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Research and development in European Chemical Industry

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ABSTRACT

According to Arora et al. (1998), the chemical industry is one of the largest and most R&D-intensive manufacturing sectors in all advanced economies, and its innovative patterns and productivity growth process can have profound impacts on economic growth as a whole. The European chemical industry supplies virtually all sectors of the economy and accounts for 17.8 % of the total chemical sales in the world. This paper gives an overview of the European chemical industries and the changing scenario of the world chemical industry. The study focusses on the top fifteen chemical companies of this region. It gives an idea about the current problems this industry is facing in Europe especially after the economic crisis and shows how the region and the top companies are investing in R&D to bring innovation to overcome the current challenges. It shows that the R&D spending in this industry in absolute term has remained similar over the years and it is still globally the largest investor for the R&D activities. In terms of R&D Investment, BASF has been making the largest investment followed by Bayer and Syngenta while the R&D intensity is highest for Syngenta and Bayer. BASF and Bayer are the leader in patent application and number of granted patent. Most of the large European company makes their first patent application in Europe compared to other Geographical location.

Keywords: Chemical Industry, Research & Development, Innovation, Patenting in chemical Industry.

INTRODUCTION

The European chemicals industry is key for economic development and wealth, providing modern products and materials and enabling technical solutions in virtually all sectors of the economy (Arora et al., 1998). The European chemical industry supplies virtually all sectors of the economy and accounts for 17.8 % of the total chemical sales in the world (Cefic, 2014). The

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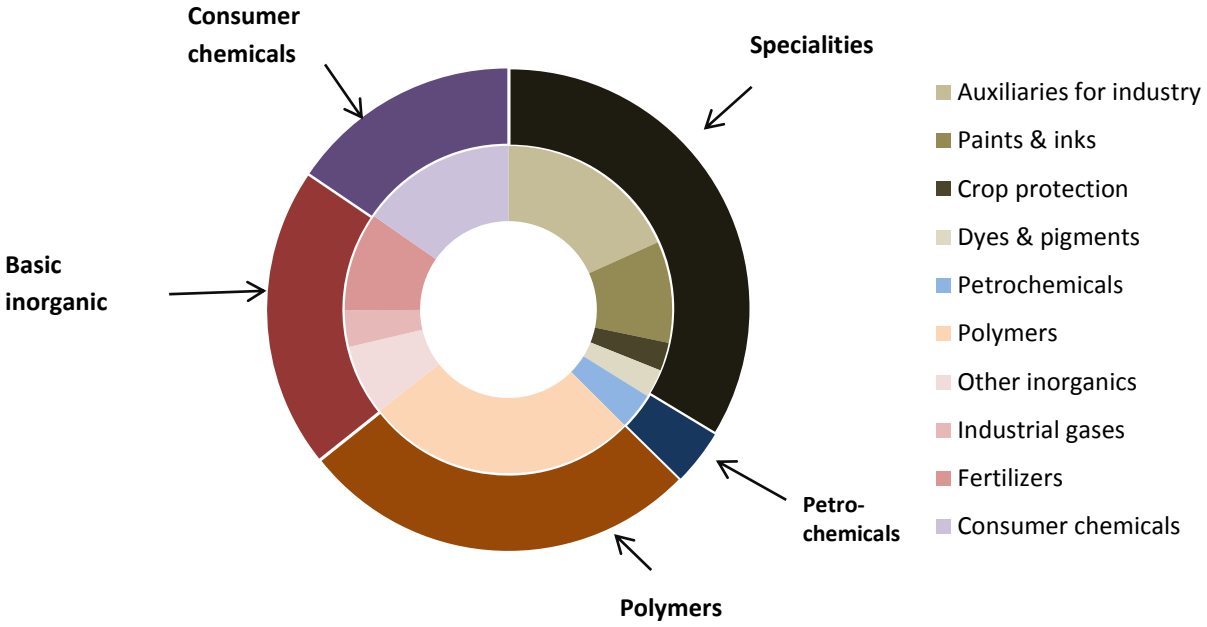
chemical industry is one of the largest and most R&D- intensive manufacturing sectors in all advanced economies, and its innovative patterns and productivity growth process can have profound impacts on economic growth as a whole. In the recent study by Tullo (2013), out of the 50 top global chemical companies, 19 are headquartered in Europe (Table 1). They consist of 14, 5 % of Global chemical sell. The purpose of this paper is to give an overview of the status of European chemical industry and the problems currently faced by it. According to the industry specialists, innovation and research are key to securing the future of the European chemical Industry. Research and development is one of the means by which companies can have future growth by developing new products or processes to improve and expand their operations. The paper also talks about the research and development investment of European chemical industry in general and also the top fifteen European chemical companies in particular. We analyse R&D investment and the patent landscape of these fifteen large companies to understand the research activities and the innovation trend of them.

CURRENT STATUS OF EUROPEAN CHEMICAL INDUSTRY

Modern society and its life style are unthinkable without the products of chemical industry and it is present everywhere in our daily lives. The European chemicals industry is key for economic development and wealth of the region, providing modern products and materials and enabling technical solutions in virtually all sectors of the European economy. More than any other manufacturing sector, this industry provides the technical basis for other economic activities, both in traditional sectors such as agriculture, construction, textiles, clothing and footwear, and in technologically advanced industries ranging from automobiles, modern healthcare to electronics and oil and gas.

The chemical industry in Europe is a world-leading, robust sector, in terms of productivity, employment and also the root of all other industries. It drives innovation not only in the chemicals sector but also provides raw materials for consumer products, health products, information technology industries and contributes to global food supply. It is also the leader of development of advanced materials and advanced process technologies that enable more flexible production with more efficient use of energy, feedstock and water. Furthermore, it contributes to improving recyclability and increases the use of renewable feedstock.

