-1: World map showing top 10 gross domestic product countries [4]

Furthermore the top European countries are represented by the European Union which has a substantial technical and economic infrastructure supported by a unified strategy for innovation and growth. This paper will highlight these aspects of Europe's accomplishments by addressing the programs that contribute to Europe's innovation and its position in the developed / industrial economies. The authors believe that a reasonable initial assumption is that a strong infrastructure supported by top-level policies and resources can enable countries and regions to at least maintain their strength in innovation. This assumption is supported by a recent report entitled "Reinventing Europe through Innovation" [5].

Methodology

The following methodology was used to address the question of Europe's position on creativity and innovation:

1. ***Brainstorming*** on the assumptions, approach, methods, and team assignment of tasks to arrive at the results and conclusion
2. ***Literature Search and Data Gathering*** on performance indicators for Europe in comparison to other economies and regions
3. ***Analysis*** of the collected information
4. ***Interpretation of the results***
5. ***Conclusions*** and recommendation

The following sections represent the analysis, interpretations, and finally the conclusion for the question, "Europe – Can It Keep Up With Creativity & Innovation?".

Innovation Trends in EU

The 2008 European Innovation Scoreboards (EIS) showed that the relative innovation gap with the US and Japan was reduced [16]. Many of the new member states showed strong progress and there has been a particular progress in HR for innovation (graduates, tertiary education). However, investment in R&D and IT expenditures are weak compared to the US and Japan. Figure 5-1 shows the innovation index for the European counties and the EU.

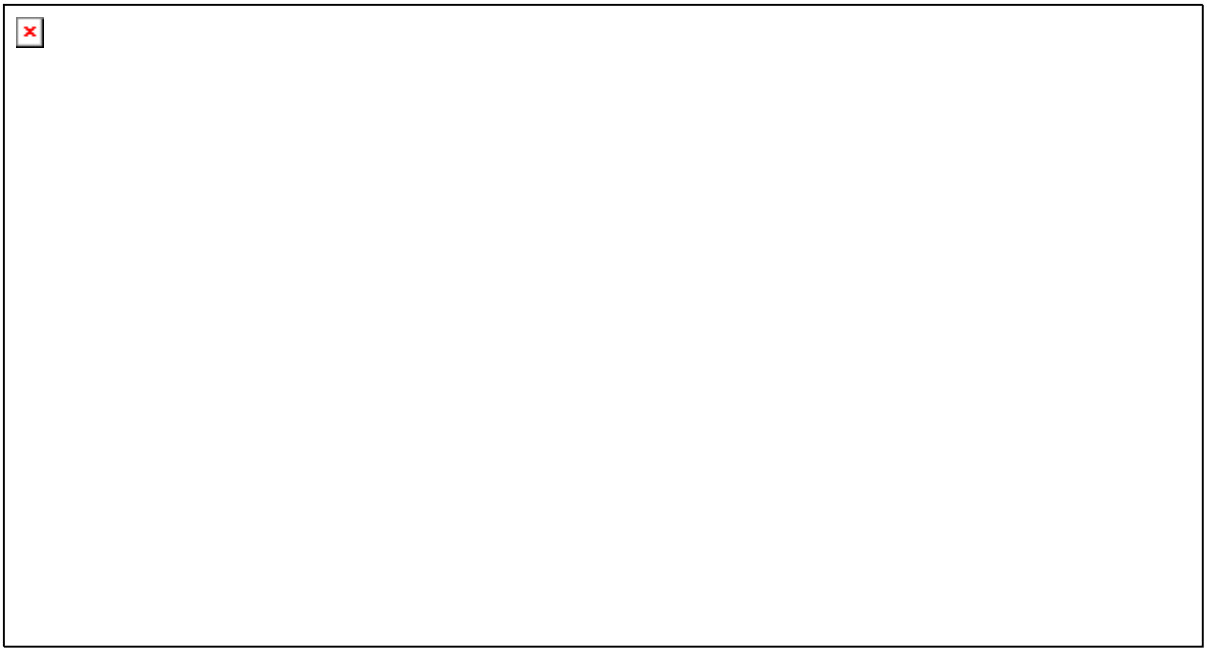


Figure **Error! No text of specified style in document.**-2: Innovation performance 2008 [26]

Based on the Figure 5-1, four groups of counties have emerged [6]:

1. ***Innovation leaders*** – Denmark, Finland, Germany, Sweden, Switzerland and the UK
2. ***Innovation followers*** – Austria, Belgium, France, Ireland, Luxembourg and the Netherlands
3. ***Moderate innovators*** – Cyprus, Czech Republic, Estonia, Greece, Iceland, Italy, Norway, Portugal, Slovenia and Spain
4. ***Catching-up countries*** – Bulgaria, Croatia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Turkey

The figure 5.2 below shows that the "Catching-up countries" have more potential entrepreneurs than the "Innovation leaders." This is a positive sign for Europe's innovative future. Where there are more entrepreneurs, there are more innovations. Innovation is driven by passion and personal interest, not by profit or business strategy.

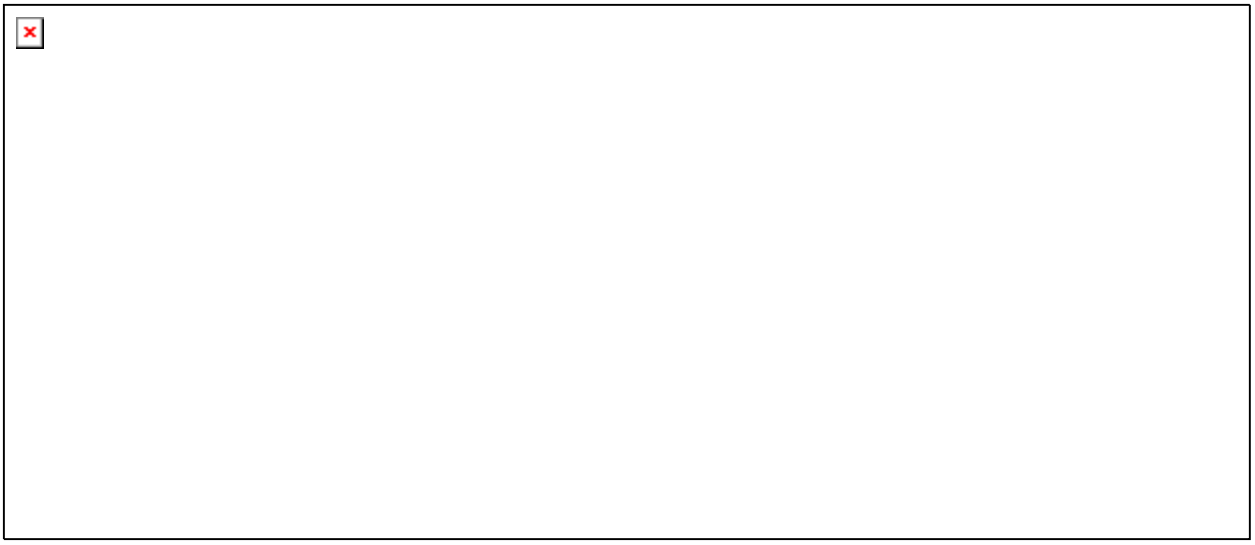


Figure **Error! No text of specified style in document.**-3: Actual and potential Entrepreneurs by Country [8]

EU Innovation Barriers

Even though there has been strong progress in innovation in Europe, there are still some barriers that need to be overcome to become the leaders in innovation. Here we have listed few of the major barriers that Europe needs to overcome to keep up with its creativity & innovations.

Risk Avoidance & Time Commitments

People do not run toward risks, they try to avoid it. But no progress is made without calculated risk taking. Since people know that innovation is risky, many people run away from it. In fact, some organizations try finding things that could go wrong, so they can avoid innovating. Once risks are identified, innovation is often stopped. However, an environment where innovation is nurtured instead of avoided can be created if risks and benefits are balanced [6].

Pihkala et al. stated that long pay-off period of innovations as being one of the main reason for organizations to not invest time, money and people into innovation [10]. Organizations are also not investing in their employees with training in new technologies or attending conferences. One of the causes for employees to not invest their time in innovation is the high risk of that individual being blamed for any failure.

"Siloing" and Inadequate Knowledge

Organizations look to create their identities, get rightful credit, sustain themselves and protect their investments. Organizations create boundaries, create roles and assign responsibilities to their employees. This boundary also extends outside of the organization. No matter how small or irrelevant the divisions are, the boundaries are maintained; even when it is beneficial for everyone if the boundaries do not exist.

By nature, innovations tend to cross boundaries and create new categories [6]. Many innovations are discarded because organizations do not see any benefit for themselves or they do not get the "fair share" of the benefit, even when the innovation is beneficial for the whole enterprise. These kinds of boundaries hinder knowledge transfer and new technological development.

Many of the European businesses lack the information to develop new technology. The organizations are "siloed" in their own country and are not collaborating with organizations from other countries. Many of the European small and medium businesses (SMBs) lack the knowledge of EU regulations [10]. These boundaries also reduce the market research available for organizations to properly analyze the market for a new product.

Employment Policy

1. Public
    1. Education system influences people to get a job rather than become entrepreneurs
    2. The national tendency towards jobs with security
    3. The national tendency to resent successful entrepreneurs
2. Government
    1. The Extensive Employee Entitlements
    2. The extensive consumer and customer rights
    3. The restrictive environmental protection laws
    4. Restrictive trade regulations
3. Corporation
    1. Reduction of employee entitlements to permanency

Financial

According to the MIT Technology Review's annual survey of R&D in 2004, corporate R&D spending across a broad cross-section of industries is on the decline. Firms may under-invest in R&D because of the high costs, the long delay in reaping market returns if any, the uncertainty of those returns, and the difficulty of adequately measuring them. The increasing speed of diffusion across global markets [7] and the diverse patterns of consumer adoption across products and countries [9] further exacerbate the challenges for firms to predict returns to new products.

