The Staying Power of Europe's Chemical Industry

Edouard Croufer, Pieter-Jan Mermans and Christian Weigel

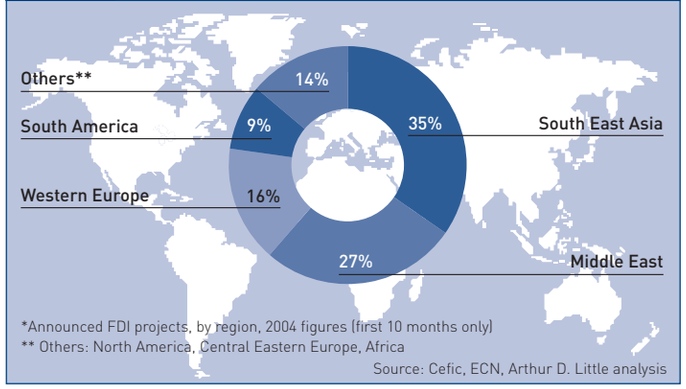
In any industry the production costs for sites in Western Europe are under scrutiny. And with more and more developing countries eager for industrialisation the pressure keeps mounting. But does this apply across all industries? To find out, Arthur D. Little compared the manufacturing costs of chemical products in Western Europe, the US, India and China. The astonishing result was that, while Europe may well be expensive, in this industry at least it is still one of the most competitive regions in the world.

Multinationals are moving hundreds of manufacturing plants to developing countries. They are abandoning the European and American continents, considered the most expensive places to manufacture goods, and transferring thousands of manufacturing jobs to 'low-cost' locations. Foreign Direct Investment (FDI) figures from UNCTAD confirm this trend. Asia, for example, accounted for 15 percent of worldwide FDI inflows in 2002, up from 10 percent in 2000. China, in particular, has seen a spectacular rise: its share of worldwide FDI inflows shot up from 1 percent in 1990 to 3 percent in 2000 and 8 percent in 2002.

Cheap labour is undoubtedly one of the drivers prompting manufacturers to move production capacity to developing countries. Moving labour-intensive manufacturing facilities to low-cost locations enables companies to serve maturing markets in developed countries more competitively. In some cases, reduced operating expenditures dramatically improve EBITDA margins, even after taking into account the additional logistics expenditures incurred.

Rapid analysis of FDI figures could lead to the flawed conclusion that these factors also apply to the chemical industry (see exhibit 1). Common opinion points to low labour costs as the main factor explaining the increasing

Exhibit 1 | Share of Investment Projects in Chemicals, by Region*



*Announced FDI projects, by region, 2004 figures (first 10 months only)
** Others: North America, Central Eastern Europe, Africa
Source: Cefic, ECN, Arthur D. Little analysis

Worst-case scenarios have appeared extensively in the press, describing a 'major structural shift in the global manufacturing base of the chemical industry[1] .

number of new large-scale chemical plants being built in South-East Asia and low feedstock costs as the main driver for increasing FDI in the Middle East. In 2004 alone, about 27 percent of the total number of investment projects announced in chemicals flowed into the Middle East, mainly representing greenfield investment in gas-based petrochemicals, and about 35 percent of all announced projects were planned for South-East Asia. Investment in China, for example, is growing in both petrochemicals and specialty chemicals.

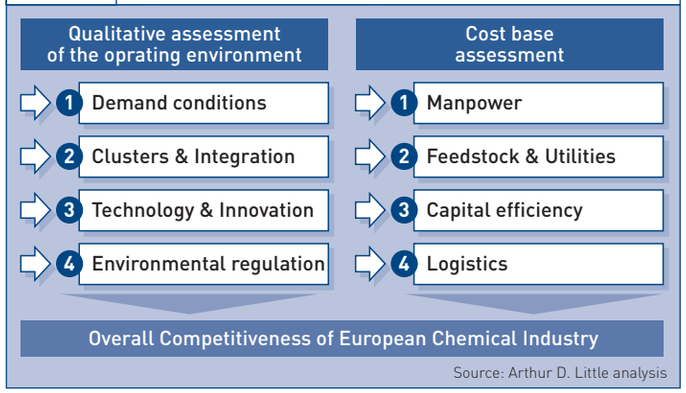
Various companies and governments have interpreted these figures as representing the start of a massive delocalisation of the European chemicals manufacturing base towards developing countries, with the aim of serving developed markets at reduced cost. Worst-case scenarios have appeared extensively in the press, describing a major structural shift in the global manufacturing base of the chemical industry[1].

At Arthur D. Little, our experience of working with leading chemical companies makes us question this superficial verdict. Knowing what makes a chemical company successful today and in the future makes it hard to accept that delocalisation is truly the key to keeping chemicals manufacturing competitive. We set out to study whether there is an economic rationale for delocalising European-based chemicals manufacturing operations. In this article, we will summarise the main findings and conclusions of that study.