Figure 1: The product mix of European chemical Industry

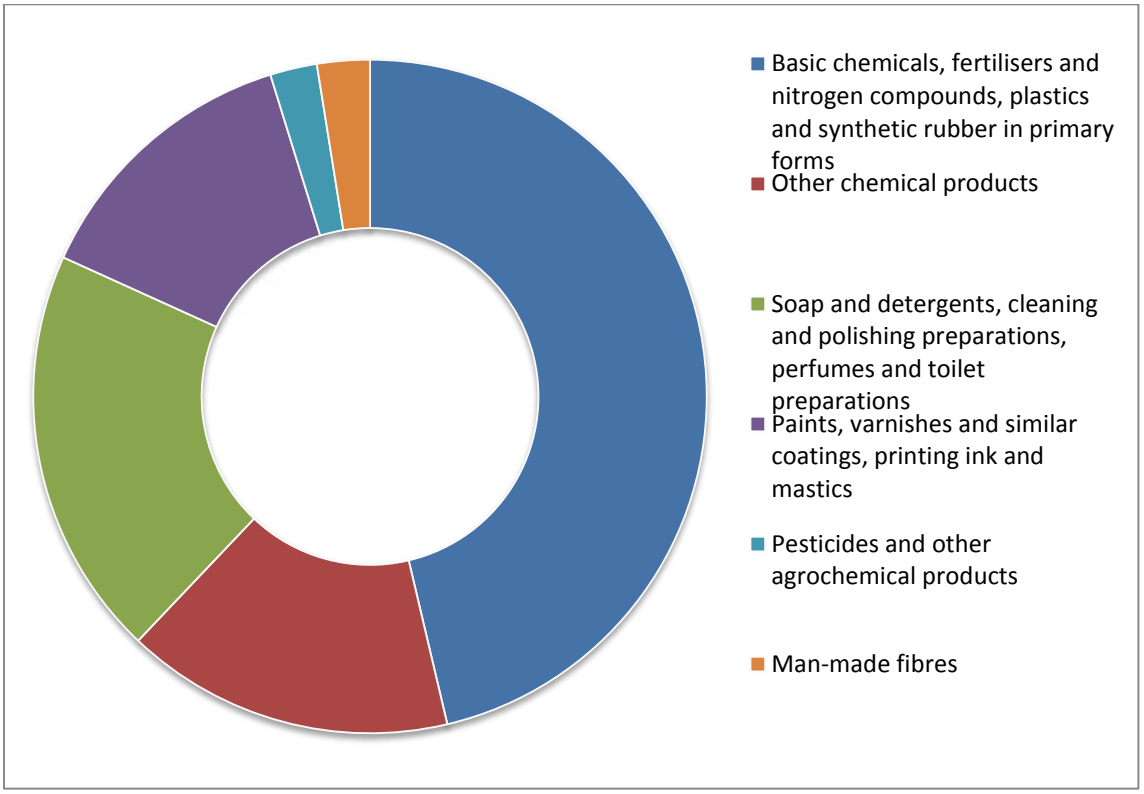


Data Source: Cefic, 2014; Graph: Author

The European chemical industry supplies virtually all sectors of the economy and accounts for 17.8 % of the total chemical sales in the world (Cefic, 2014). The European chemical industry is based on the following six categories of products: Basic chemicals, Specialty chemicals, Petrochemicals, Polymers, Pharmaceuticals, Consumer chemicals. The industry has an extremely broad range of customers and only 30 % of the combined output of the chemicals and pharmaceuticals industries is sold to private households and other end users.

With a workforce of 1.2 million and sales of €642 billion, it is one of the biggest industrial sectors and an important source of direct and indirect employment in many regions of the European Union (Cefic, 2013). The chart below shows the distribution of the direct work force based on the product mix. It is seen that bulk of the work force is employed in producing the basic chemicals and its related products.

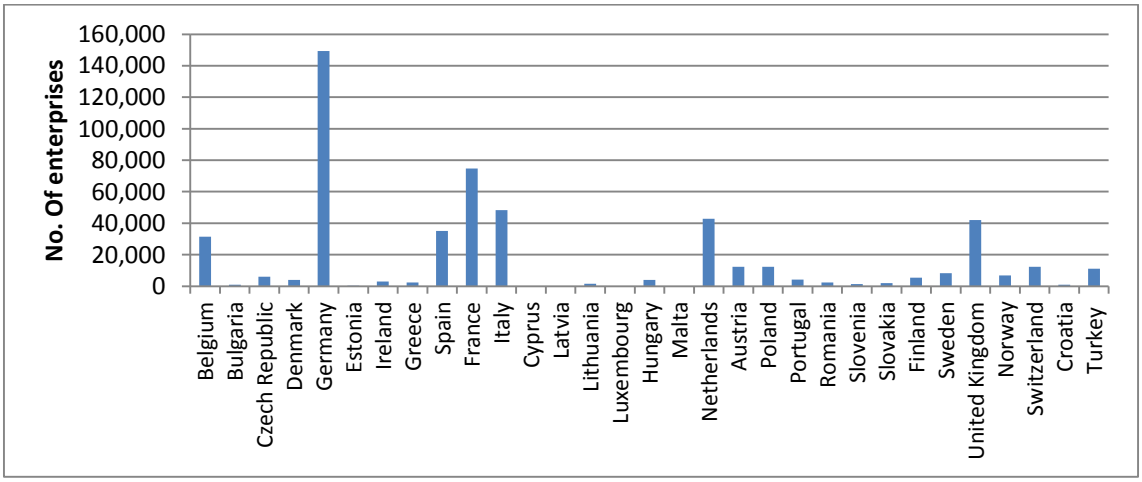
Figure 2: Percentage of employees in each sector of European chemical industry



Data Source: EUROSTAT, 2013; Graph: Author

The bulk of European chemical companies are located in seven EU countries: Germany, France, Italy, UK, Netherlands, Spain and Belgium. Among them, Germany is the leader with more than 140000 enterprises followed by France and Italy.