The high cost associated with innovation is also a barrier for many organizations. For example, an organization from an EPC state will pay on average EUR 24,100 to have a Euro-direct patent granted and validated; a US company will pay EUR 10,250 to have a USPTO grant; a Japanese company will pay EUR 5,460 to have a JPO grant. This is a disadvantage for the European organizations to patent any new technology, process or service compared to the US or Japan. For SMBs to invest twice as much as a US organization or almost six times as much as a Japanese organization is too risky for them. For a Statute for a European public limited-liability company (*Societas Europaea* or SE), "the subscribed capital shall not be less than EUR 120 000" (Article 4.2). It takes substantially a lot more to start a new business in Europe than US. Pihkala et al. stated that the low availability of loan capital and venture capital are few of the reasons organizations are not innovating.

EU Innovation Drivers

Even with all these barriers, there are many drivers that enable Europe to compete with US and Japan in innovation. There are many potential entrepreneurs, the employees are motivated, the organizations have good leadership and there are many talented students and employees available.

Finding and Fostering Talent

Four types of people drive innovation: inventors, entrepreneurs, extreme individual achievers in their fields, and super mentors [13]. Organizations need to identify candidates who are most likely the best in their roles based on their natural talents.

Innovative Managers

Companies must do more with their employees' creativity than just acknowledge that an employee has a good idea. Looking at the four categories of innovators, often the inventors, entrepreneurs, and high achievers would be nothing without that last category of super mentors. Super mentors inspire their protégés and help them connect with the people who can couple action with their ideas [13]. These super mentors are the managers that are needed for organizations to be innovative. If the managers enable the employees to be innovative, the organization will be innovative.

Employee Relationships

Employee relationship is one of the most important drivers of innovations. If the employee is not happy or satisfied with the organization, there will be no motivation to innovate. In the European Motivation Index for employee satisfaction, fourteen out of the top twenty countries are European countries. Figures 5-3, 5-4, and 5-5 show the European employee's motivation index. As you can see, the numbers are not changing at all even through the tough economic times. In fact, satisfaction and motivation increased since 2007. Employee satisfaction is the key to employee retention. If the top performers in the company are not satisfied, the innovation will stop. They will not be able to mentor the new talents that were recruited. Employee motivation, satisfaction and loyalty are the key factors for innovations by employees.

Figure **Error! No text of specified style in document.**-4: Europe Motivation Index 2009 [14]

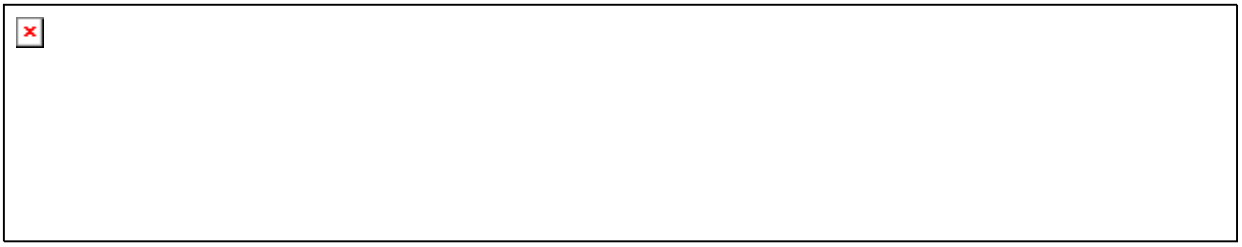


Figure **Error! No text of specified style in document.**-5: Europe Motivation Index 2008 [14]

Figure **Error! No text of specified style in document.**-6: Europe Motivation Index 2007 [14]

Comparison of Innovation in Europe, United States, and Japan

In order to provide an answer to the main question: Can Europe keep up with Creativity and Innovation? It makes sense to compare the development in Europe with other strong economies. But how can you compare something abstract like innovation. This paragraph will present and critically review common measures for innovation, as used for example by the European Innovation Scoreboard rankings [16]. The presented criteria are used to describe the development of the European innovation gap. Because of the difficulties with any quantitative approach to innovation a qualitative analysis is added, based on strategic arguments which can be found in the literature.

Performance Metrics

Criteria Summary

The measures presented in this paragraph can be grouped into three major criteria areas:

1. *Innovation Enablers.* These criteria refer to circumstances, which make innovation more likely.
2. *Firm Activities.* The innovation tasks and programs that companies are engaged in.
3. *Innovation Outputs.* Employment and export of goods and services related to high-tech.

It is important to keep in mind that a significant conclusion can only be drawn by using a combination of all measures. Analyzes, which were based on only one measure can be misleading, since every criterion has to be seen in a broader context.

Innovation Enablers

These measures deal with the main requirements for an innovative society and the public initiatives to boost innovation. As today's innovations are usually based on complex systems, innovators have to be well educated. Therefore it makes sense to analyze how many people have a university degree. As we focus on technology driven innovations, especially degrees in science and engineering are important. But also the general level of higher education should be considered. Many innovations are the outcome of research projects. One way to take that into account is considering the number of researchers. Of course the researchers, who are usually paid by the government, need sufficient funds. Hence, public R&D expenditures are another criterion to measure the innovativeness of a society.

To implement innovations money is needed. As new product or service ideas go along with a high risk, risk friendly investors are required. The amount of venture capital is one way to measure the likelihood that innovator can finance their ideas.

The internet has changed how innovations take place [17]. One necessary prerequisite to make use of the internet's opportunities is a fast internet connection; therefore the number of broadband subscriber can be a measure too.

Firm Activities

One key driver of innovations is companies' actions. A changing world and global markets demand continued innovation in order to stay competitive.

Business R&D expenditures therefore are an appropriate criterion. The increasing importance of the internet and information technology has already been mentioned above. Thus, companies' IT expenditures should be taken into account. The outcome of the innovation efforts are patents and new trademarks. These to criteria are one way to quantify innovations. Nevertheless patents provide only

information about the quantity of new inventions and do not include information about the quality and importance of the invention.

As R&D projects are risky, not all companies can take the risk on their own. Public private partnerships represent a way to share the risk and make crucial R&D projects more affordable to firms. Often public-private-co publications are the outcomes of those projects and can be appropriate indicators for innovativeness.

An interesting way to determine the innovativeness of a country is to take a look at the technology balance of payment flows. “The technology balance of payments measures international technology transfers: license fees, patents, purchases and royalties paid, know-how, research and technical assistance. Unlike R&D expenditure, these are payments for production-ready technologies [18].

Outputs

Successful innovation in the past usually results into a growth of certain high-tech industries. In order to get an idea of how important high-tech industry for a country is the employment in this sector is a suitable measure. The competitiveness of the produced high-tech products and services can be measured by the percentage of total exports.

Criteria: Critical Review

The criteria stated above are used in the “European Innovation Scoreboard (EIS) 2008 - Comparative Analysis of Innovation Performance”. The EIS is the greatest approach to compare innovation performance based on quantifiable numbers. Therefore the innovation scoreboard report is also used to describe the innovation gap between Europe and the United States of America respectively Japan. Numerical indicators go along with several disadvantages and should be carefully reviewed, before they are used for any conclusions. One comprehensive critical review is provided by Andreas Schibany and others on behalf of several Austrian government agencies [19]. The main points of criticism are discussed in the following section.

The indicators are grouped into three main sections. However, the selection of the criteria seams arbitrary, as one could think of other indicators that are not included as well as some indicators that are included but not absolutely necessary. Another difficulty with the measure selection is that there are interdependencies between several indicators. This correlation leads to an overestimation of some criteria. Regions that score well in these areas are ranked better than they actually are.

The indicators, which are used by the EIS report, focus on the high tech industry and neglect other sectors. It has to be considered that innovation is a core component of the high tech industry, but not limited to the high-tech.

Many papers use the approach “the more the merrier” to evaluate the criteria results, as the EIS does. But this approach is not adequate for all of the criteria. For some indicators 100% is not the optimal

value, but an indication of an inefficient allocation of limited recourses. For example if a country spends 100% of its GDP on R&D this is obviously neither realistic nor the best choice.

University degrees in general are an appropriate way to measure the qualification of a society. But because of different education systems the simple number of graduates can be misleading. For example in Germany in the education process of many technical jobs the system of apprenticeship is used. This combines a on the job training and lectures a school. As there is no comparable system in the United States, workers with this kind of education are not included in the report, although they are highly qualified. In addition to that the number of graduates does not account for any migration. Graduates, who leave the country after graduating, do not longer contribute to the country's innovation performance.

A more relevant criterion, since it includes migration, is the number of people with a tertiary education in the age of 25-64. A problem of this criterion is the high correlation with the number of graduates, which puts hidden weight on this innovation aspect.

The number of broadband subscribers is a measure for the "Information-Society-Readiness". But to weight it equally with indicator like R&D expenditures might be over exaggerated. Moreover, one has to keep in mind that high growths rates can hardly be achieved by country that already have a high percentage of fast internet connections.

The attempt to take venture capital into consideration in order to measure the possibilities for start-up companies to finance their projects is reasonable. But the venture capital business is extremely globalized. Not necessarily all of the money is used for projects in the same country. Therefore this criterion is more a measure for the situation of the venture capital industry in general.

It is a common approach to take the number of patents to measure the output of R&D efforts. Different legal systems can affect the comparability negatively, especially for international comparisons. Furthermore, the patent propensity differs from industry to industry. For example in the chemical industry a high percentage of innovations are patented compared to the automotive industry [20]. The patent propensity leads to a distortion of results, depending on the region's industry structure.

The final challenge is to come up with a coherent overall evaluation. If a development is examined over a longer time period problems might occur because of the following three reasons. First of all often the list of criteria might be changed due to new upcoming trends. Secondly, the weight of the indicators changes, since the number of indicators is not constant. Finally the available database is changes and leads to distortion of results.

From this section it can be seen, that caution should be used whenever one is dealing with quantitative innovation indicators.