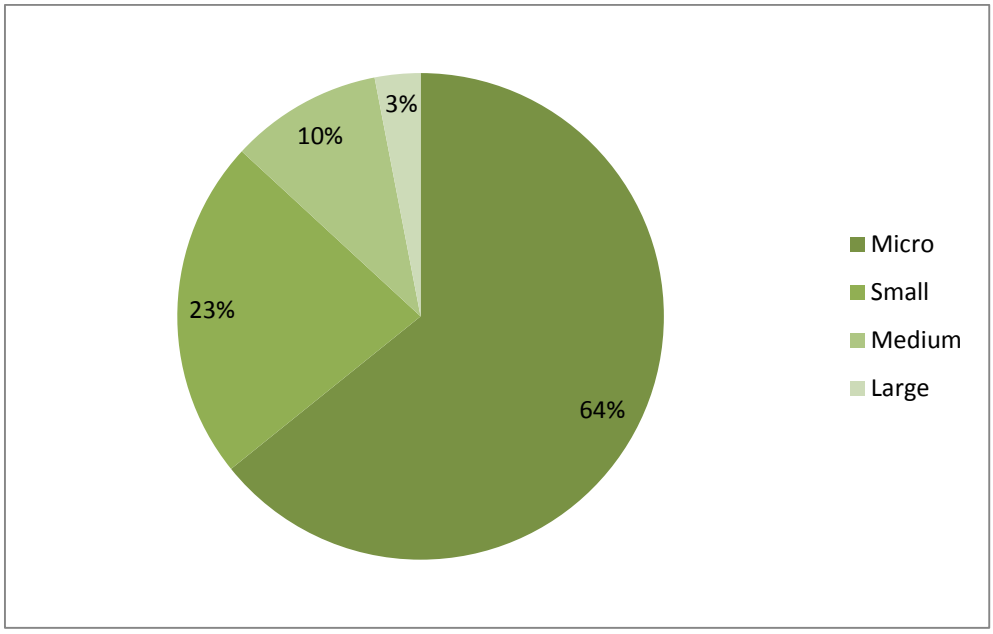
Figure 3: The number of chemical companies in various EU countries.



Data Source: EUROSTAT, 2013; Graph: Author

In the EU, there are around 29,000 semi-medium, medium and large chemical companies which employ a total staff of about 1.2 million. This is equivalent to 4% of the manufacturing industry's overall workforce (EUROSTAT, 2013). Employment in the industry has decreased by 2% annually over the past ten years. 4 % of all chemical companies have more than 250 employees and these are responsible for 72 % of all sales and 65% of total employment (EUROSTAT, 2013). They make a major contribution to the transfer of innovation generated upstream in the chemicals value chain to downstream manufacturing industry. As producers of basic and specialties, large chemical companies are often supplier to SMEs and also source for innovation.

Figure 4: The percentage of companies of various sizes in Europe.

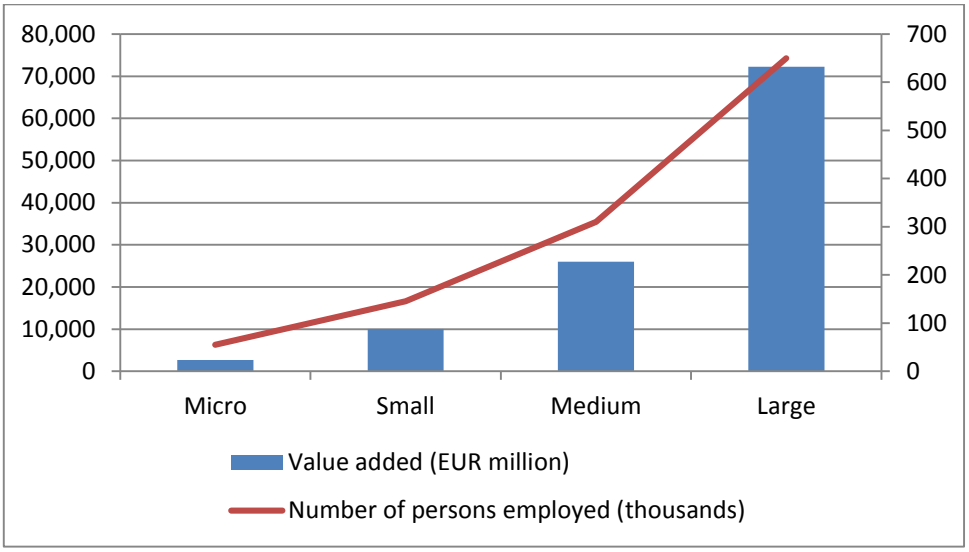


Data Source: EUROSTAT, 2013; Graph: Author

Even though the large chemical companies makes up only 3 % of total chemical companies, their contribution is significant as they are the largest supplier of product and also the biggest employer. The grouping of the enterprise is based on the following criteria as given by EUROSTAT (2013):

- small enterprises: with 10-49 persons employed;
- medium-sized enterprises: with 50-249 persons employed;
- large enterprises: with 250 or more persons employed.

Figure 5: The value addition of different sizes of EU companies and the number of persons employed in each size.



Data Source: EUROSTAT, 2013; Graph: Author

Since large companies of Europe contribute significantly on value creation and also the largest employer, understanding of their innovation trend is very important. Table I shows the list of the top 19 chemical companies headquartered in Europe. The paper will focus on the R&D investment and patent landscape analysis of these 19 companies.

Table I: The top 19 chemical companies of Europe.

	Companies	**Headquater**			**Companies**	**Headquater**
1	BASF	Germany		11	Yara	Norway
2	Shell	Netherlands		12	DSM	Netherlands
3	LyondellBasell	Netherlands		13	Lanxess	Germany
4	Bayer	Germany		14	Syngenta	Switzerland
5	Ineos Group	Switzerland		15	Borealis	Austria
6	AkzoNobel	Netherlands		16	Arkema	France
7	Air Liquide	France		17	Eni	Italy
8	Evonik	Germany		18	Styrolution	Germany
9	Solvay	Belgium		19	Total	France
10	Linde	Germany				

Data Source: Tullo, 2013; Table: Author

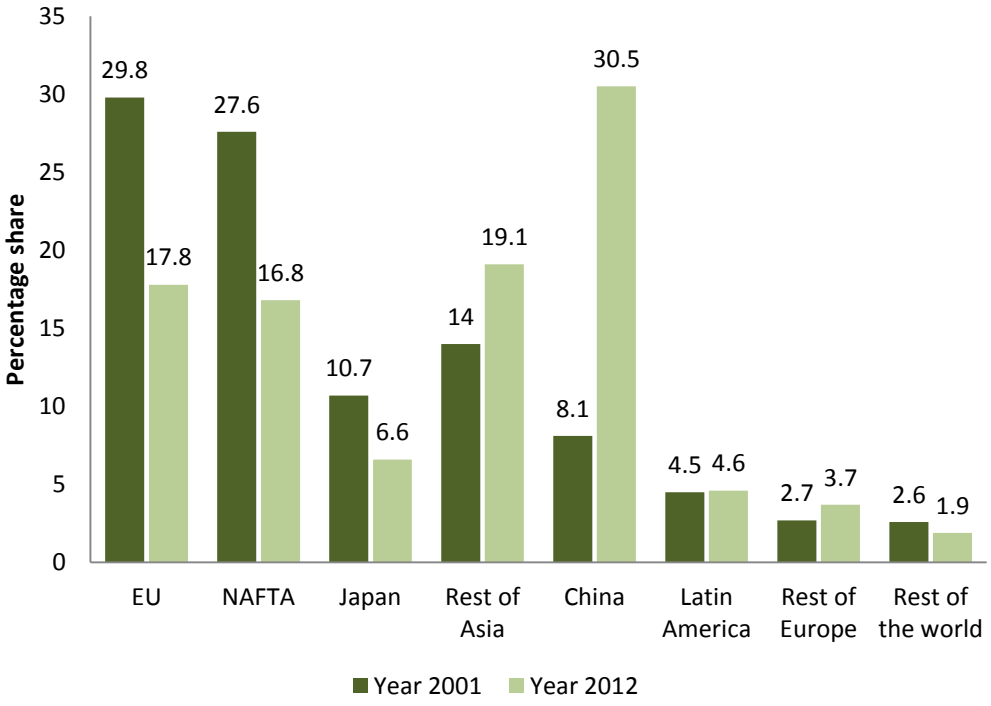
It is the time for the big European players to prepare to defend their home markets, develop growth platforms based on innovation and better value capture and build the skill and scale required to compete. The key to survival for European chemical companies is based on innovation at three different levels-moving from bulk chemical production to the specialty end of the value chain, leveraging their traditional advantage in technology and establishing closer customer and competitor relationships through joint development agreements, acquisitions, value add services and other strategies initiatives (Schulz et al., 2012).

So, in perspective of the current scenario of the chemical industry in Europe, the study is even more relevant. The project studies the research and development that this industry has seen in the recent past. There is also intent to understand the result of such research through innovation and patent disclosure of the nineteen large chemical companies.

PROBLEM OF THE EUROPEAN CHEMICAL INDUSTRY

In 2007, 12 of the 30 leading chemical companies in the world were headquartered in Europe, representing 10 percent of world chemical sales while in 2012, 11 of the 30 top global chemical companies were from Europe (Cefic, 2013). Over the years, the European chemical industry has shown considerable resilience, strength and adaptability. Like virtually every other industry worldwide, the European chemical industry has felt an enormous impact from the recent global recession. At its lowest point in March 2009, the industry saw a monthly year-on-year decline of 13.2 percent, a figure that if annualized would represent an output decline of approximately EUR 56 billion (Cefic, 2013). In Europe, the chemical industry saw massive reductions in demand for plastics, paint and man-made fibers, especially in key markets such as automotive and construction. This fall in demand led to a severe reduction in production by many companies, with some companies (particularly in the base chemicals, polymers and specialty chemicals sectors) watching their own output decline by over 30 percent. It is currently facing unprecedented challenges arising from the strong competition from emerging countries, notably in Asia, the Middle East and Russia. The European chemical industry share of world chemical sales declined from 29,8 % in 2001 to 17,8 % in 2012 which translates into 34 % decline over a period of 10 years (figure 6).

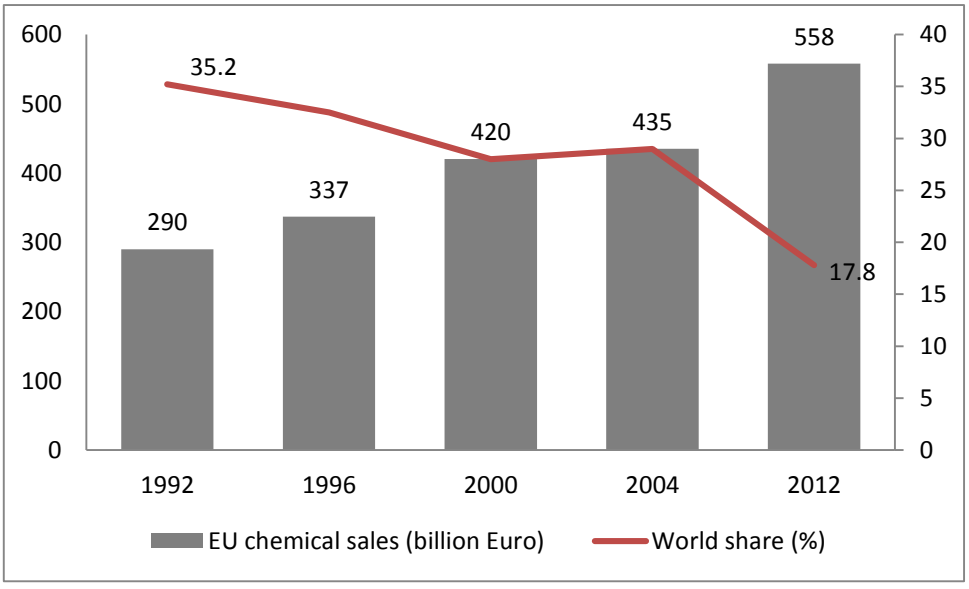
Figure 6: Contribution of each region to global chemical sell for the year 2001 and 2012.



Source: Cefic, 2014

The graph below shows even though EU chemicals sales have increased over time, they have lost in world market share depicting that the other geographies has increased at a much faster rate.

Figure 7: EU chemical sales over times and declining trend of percentage of total world shares.