Review of Developments

Even though there are some issues with quantitative innovation indicators, they provide the only way to discuss innovation performance based on hard facts. The World Knowledge

Competitiveness Index published by the Centre for International Competitiveness at the University of Wales Institute in Cardiff focuses on regions' knowledgebase [21]. However this paper uses the data from EIS to compare Europe's innovativeness with other regions, because it includes the innovation enablers and innovation outputs.

The Figure 6-1 below depicts the innovation gap between Europe, US, and Japan and the trend indicates that the gap is diminishing.

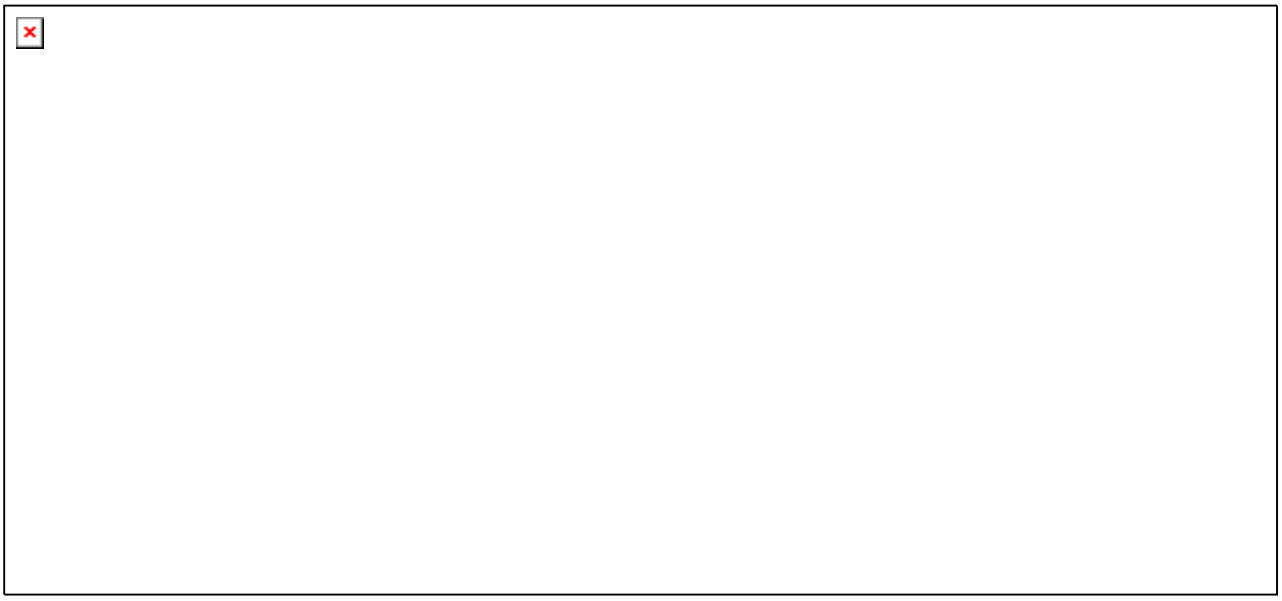


Figure **Error! No text of specified style in document.**-7 – EU Innovation GAP towards US and Japan [16]

The next figure shows the areas of innovation in which the US leads. The US outperforms Europe in 12 out of 16 innovation indicators. In the metrics of S&E graduates, Trademarks, Technology Balance of Payments flows and Medium-high and high-tech manufacturing employment, the EU 27 performs better than the US. But the innovation gap in favor of the US is shrinking, since the US's annual innovation indicator growth rate was 0.95% while Europe grew by 2.65%, in 2008. The EU closes the gap in the areas of Tertiary education, Researchers, Public R&D, Venture capital, Broadband subscribers, Public-private co-publications, Knowledge-intensive services employment and medium-high to high-tech manufacturing exports. In S&E graduates, Trademarks, Technology Balance of Payments flows and Medium-high and high-tech manufacturing employment Europe even increases its lead. Only in Business R&D and patents the US enlarge its lead.

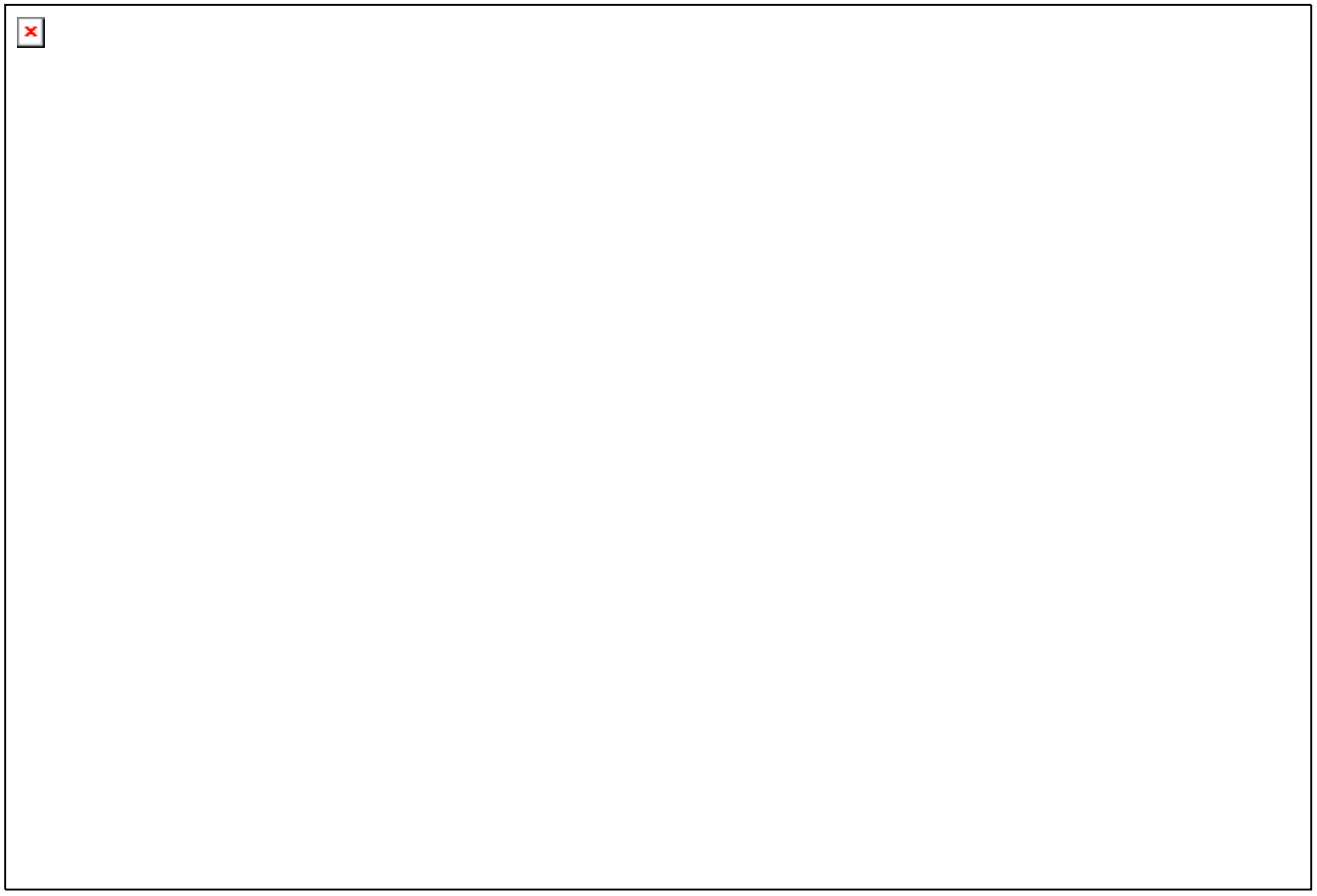


Figure **Error! No text of specified style in document.**-8 EU-US Comparison [16]

Key	
KIS: Knowledge Intensive Services employment	TBP = Technology Balance of Payments
PCT: Patent Cooperation Treaty (Worldwide Patents)	EPO: European Patent Office
TBP: Technology Balance of Payments	S&E: Science and Engineering

The assessment of the Japanese innovation performance also shows an innovation gap compared with the EU. Japan also leads in 12 out of 16 indicators. Europe only leads in Trademarks, Technology Balance of Payments flows, Knowledge-intensive services employment and Knowledge-intensive services exports. Nevertheless, the innovation gap declines. The 2.65% growth of the EU exceeds Japan's which is only 1.65%. EU enhances its leadership role in the areas of Trademarks, Technology Balance of Payments flows and Knowledge-intensive services employment. In S&E graduates, Tertiary education, Researchers, Public R&D, Broadband subscribers, Public-private co-publications and medium-high and high-tech manufacturing exports Europe reduces its gap. Japan grows faster only in Business R&D expenditures, EPO patents, PCT patents and Medium-high and high-tech manufacturing employment also Japan can slightly close the gap in Knowledge-intensive services exports.