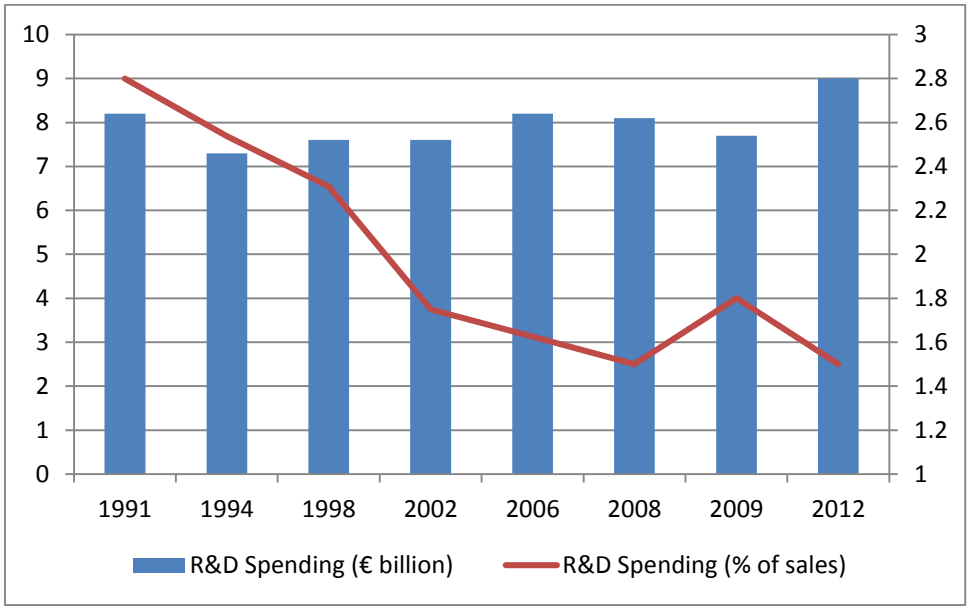
Data Source: Cefic, 2014

R&D INVESTMENT: AN INDICATOR FOR RESEARCH ACTIVITIES

European leadership in science, research and technology is the pillar to becoming a key player in the field of innovation. While innovation is more than simply doing research and development, there is a strong link between research in chemistry and innovation. Overall, it is necessary to increase the quantity of research.

The European chemical industry is therefore uniquely placed to grow in the internal market as well as develop with a global competitive advantage in development-driven and breakthrough. In European Union, R&D spending in chemical industry in terms of absolute value has remained almost constant while R&D spending as a percentage of sales has steadily declined as shown in the figure 8. Many of the challenges faced by the chemicals industry affect economic activity and society as a whole and concern manufacturing industry across the board. R&D and Innovation are indispensable to overcome these challenges, avail of related opportunities and ensure the industry's further success. Europe must retain a strong base in this sector, not only because of its economic weight, but also because of its ability to continually generate innovation critical to meeting the major challenges of other sectors of the economy.

Figure 8: R&D spending and R&D spending as a percentage of total sales.

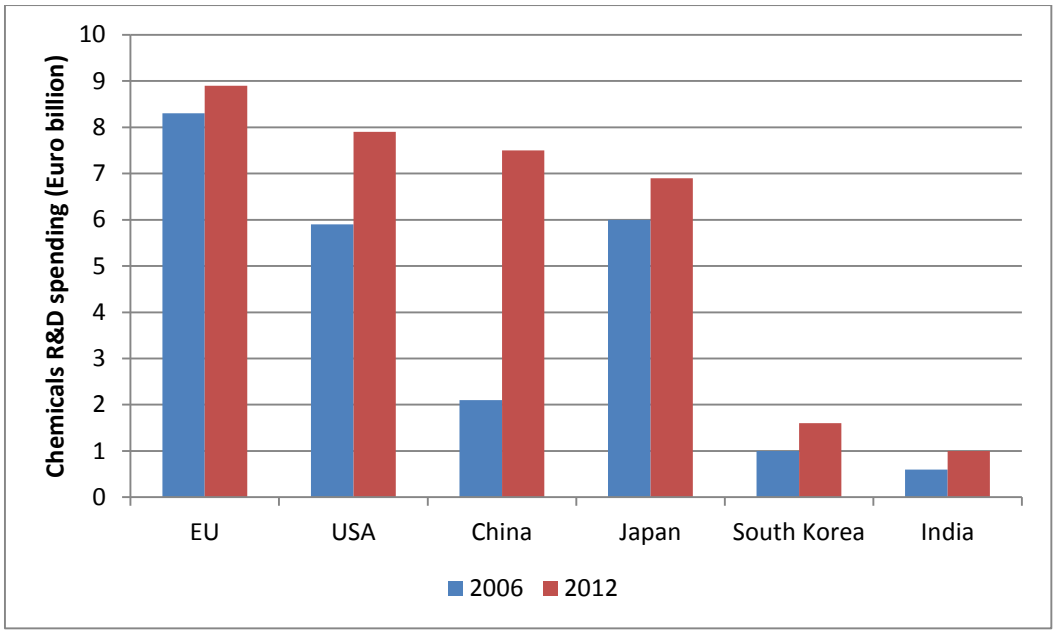


Data Source: Cefic, 2014; Graph: Author

Even though the R&D spending in absolute term has remained almost the same over the years, it is way ahead compared to other geographical region. In case of china there has been three

folds increase of R&D investment in 2012 compared to that of 2006. For other regions, the R&D spending has slightly increased.

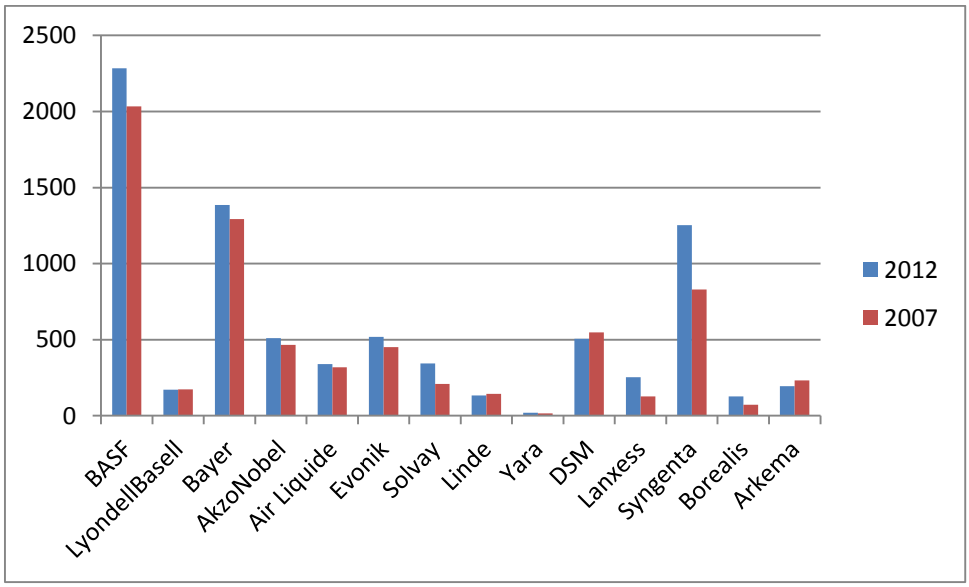
Figure 9: R&D spending of different geographical regions in 2012 compared to 2006



Data Source: Cefic, 2014

It will be interesting to understand the large European chemical companies´ strategy in terms of R&D investment. It is seen BASF as the leader followed by Bayer. The Other top investors in R&D are Syngenta, Evonik, DSM and Akzo Nobel.

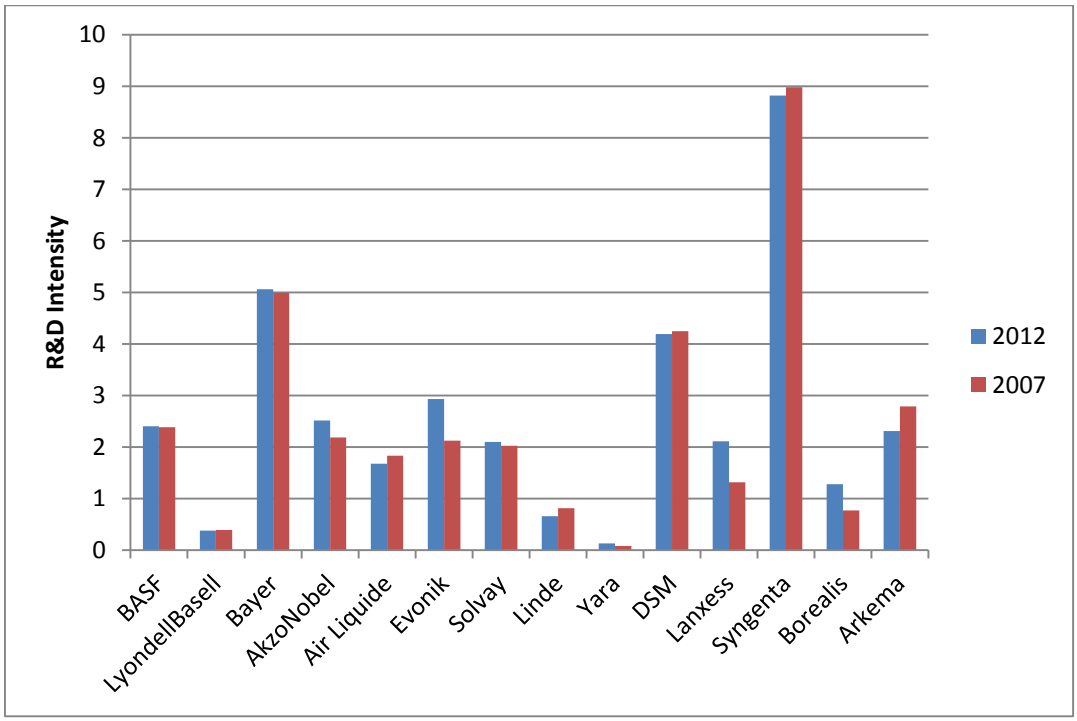
Figure 10: Investment in R&D for the top European chemical companies.



Data Source: Davis, 2013; Author´s analysis

R&D intensity is the ratio of the R&D investment to total sales and expressed as percentage. It is another measure of efficiency of R&D activities. Syngenta has the highest R&D intensity followed by Bayer and DSM.

Figure 11: R&D intensity of top chemical companies of Europe



Data Source: Davis, 2013; Author´s analysis

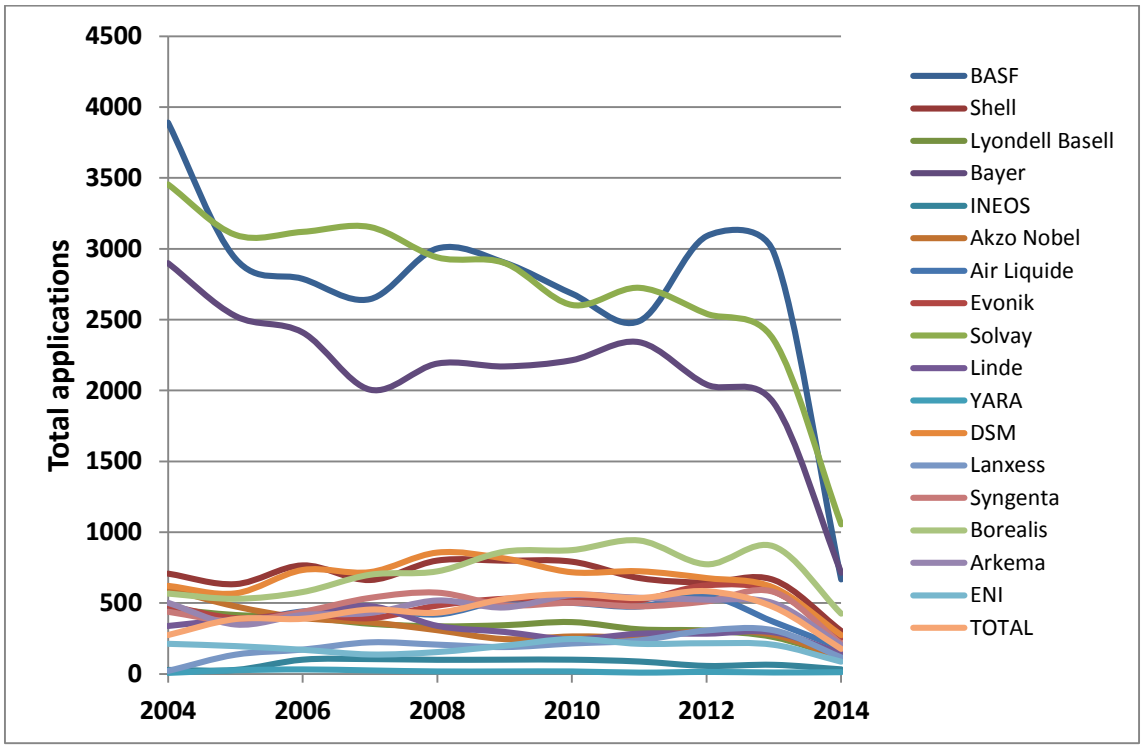
PATENTING TREND: AN INDICATOR OF R&D ACTIVITIES

Patent is defined as a government authority or license conferring a right or title for a set period, especially the sole right to exclude others from making, using, or selling an invention (Wikipedia, 2014). It may be granted to a firm, individual or public body by a national patent office and patent propensity rate is a potentially valuable indicator for innovative activities. Patents are undoubtedly one of the instruments that firms use to capture values from innovation and R&D activities. Among the few available indicators of technology output, patent-based indicators are probably the most frequently used..