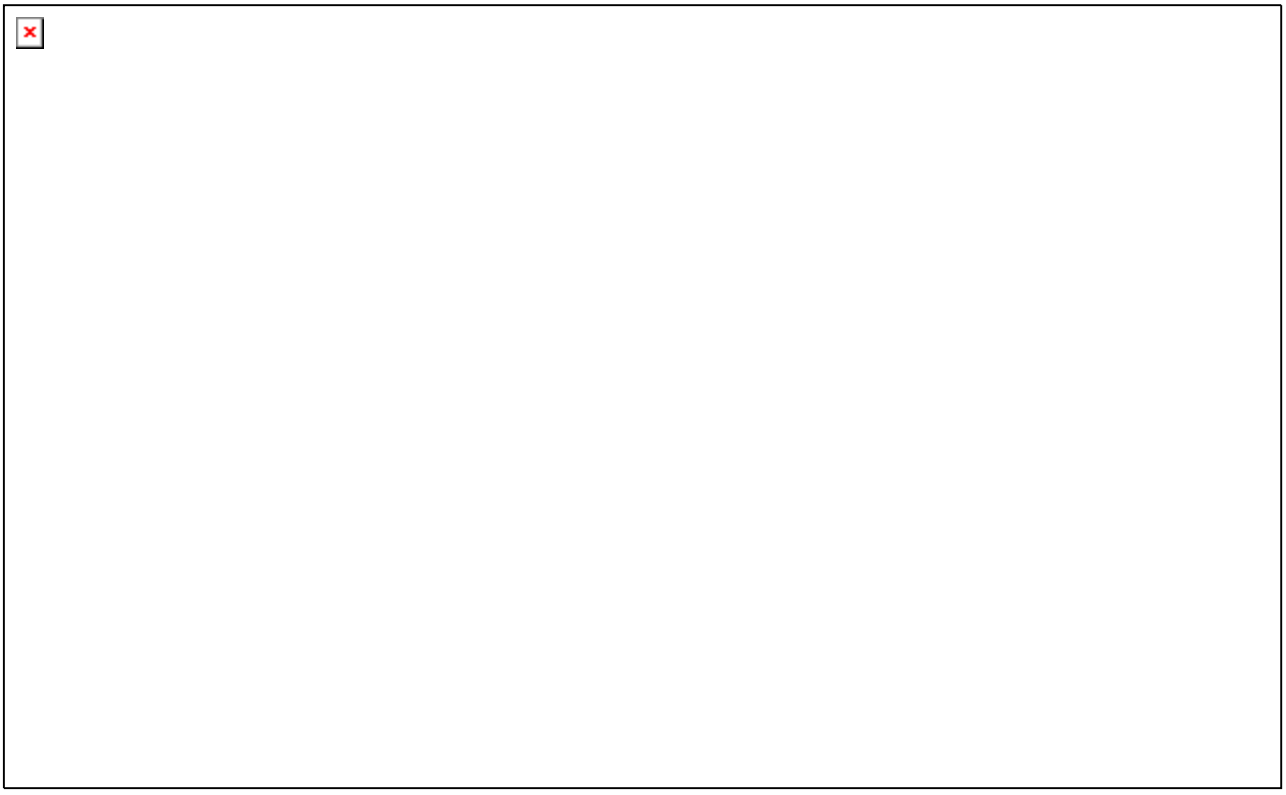


Figure **Error! No text of specified style in document.**-9 EU-Japan Comparison [16]

A Qualitative Analysis

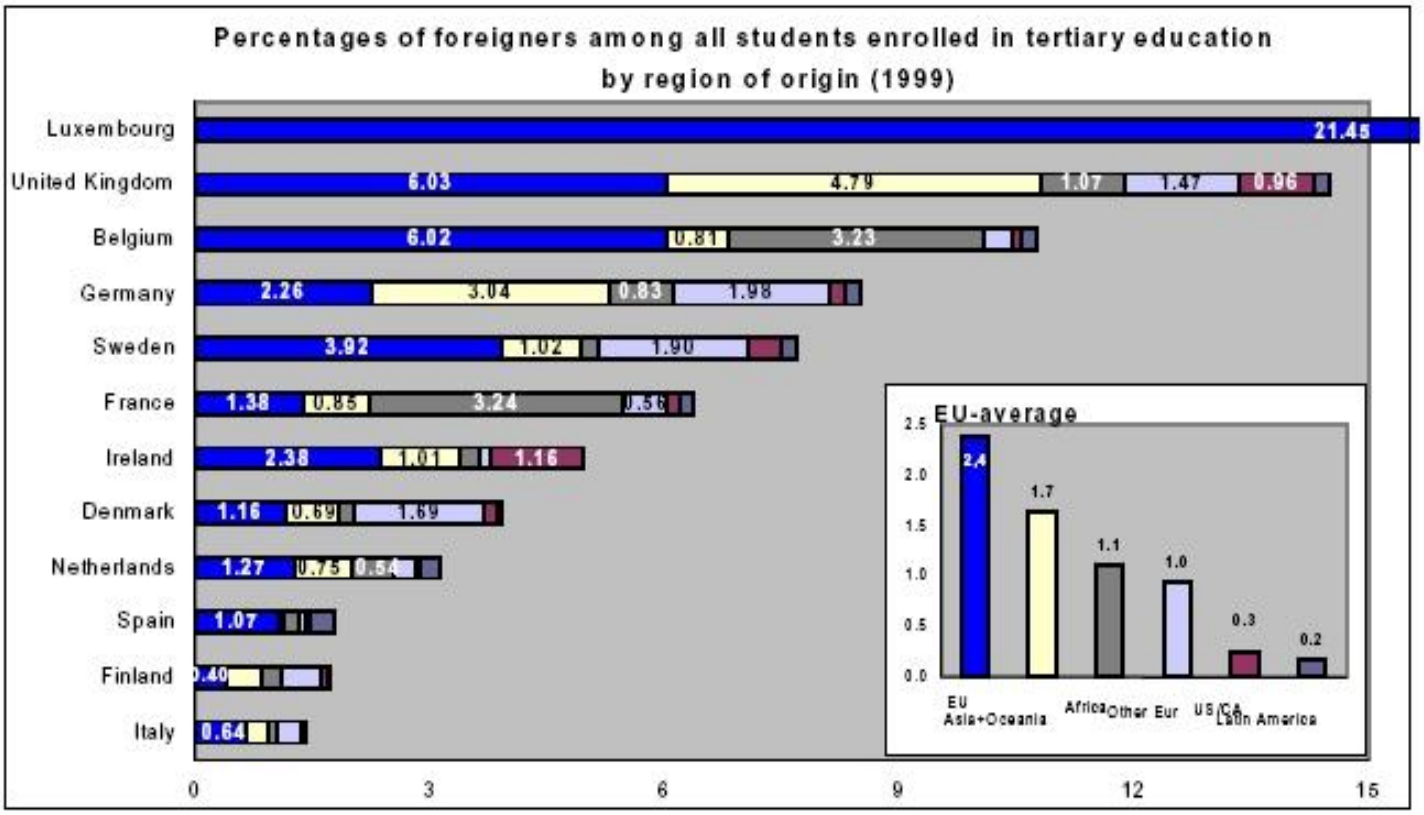
This section will provide a number of qualitative arguments to the discussion of Europe's innovation development. A review of these soft facts makes sense, since the review of the measurement criteria revealed several problems with an approach that is based on numbers only.

Europe has a long innovation tradition. In the 19th century the industrial revolution was driven by Europe [22**].** In the 20th century Europe lost its outstanding innovation position. Reasons for the decreasing innovation performance might be the common risk-averse mind set. In his book about the foundation process of technology driven companies Steven Casper describes the challenges that entrepreneurs have to face in Germany [23]. For instance, the large amount of equity that is needed in order to get the status that protects the private funds of the entrepreneur. On the other hand, these rules provide stability in the situation of the current financial crisis. Nevertheless the need for innovation is accepted in all European countries [24]. Also in the southern and eastern parts of Europe, as the competitive advantage of low labour costs decreases.

Barriers like the diversity of domestic markets and their individual rules and laws have been replaced by a single European market. In the past US innovators had the advantage that they were able to sell their new products right a way to a big US domestic market with only one authorization process for their product. European inventors had to face several different processes to get their products approved for

the different countries. But that changed and the simplified and standardized laws help innovators within the EU to commercialize their inventions [25]. A detailed discussion is provided in chapter 8 of this paper.

In most of the European countries the access to higher education is cheaper than for example in the United States. One the on hand, this allows every talented European citizen to get the education that fits best, and on the other hand it attracts students from outside the EU. This fact reduces the dependence of migration of foreign scholars. According to the Institute of International Education (IIE), more than 33% of Nobel laureates from the United States are immigrants, and there are 62 patent applications for every 100 foreign PhD graduates in science and engineering (S&E) programs. The increasing role that foreign students play in US the science and engineering can be seen from the chart below, which shows the enormous growth of enrolment of foreign students in the US. But the numbers have stagnated since 2001. This is a sign of the growing competition for the brightest heads. The dependence of foreign brainpower in the United States can become a serious risk. As the pie chart shows one quarter of all students are either from India or China. The demand for well educated people in these two emerging countries is rising and as more and more opportunities for Indian and Chinese people exist to become successful in their home country the flow of brain power to the US can be interrupted. The European countries depend less on foreign students and rely more on education of their own population.



Source Third European Report on S&T indicators; 2003
Note: No data for P, EL could be included into, in the EU average.

Figure **Error! No text of specified style in document.**-10: Foreign Students by Country of Origin, 1999

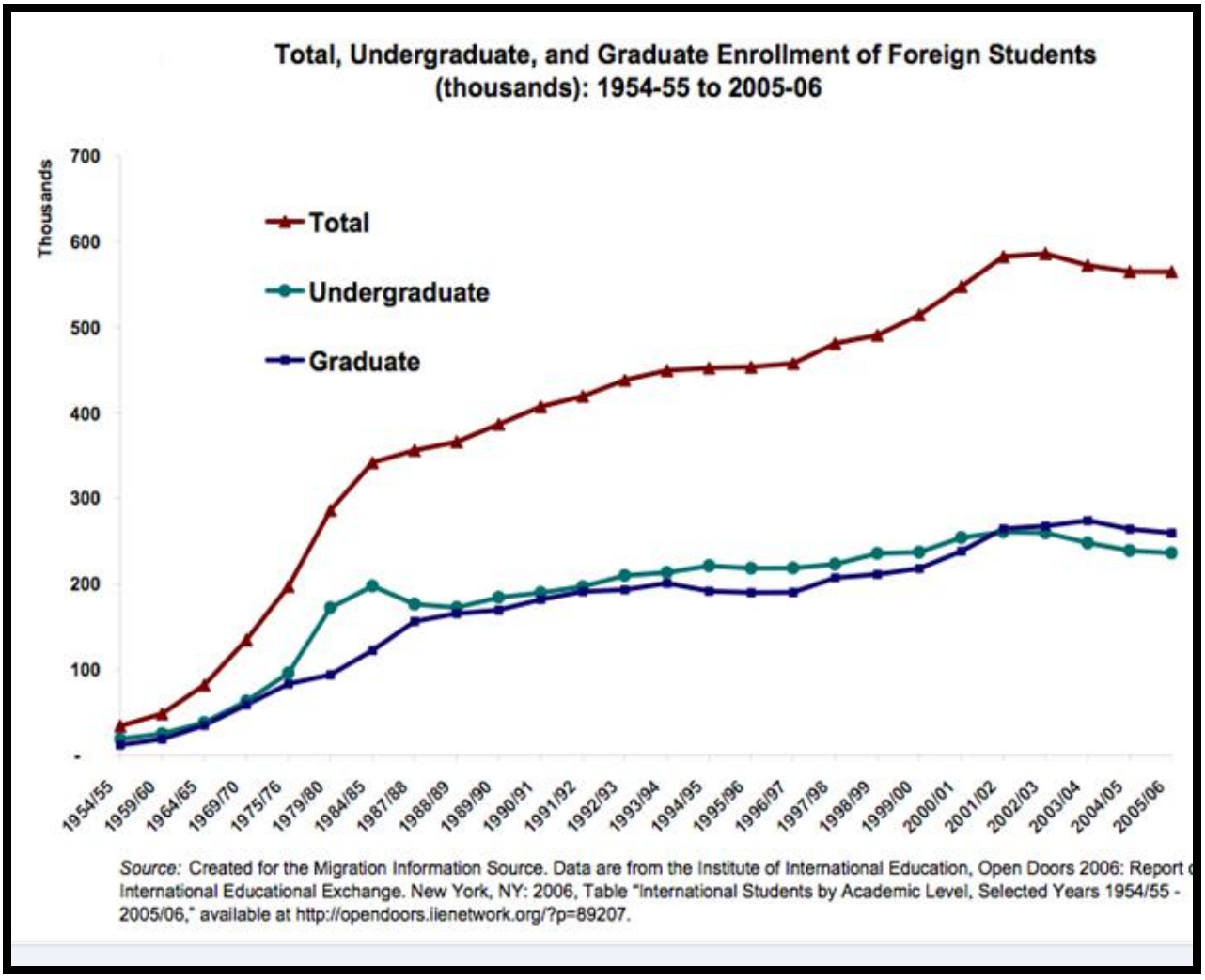


Figure **Error! No text of specified style in document.**-11: Total Undergraduate Enrollment of Foreign Students, 1954-2006 [39]

This section shows that there are several qualitative aspects of innovation enablers in favour of the European innovation performance. Other aspects not mentioned here like the EU law regulations and initiatives to build up clusters are discussed in detail in the following sections.

Technology Clusters in Europe

Clusters (also known as economic or technology clusters) and the broader patterns of economic specialization across geographies have become an important concern for European policy makers. One motivation is the set of ambitious goals on productivity growth and innovation that European leaders have defined for the EU. Europe tends to rank high on the quality of institutions and many factor conditions, but low on its ability to mobilize these inputs through entrepreneurship, new firm formation and corporate renewal. Europe also tends to rank high on R&D spending and scientific capacity but low on its ability to turn research into economically valuable innovations. Clusters have the potential to transform outcomes in both dimensions: Healthy clusters provide an accessible network of skills and capabilities, i.e. a microeconomic business and innovation environment that enable entrepreneurs to move from an idea to a business activity. And healthy clusters provide an efficient environment to move from a scientific advance or new business concept to a market test. [Refer to Appendix for an overview of clusters and their benefits.]

Figure 7-1.depicts the benefit of clusters to firms, Figure 7-2 indicates that Europe has a strong diversified portfolio of clusters (although not as strong as the US) with strong broad policy support (Figure 7-3).

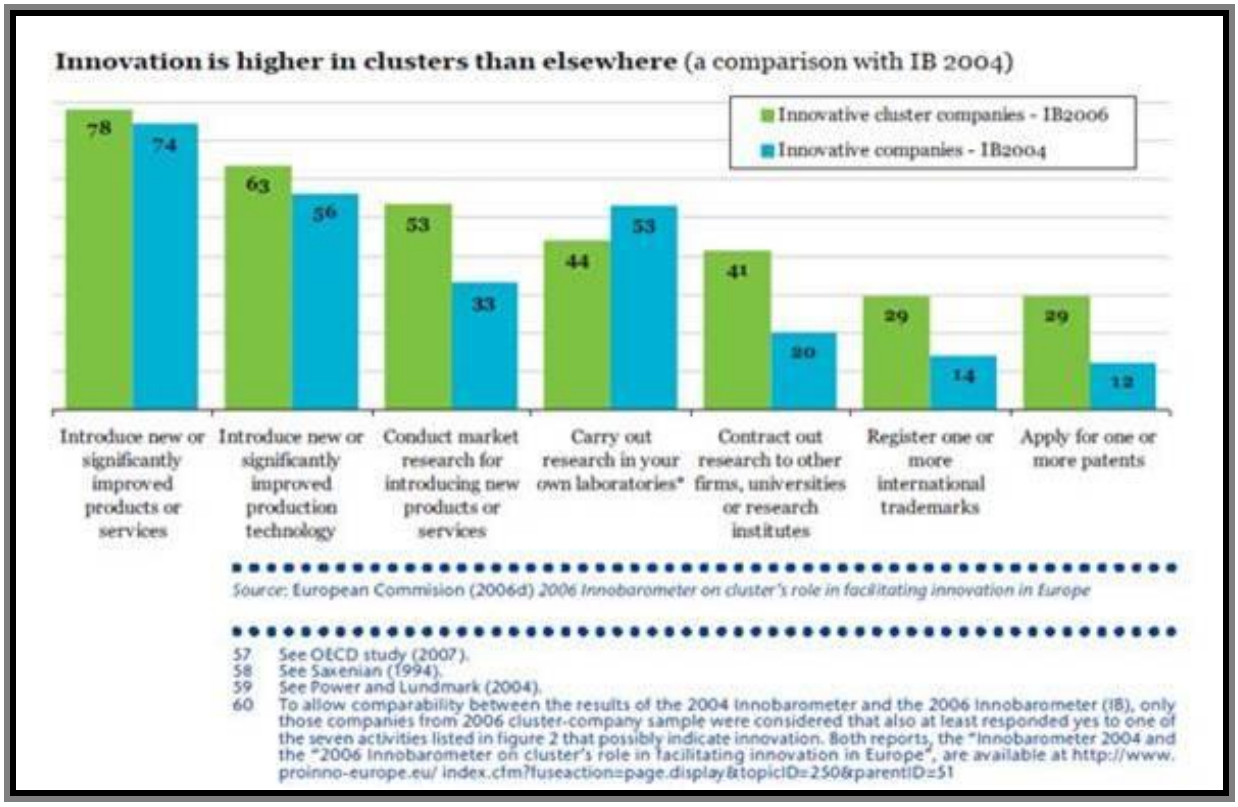


Figure **Error! No text of specified style in document.**-12: Comparison between clustered and non-clustered firms [28]

As shown in Figure 7-1, cluster firms are more innovative than non-cluster firms. The majority of the firms are the innovative clustered firms. This is because of the importance of the European innovation clusters which create tangible economic benefits - such firms can work with a higher level of efficiency, achieve higher levels of innovation, and clusters can help them in reducing the cost of failure. On the other hand, firms which carry out research in their own laboratories are considered as innovative non-cluster firms. These firms use limited resources which restrict knowledge sharing and enabling other innovation.