The most commonly used indicators are counts of patent family that share a number of common elements. This section focuses on patent landscape of the top chemical companies in Europe. In the list of top nineteen chemical companies, three oil companies were included. For the sake of not mixing up the patent from chemical industry with patents from other application, these three companies are ignored in this study.

The graph 12 shows the patent applications made by these companies over last ten years in all the prominent patent authorities all over the world. In order to avoid counting more than once of the same type of patent applied in two different countries, patent families were counted instead of actual patent number. A patent family is a set of patents taken in various countries to protect a single invention (when a first application in a country – the priority – is then extended to other offices). In other words, a patent family is the same invention disclosed by a common inventor(s) and patented in more than one country. It is seen that BASF, Bayer and LyondellBasel are the top applicants. All other companies were predominately have lower number of application, while Solvay showed an upward trend. So it can be stated that these three companies are forefront of reach and development.

Figure 12: Global patent application and patent related document publication.

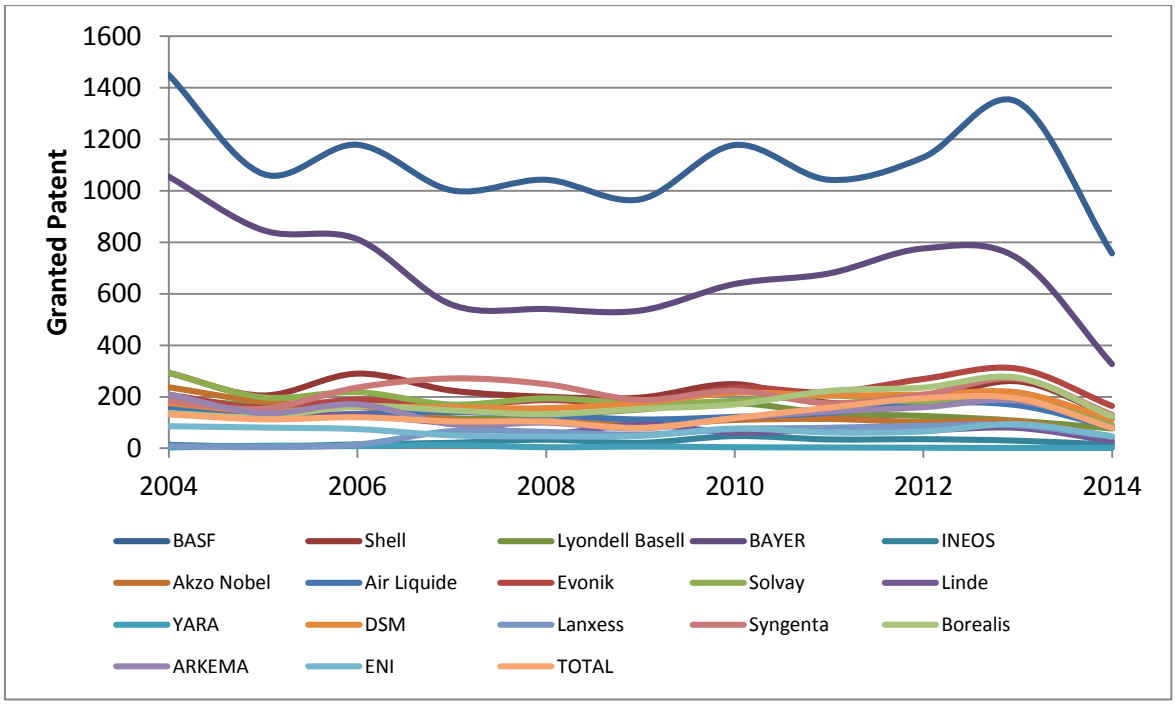


Data Source: Thomson Innovation, 2014; Author´s analysis

The figure 13 below shows the number of granted patent families for the top fifteen chemical companies of Europe. The granted patents were searched from the database of the most important patent authorities: US, European, Australian, Canadian, German, Chinese, Indian, Japanese, Korean, Singaporean and Vietnamese. Based on the granted patents, the companies can be divided as highly patenting companies, médium patenting companies and low patenting companies. It is seen that BASF has highest number of granted patent families followed by

Bayer. It is also seen for both of them, there has been fall of number of granted from the year 2004 until 2009. Then they seem to have recovered. For the year 2014, we have considered data until mid of the year. Many of the companies fall in the range of 150 to 250 granted patent which we can consider as médium innovative companies.