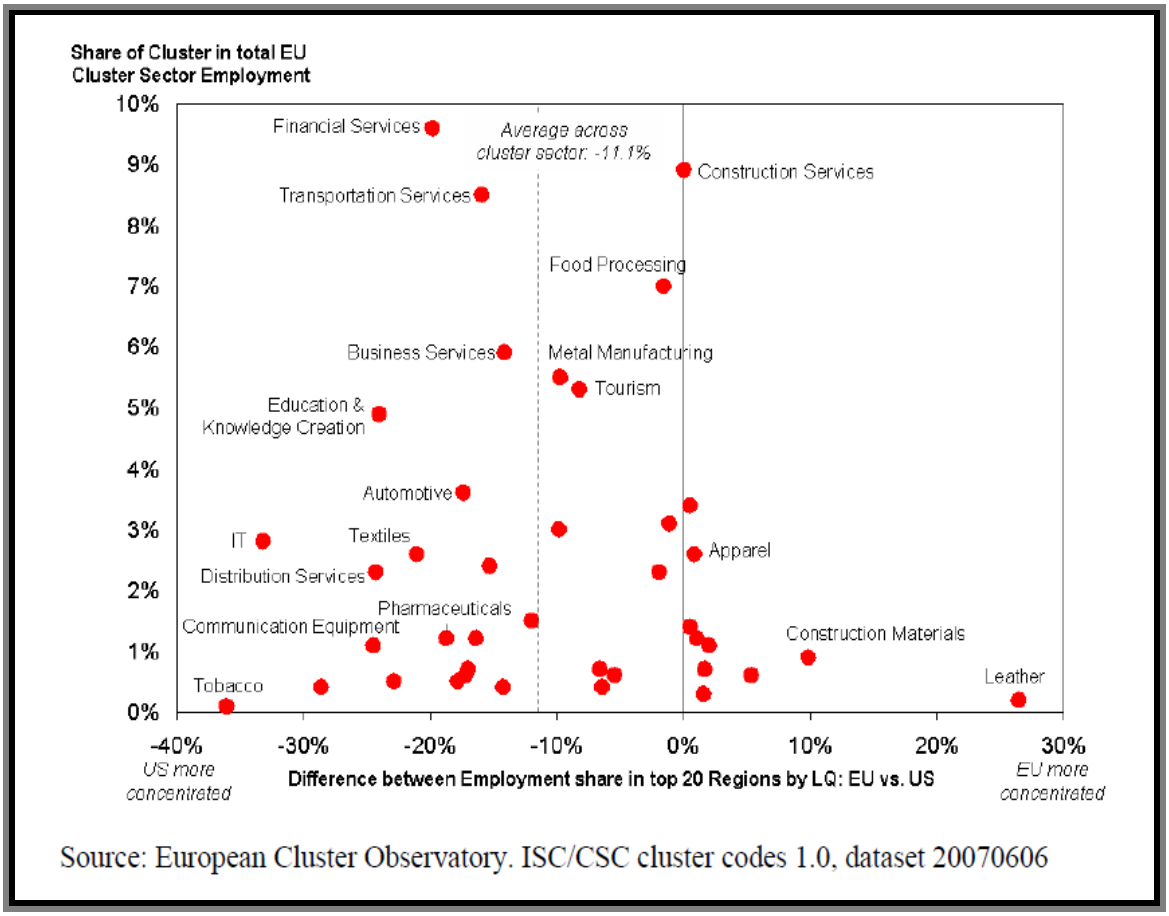
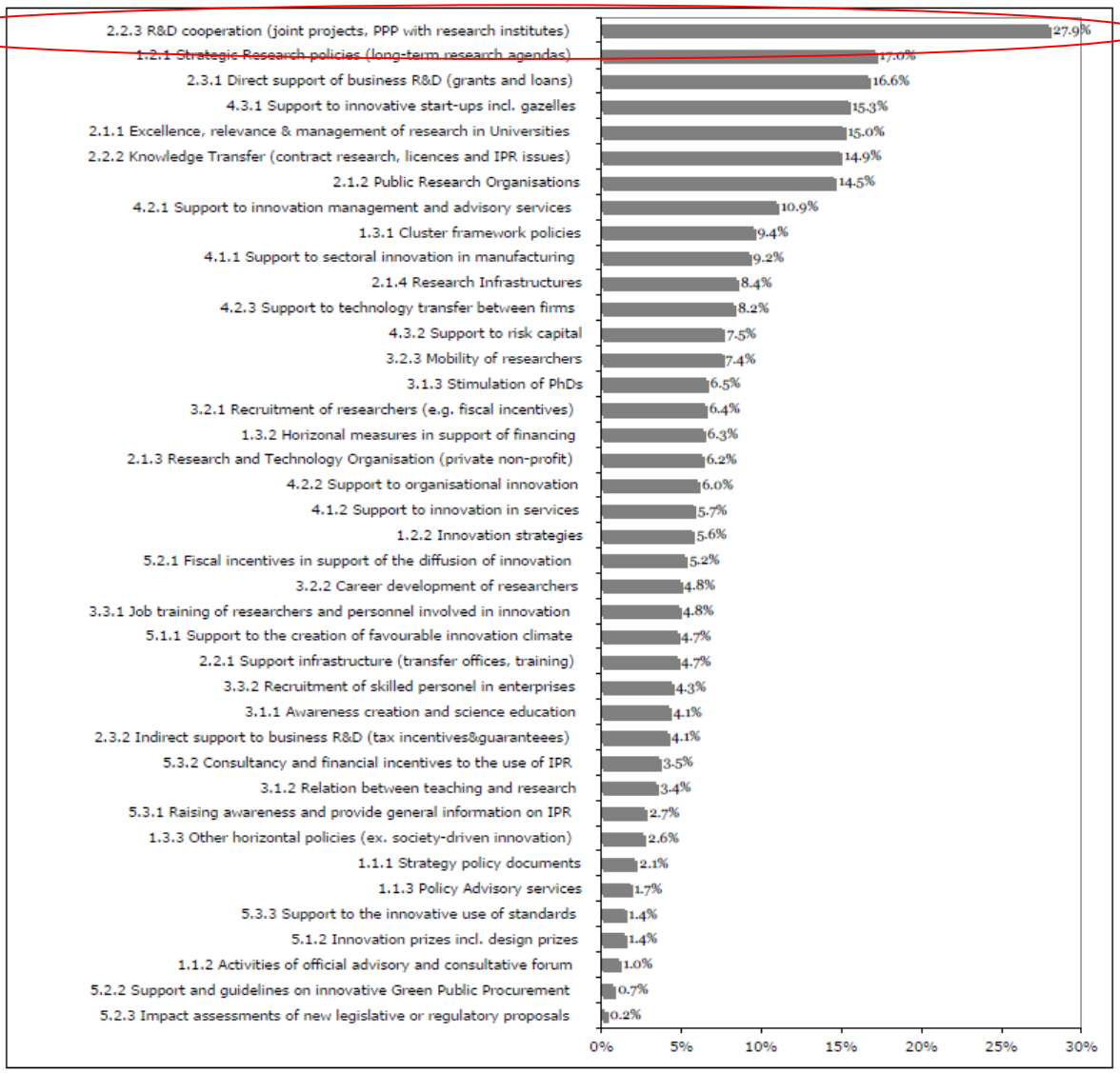


Figure **Error! No text of specified style in document.**-13: Employment concentration in strong clusters by cluster category [28]

Based on Figure 7-2, in terms of cluster strength the average region in Europe is less concentrated than the average region in the US. This might be because of the market incorporation is not as strong as in the US. However, European clusters are well-diversified and form a strong foundation for commercial, technical, and innovation growth.

Policy Support

In addition to the existing benefits of clusters, EU considers R&D cooperation in technology clusters that contain research institutes as the highest policy priority for innovation as shown in Figure 8-4. European national and regional governments are being encouraged to increase funding in this direction.



Source: TrendChart-ERAWATCH database of support measures; analysis Technopolis Group (N=1157)
Note: Percentages refer to the share of measures addressing a given policy priority in the overall EU innovation policy mix (N=1157). A single support measure can be assigned up to four policy priorities.

Figure **Error! No text of specified style in document.**-14: Policy priorities in the EU-27 innovation policy mix [29]

Germany: Examples of Clusters

Consequent development of clusters is an essential part of Europe cluster policy, with the aim to boost the innovation efficiency of the companies when cooperating with other firms in their areas. Therefore, clusters were gradually developed in important economic regions, such as automotive cluster, plastics cluster, eco energy cluster, furniture and timber construction cluster, food, and health technology.

The products of chemical industry are the base for almost every manufacturing activity. They can be found in the manufacturing of paint, medicine, fertilizers, pesticides, herbicides, animal health products, water treatment materials, coloring agents, manmade fabrics, detergents, disinfectants, polishes, cleansers, cosmetics, and toiletries. Chemical industry in terms of turnover, productivity, export, employment and R&D, is the leading industry with strong influence on other economic sectors. The major parts of the chemical enterprises are SME that are more competitive in comparison to the structure-dominating multinational enterprises.

The European chemical industry, still a world-leader among American and Japanese counterparts, has a strong scientific basis. In fact, the focus on innovation, research and knowledge are still seen as the key elements to increase industry's competitiveness. Germany has the largest economy in Europe and ranks third in the world economy, surpassed by the United States and Japan. The export of goods is an essential part of the German economy and one of the main factors contributing into its wealth. Most of the country's exports come from engineering, especially in automobile engineering, machinery, metals, and chemical goods.

Innovativeness in Europe

As presented above, Germany has a high innovative potential. But Germany is not the only region in Europe in this context. Recently, much innovation came from the northern part of Europe. In the following, an insight to this innovative area will be provided with a focus on Denmark and Sweden. The subsequent figure shows where those countries are located.

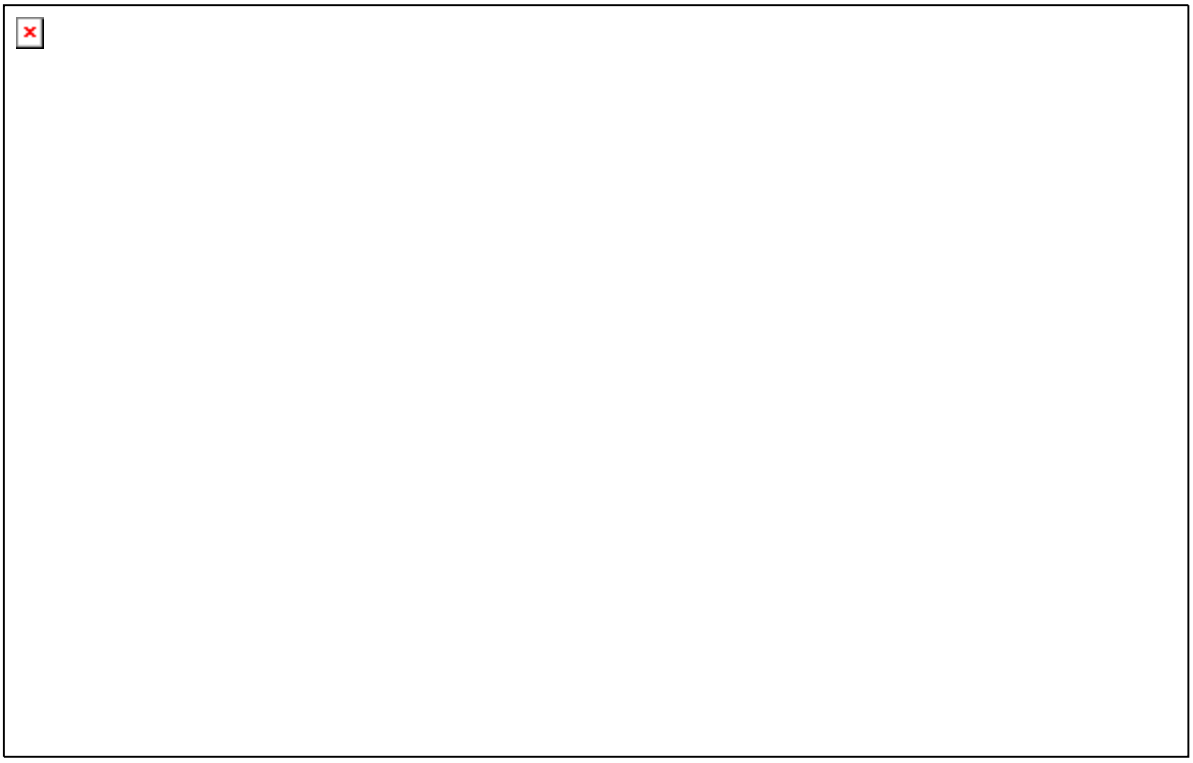


Figure **Error! No text of specified style in document.**-15: World Map – Northern Europe (with Focus of Sweden, Finland and Denmark)