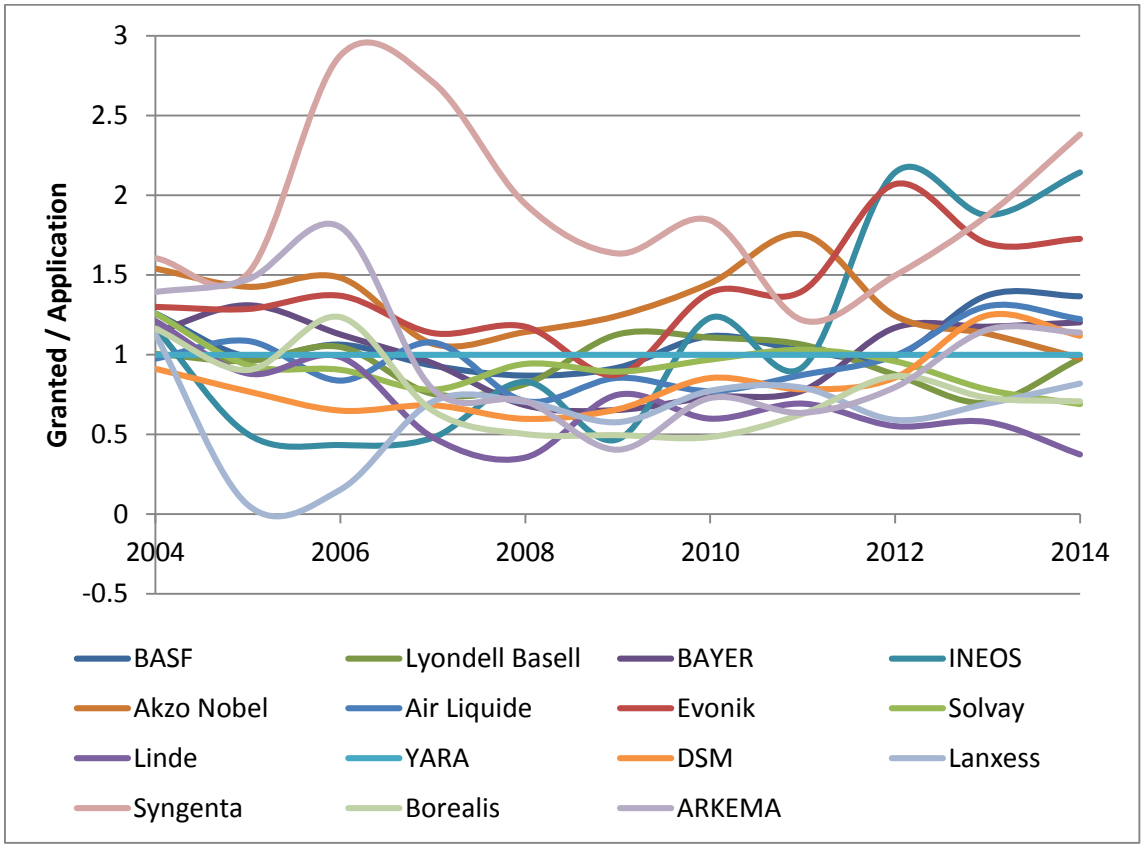
Figure 13: Granted patent families of the top chemical companies at the important patent offices



Data Source: Thomson Innovation, 2014; Author´s analysis

It is generally believed that the higher quantity of research of a company can result in larger number of patent applications, while the quality of research is judged by the number of granted patents. The graph 14 below shows the ratio of granted patent to patent applied for a particular year. It can be seen that in most cases the ratio is between 0.5 and 1.5 which suggest high quality of their patent application which in turn represent high quality of research. It is seen in many cases that the ratio is above one. This is due the fact that a patent applied can take few years before it is granted. So many cases the number of granted is higher than number of applied for a particular year.

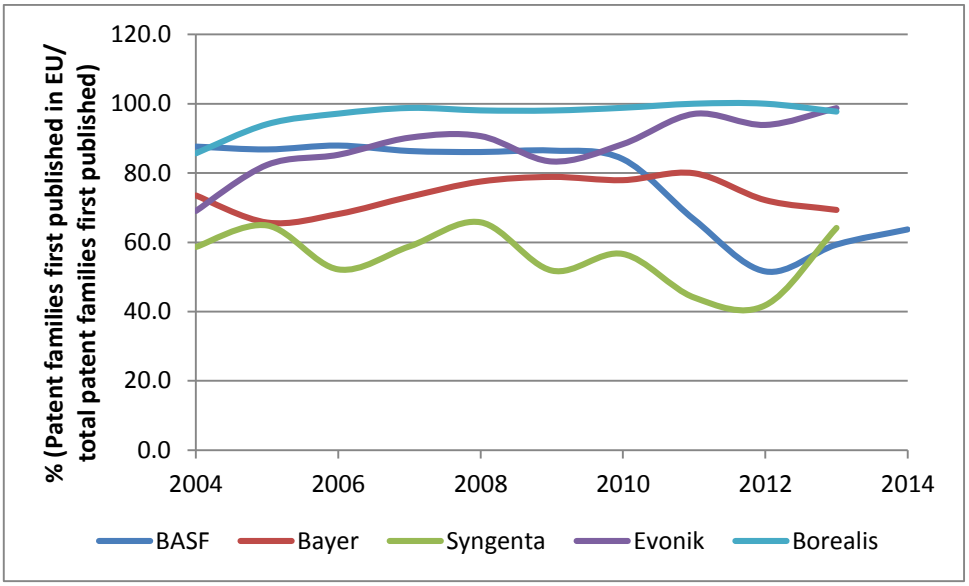
Figure 14: Ratio of application to granted patent for the top chemicals of Europe.



Data Source: Thomson Innovation 2014, Authors´ analysis

The graph 15 shows the percentage of the patents of a particular patent family that were first applied in EU compared to total global application of the first patent of that family for the companies having highest granted patents. It is seen in most cases, 50 % of the first patent is applied in EU which can be due to the fact that the research is coming out of the laboratories in EU or the companies see higher urge to protect their technology in the EU market.

Figure 15: Percentage of patent families first published in EU compared to total patent published first time.



Data Source: Thomson Innovation, 2014; Authors´ analysis

CONCLUSION

The European chemical Industry supplies raw material virtually to almost all industry and concentrated mainly in seven EU countries of Germany, France, UK, Netherlands, Spain and Belgium. Even though there are huge amount of micro and small chemical enterprise in Europe, large enterprises are the biggest value creator and also the largest employer. The chemical industry in Europe has felt an enormous impact from the recent global recession and it global share of the chemical market has fallen to 17.8 % in 2012 from 29,8 % in 2001. The R&D spending in absolute term has remained similar over the years and it is globally the largest investor for the R&D activities. Out of the 50 top global chemical companies, 19 are headquartered in Europe which provides 14,5 % of Global chemical sell. In terms of R&D Investment, BASF has been making the largest investment followed by Bayer and Syngenta while the R&D intensity is highest for Syngenta and Bayer. BASF and Bayer are the leader in patent application and number of granted patent. Most of the large European company makes their first patent application in Europe compared to other Geographical location. M&A is another strategy that large chemical companies are using to acquire know-how of the sectors for which they do not have core competencies.

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