Europe: Rankings and Scorecard

This paragraph intends to provide an outline of the general position in correlation with innovativeness of northern Europe in comparison to the US. As you can see in the following table, Sweden is in the first place of the global innovation scoreboard ranking. Finland also gained a better position than the US and Denmark obtains the place right after the US. Additionally, if one regards the rank variation which means the improvement referring to the last ten years, the table shows that Denmark was able to improve its situation in multiple criteria. In contrast to that, the US dropped in rank. With respect to Finland and Sweden, the figures show positive and negative changes. However, the overall ranking of criteria of Sweden and Finland is still better than the one of the US. In fact they are ranked in the top three. As a conclusion it could be said that regarding the trend of development in northern Europe and the US, Europe indicates a positive trend. With reference to the general topic and the question whether Europe could keep up, it could be stated that the hitherto analysis indicates that Europe definitely has potential to keep up [16].

	GIS		Firm activities		Human Resources		Infrastructures and Absorptive Capacity	
Country	rank 2005	rank variation	rank 2005	rank variation	rank 2005	rank variation	rank 2005	rank variation
Sweden	1	0	4	-3	4	-2	1	1
Switzerland	2	0	2	0	5	-2	3	6
Finland	3	3	5	-1	1	3	2	12
Israel	4	1	3	4	3	-2	11	-7
Japan	5	-1	1	2	13	-3	9	-4
United States	6	-3	8	-2	6	-1	7	-6
Denmark	7	3	10	3	8	1	4	7
Korea, Rep.	8	4	7	5	7	10	14	-4
Canada	9	0	18	0	2	5	8	-1
Germany	10	-2	6	-1	17	-1	17	3
Netherlands	11	-4	9	1	20	-1	6	0
Singapore	12	7	15	6	10	11	10	2
France	13	-2	13	-4	18	-7	12	3

Figure **Error! No text of specified style in document.**-16: GIS ranks and ranks variations for each pillar, 1995 and 2005 [16]

Regarding the position of northern Europe within Europe the following figure depicts that those countries are the leading ones. The innovation performance is measured along three categories. The first one is named enablers which include human resources and finance and support. Secondly, firm activities which mean firm investments, linkages & entrepreneurship and throughputs are considered. Lastly, outputs which refer to innovation and economic effects are investigated. In the summary, northern part of Europe spearheads the innovation performance of EU member states [16].

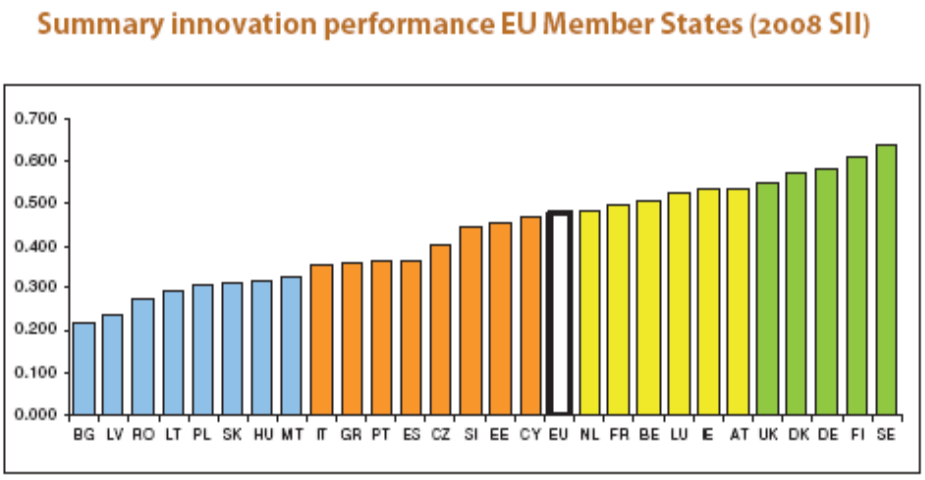


Figure **Error! No text of specified style in document.**-17: Innovation Performance – Sweden, Finland and Denmark under top 5 [16]

The fundamental basis of innovativeness is, among others, formed by bright people. So the future innovativeness is partly shaped by human resources. Regarding the ranking of northern Europe of this criterion shows that they are leading in this area. So, with respect to their future possibilities they will be in a good position [26].

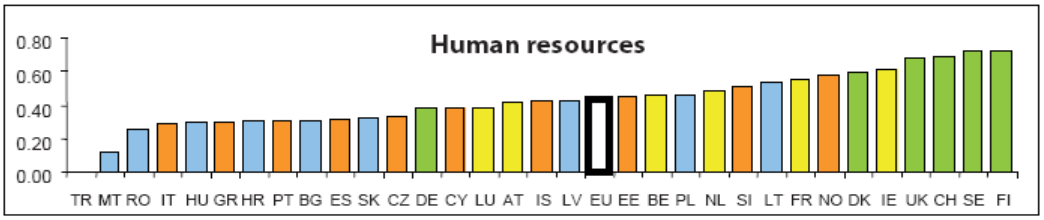


Figure **Error! No text of specified style in document.**-18: Innovation Performance regarding Human Resources [16]

The reason for their strength in human resources is that they spend much more money in the field of education. The subsequent table shows the total public expenses for educational establishments in percent of the GDP according to the year 2006.

Country	Expenses
Denmark	7.98
Sweden	6.85
Finland	6.14
USA	5.51
Germany	4.41
Japan	3.47

Table 1: public expenditure on educational establishments in % of the GDP, 2006 [31]

As one can see all of the northern European countries spend more than the US and Japan trails the others at the bottom of the table. As a conclusion, northern Europe will obtain a better basic position in future.

Regarding the other criteria of the global innovation scoreboard ranking further strengths of northern Europe could be found in the areas of finance and support as well as in firm investments. Examples of these will be provided in the next paragraph. What could be stated at this point is that northern Europe has a leading strength in the field of enablers which constitute the basis for future economic success. As a general weakness throughputs and innovators could be named. However, major improvements have been and will be made in these fields [16].

As a final result of this paragraph it could be recorded that northern Europe's possibilities for the future will be very high. Of course, these trend analyses are not predictions but they show the opportunities and those will be quite good.

Innovation in northern Europe

In this paragraph the areas of innovation in northern Europe will be presented. In general, one can say that those areas are information technologies, biotechnology and business innovations.

First, Sweden which is well known because of brands like IKEA, H&M, Volvo, Electrolux, Saab and Ericsson will be discussed. Sweden is very high in internet and mobile penetration and was able to develop an ecosystem in this area through government initiatives, infrastructure, eager users and demanding public as well as private institutions. As an example in this context, the Swedish government supported the building of infrastructure for high speed connectivity through broadband [32].

Furthermore, Sweden is famous for its business innovations. A part of Sweden's success lies in its inclusive and decentralized approach to management. Swedish companies implemented the idea of internal bottom up innovations. Therefore companies make everyone from employees to suppliers and customers feel included. However, the success factor in this context lies in having good management qualities. The managers decide, if a good idea is the right idea at the current time or if something else needs to be done first. Moreover, Sweden is the world's leader in cooperate social responsibility. This means that Sweden knows how to do business while taking climate change, gender, human rights and anticorruption into account. Besides, Simon Zadek, chief executive officer of Account Ability, examined that Swedish business acts fast. Analyses of the past have shown that Swedish companies move very quickly in addressing new opportunities [33]. Another part in Sweden's concept of success is the close cooperation of universities and research institution [34].

Apart from Sweden, Denmark has proven that it has a promising future as well. Denmark has started a program to build technology clusters in the fields of furniture and wood, wind energy, technology and IT, biotechnology, manufacturing and horticulture in different areas of Denmark based on traditional regional industrial specializations or on existing competence clusters. The purpose of this program is to improve Denmark's weakness in the field of innovations. This approach is empowering Denmark to be a leader in innovation [35], [36].

Last but not least, Finland has several key clusters as well. Those could be found in the fields of information and communication, forest, metal processing, mechanical engineering, foodstuffs, business services, construction, energy and healthcare. All of them are predicted to grow in the next years. Especially the areas of business service and health care will be Finland key factors of success [37].

As final conclusion it could be said that northern Europe will have a promising future with respect to innovation. Considering the enablers they have already obtained the best possible position. Regarding their weaknesses shows that they have made some promising plans to improve their situation. Taking all this information into account demonstrates that Europe is able to keep up.

Conclusion and Recommendations

Europe is still an innovation force to be reckoned with as is shown by the positive innovation trends in chapter 5 and the ranking of the top European countries in chapters 6 and 8. Also, Europe has a significant set of economic/technology clusters that support a diversified industrial base as is evidenced in chapter 7.

In chapter 5, motivation index indicated that human resources (HR) were an important positive driver for job satisfaction, productivity, and innovation. The motivation index trend is upward despite the recent economic downturn and is in contrast to that of United States.

In chapter 8, research revealed that Sweden and Finland actually lead in the global innovation scoreboard (GIS) rankings. [Switzerland is ranked second in GIS, however, the authors had restricted their research to EU.]

In chapter 6, a qualitative analysis indicates that Europe will continue to be strong in education, research, and innovation due to the fact that most students are citizens and not foreign students. In the past the US has attracted bright foreign students and immigrants who have made significant contributions to technology and innovation. This trend is now declining due to recent US policies and the fact that other developing countries (such as China and India) are also competing for the best minds.

In conclusion, Europe is still strong in innovation due to its diversified and established infrastructure and skilled and motivated talent. The authors recommend that Europe should focus on the strengths of each country, region, and technology cluster to continue to develop its innovation leadership.

Europe has been keeping up for the last century—in fact has achieved top ranking in multiple aspects of innovation—and there is no reason that it should not continue “keeping up”.

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Appendix

Technology Clusters: Overview

In general, clusters are natural existing areas of economic and technological strength. They are groups of interconnected firms, suppliers, related industries and institutions that arise in certain locations. Also, clusters give a key position with a sustainable competitive advantage over other companies, and they have policy targets which are: improvement of the competitiveness and innovative strengths of companies, supporting particularly small & medium-sized enterprises, and innovation through cooperation.

Clusters often go through a history of emergence, growth, decline or transformation. Although individual clusters develop differently, six steps in a model of cluster development are sumarized below.

Firstly, the birth of a cluster can often be traced to historical circumstances, such as the availability of raw materials, specific knowledge in R&D organizations or traditional know-how, the specific or sophisticated needs of a certain group of (geographically concentrated) customers or firms, and the location of firms or entrepreneurs performing some important new technological innovations that stimulate the growth of many others. Accidental reasons may also affect the growth of a cluster. However, the growth is often set off by some explicit location factors, in particular long-term development of specific knowledge that may be turned into new productive use (Pinch and Henry, 1999). Emerging clusters can often be traced back to a history of events that led to the 'sudden' rise of clusters in more recent years.

1. The first stage in cluster development often involves new firm spin-offs leading to a geographical concentration of firms in nearly the same production stage. The agglomeration is followed by local competition that is an essential driver of innovation and entrepreneurship (Porter, 1998b).

1. Secondly, once an agglomeration of firms becomes established, progressively more external economies are created, forming a cumulative process. The first external economies often include (i) the creation of a set of specialized suppliers and service firms, frequently originating from vertical disintegration of firms, and (ii) the creation of a specialized labor market (Stopper and Walker, 1989). The development may lower the cost of shared inputs as savings in production costs are passed from specialized suppliers (serving numerous local firms) to client firms. The client firms will then derive a benefit not available to similar firms in less highly localized settings (Harrison, 1996). Cost saving also occurs through the presence of a pool of experienced and skilled workers.

2. A third step may be the formation of new organizations that serve several firms in the growing cluster, e.g. knowledge organizations, specialized education establishments and business associations. The organizations advance local collaboration, learning process and technological

knowledge spillovers, as well as the creation of localized forms of knowledge by key personnel in the local industry. An example is the set up of centers for real services in some industrial districts in the 'Third Italy' during the 1980s. These centers hold specialized competence (on market development, technology, strategy etc.), and are able to supply the system of firms with professional competence that small firms seldom acquire themselves, but which is often necessary in accomplishing larger innovations. Brusco claims that the introduction of the centers raised the innovative capability in the local network of small producers.

3. Fourthly, the development of external economies and the emergence of new local organizations increase the visibility, prestige, and attractiveness of a cluster. This may result in more firms and skilled employees moving into the cluster, thus raising the attractiveness even further, as well as resulting in a fertile breeding-place for new local companies.

4. A fifth step relates to the creation of non-market, relational assets that foster an untraded circulation of information and knowledge, through e.g. informal collaboration, and help with coordinating economic activity. Thus, mature regional clusters may contain ensembles of specific, differentiated, and localized relations between persons and organizations that are coordinated by routines or conventions that often only work in the context of proximity (Storper, 1997). Communication that contains flows of non-codified knowledge, and which is complex and uncertain, frequently involves dense human relations, which in turn are stimulated by proximity between individuals, firms, and organizations.

5. Lastly, although a cluster can renew its success for decades or become part of a new cluster, many regional clusters sooner or later enter a period of decline. Cluster decline is often seen to reflect a situation of technological, institutional, social and/or cultural 'lock-in' in business behavior. Regional industrial development may become 'locked in' by the very socio-economic conditions that once made the region into a core region in a specific industry. The initial strength of a regional cluster in the past - be it a well educated or experienced workforce holding unique know-how and skill; a highly developed and specialized infrastructure of firms, knowledge organizations, and education and training institutions; close inter-firm linkages; or strong political support by regional institutions - may turn into an inflexible obstacle to innovation (Grabher, 1993). Clusters may fall into a trap of 'rigid specialization'. Cluster development sometimes tends to reinforce old behaviors and suppress new ideas, which in particular is a danger for the continued survival of a cluster when technological and global economic conditions change (Porter, 1998b).

Moreover, clusters have five important factors.

1. ***F****actor Conditions* describe the situation in a country regarding production factors, like skilled labor, infrastructure, unexpected events, etc. which are relevant for competition in particular industries

2. *Home Demand Conditions* that describe the state of home demand for products and services produced in a country

3. ***R**elated and Supporting Industries* which are the existence or non-existence of internationally competitive supplying industries and supporting industries.

4. *Firm strategy, structure, and rivalry* which are the conditions in a country that determine how companies are established, organized and managed, as well as the characteristics of domestic competition industries

5. **G**overnment that can influence development

Furthermore, the success of some European clusters has focused attention on the creation of external economies and on the role of knowledge intensive, local environments in stimulating the competitiveness of networks of firms. Competition is increasingly seen to occur between clusters, value chains or network of firms rather than just between individual firms. It is also argued that regional clusters are the best environment for stimulating innovation and competitiveness of firms (Asheim and Isaksen, 2000). This definition uncovers two main criteria for delimiting regional clusters:

1. Firstly, regional clusters are limited geographical areas with a relatively large number of firms and employees within a small number of related industrial sectors. Thus, the clusters are specialized in a small number of industries. This reflects the more general point that economic, entrepreneurial and technological activities in specific industrial sectors tend to agglomerate at certain places (Malmberg, 1996).

2. Secondly, although firms in regional clusters may co-operate with firms, R&D institutes etc. in many places, the firms are part of local networks, often in the form of production systems. These systems first and foremost tend to incorporate subcontractors, but may also involve horizontal co-operation between firms at the same production stage. Using a common technology or knowledge base or the same raw material source may also connect the firms in the area. The size of the geographical area constituting a regional cluster depends on where the firms in the local production system are located. Often a regional cluster covers a local labor market area or travel-to work area.

In addition, Porter (1998a) employs a somewhat wider meaning of clusters, as “geographic concentrations of interconnected companies and institutions in a particular field”. On the one hand, this is a more limited definition than Porter’s (1990) original cluster concept focusing on national industrial clusters, i.e. firms and industries linked through vertical (buyer/supplier) or horizontal (common customers, technology etc.) relationships, and with the main players located in a single nation/state. However, also in 1990 Porter emphasized that geographic concentration of rivals, customers and suppliers in a region will promote innovation and competitiveness in a cluster even more. On the other hand, Porter (1998a) employs a wider meaning in that he also includes institutions (formal organizations) as part of regional clusters. However, in discussing the cluster concept, Porter does not

strictly define the necessary elements that constitute a cluster, but rather refers to empirical cases. Thus, Porter (1998a) claims that 'many clusters include governmental and other institutions'. Then, the term regional clusters are not reserved only to denote geographical concentrations of both interconnected companies and institutions. Some clusters contain institutions, others do not.

Influence on Innovation

Many areas influence a company's competitiveness and competence. Experiences from one branch can often be used in another sector as well. Therefore, inter-branch networks have been developed in Upper Austria in the areas of human resources, design & media, environmental technology and energy efficiency. Non-technological innovations are the focus of activities. All Upper Austrian companies are invited to participate in, profit from and raise their operational efficiency through these theme networks. Above all, special attention will be paid to the needs of Small and Medium Enterprises (SMEs). Furthermore, the policy targets of inter-branch networks are: strengthening the competence of Upper Austrian companies, especially SMEs, in themes critical for success, know-how transfer, and be innovated through competence.

Innovation Networks in Europe

To constitute an innovation system firms in a regional cluster first have to form regional innovative networks involving more organized and formal co-operation between firms in innovation projects (Table 2). For example, suppliers not only produce components or modules to customers' specifications but also co-operate with their customers in developing new products. The focus on innovative networks corresponds with the emphasis in (OECD, 2001) on how enterprise clusters stimulate firms' innovation process by the flow of ideas, information and knowledge within clusters.

A complete European regional innovation system also involves co-operation in innovation activity between firms and knowledge creating and diffusing organizations, such as universities, colleges, training organizations, R&D institutes, technology transfer agencies, business associations, and finance institutions. These organizations possess important competence, train labor, and provide necessary finance etc. to support regional innovation. Thus, regional innovation systems consist of (i) firms from the industrial clusters of the region, including their support industries, and (ii) 'supporting' knowledge organizations, and (iii) the interaction between these actors.

Concepts Definitions and differences

Regional cluster	A concentration of 'interdependent' firms within the same or adjacent industrial sectors in a small geographical area
Regional innovation network	More organized co-operation (agreement) between firms, stimulated by trust, norms and conventions, which encourages firms' innovation activity
Regional innovation system	Co-operation also between firms and different organizations for knowledge development and diffusion

Table 2: A hierarchy of three concepts

Distinguishing between the three distinct concepts of regional clusters, regional innovation networks and regional innovation systems is especially relevant when discussing how public policy can stimulate the competitiveness of cluster firms. Regional clusters are seen mainly as a spontaneous phenomenon; a geographical concentration of firms often developed through local spin-offs and entrepreneurial activity. Regional innovation systems, on the other hand, have a more planned and systemic character. The development from a cluster to an innovation system may be one way to increase the innovation capability and competitiveness of cluster firms. The development requires strengthening inter-firm collaboration and the institutional infrastructure, i.e. that more knowledge organizations (both regional and national) are involved in innovation co-operation. Intervention between firms and knowledge organizations introduces an important role for government in "cluster policy".

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