Our analytical framework is built upon the eight factors that determine whether a chemical company is in a position to create value (see exhibit 2). Four of these factors are related to the quality of the environment in which the chemical company operates. The other four are related to the cost of running a chemical business in a given region. Only the combined understanding of the operating environment and the cost attractiveness provides a comprehensive view of the relative competitiveness of different regions.

[1] N. Checker, A. Carman 2002. "European Exodus." European Chemical News, Chemical Investment Sites Supplement: 4-6.

Exhibit 2 **Eight Factors for Creating Value**



Source: Arthur D. Little analysis

The four factors that determine the quality of the operating environment in any region are demand conditions, cluster formation, technological advancement and innovation, and environmental regulation.

We compared Western Europe with four competing regions around the globe: the US, the Middle East, China and India. Whenever specific data were required to perform a fact-based analysis, we selected the Antwerp-Rotterdam-Area (ARA), Houston, Al Jubail, Shanghai and Gujarat as representative locations within their respective regions.

The Impact of the Operating Environment on Regional Competitiveness

The four factors that determine the quality of the operating environment in any region are demand conditions, cluster formation, technological advancement and innovation, and environmental regulation. As indicated below, the chemical industry's operating environment in Western Europe can offer the right conditions to support manufacturers' overall competitiveness. Western Europe benefits from large demand, the presence of strongly integrated clusters, and cutting-edge technological innovation. At the same time, Western European companies have yet to tap growth opportunities in Central and Eastern Europe, and governments must improve cooperation with companies to develop environmental efficiency at low administrative cost.

a. Demand conditions

While demand in Europe is large, growth prospects are relatively small. Taken together, Western, Central and

Eastern Europe are the largest chemicals consumers in the world, representing a total value of $US625 billion in 2003, compared to $US590 billion in South-East Asia and $US540 billion in the US. Comparing the regions on the basis of demand growth yields a slightly different picture: annual growth in Europe and the US is below the global average, while South-East Asia exceeds this average by several percentage points. Still, even if Western European market growth merely mirrors GDP growth, Central and Eastern Europe have an attractive growth potential given the strongly developing local demand.

Demand for chemicals in China represented about $US150 billion in 2003. Annual demand growth amounted to 14 percent over the past five years, exceeding average annual GDP growth by about 5 percent. Supply has been growing at a lower pace than demand, even though China has been capturing 12 percent of total FDI inflows in chemicals. Moreover, industry experts expect the gap between supply and demand growth to persist in the short run due to the significant construction time needed to build new chemical plants. As a result, China will have to meet a large part of its domestic demand through imports.

The Middle East continues to attract massive FDI in the petrochemical industry. High oil prices have further accelerated this trend since gas feedstock costs in the Middle East have remained very attractive. With limited population and domestic industrialisation, expansion in the Gulf will continue to be aimed at exports, mainly targeting the South-East Asian market, and China in particular, given the supply shortage in that region. Hence, the majority of the capacity build-up in the Middle East will be deployed to meet Asia's developing demand, largely with high-volume, undifferentiated products. In other words, output might not flow into Europe initially. But the chemicals business is volatile and there are many uncertainties. It would only take Chinese demand to dip for Middle Eastern output to flow inevitably into the most attractive market.

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b. Cluster formation

Western Europe can take advantage of the presence of a limited number of strongly clustered areas. Since raw materials are the main input of the chemicals industry, their immediate availability is of prime importance. Moreover, each chemical process creates a family of molecules, to be valorised in derivative products with minimal logistics cost. These requirements cause the establishment of clusters of chemicals manufacturers, seeking to optimize the flow of material.

For the petrochemical industry, we studied cluster intensity by looking into the operational asset base of each of the regions involved in the analysis. From there, we determined the share of total national capacity that is situated in clusters. India shows the most fragmented chemical production of all regions studied: about 80 percent of total capacity is not situated on clustered sites. By contrast, regions such as the Benelux countries in Western Europe and Texas in the US prove to be strongly integrated, with more than 50 percent of total capacity located in large chemical clusters.

c. Technological advancement and innovation

Western Europe is at the centre of technological innovation. American and European corporations own more than 70 percent of global intellectual property in the chemical industry, according to figures from the European Patent Office (EPO). On average, they submit more than 13,000 new patent registrations each year, out of which 7,000 patents are finally granted. At the other end of the spectrum, the EPO grants about three to four patents a year to Chinese and Middle Eastern companies. As a consequence, the heart of product and production-technology development is clearly situated in developed countries. Operating units situated in Western Europe clearly benefit from this advantage.

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Western Europe also capitalises on its dense network of engineering institutes. The Benelux countries, for example, have one of the highest densities of engineering institutes in the world, with 640,000 inhabitants per institute.

By contrast, Saudi Arabia and China count respectively 5 million and 24 million inhabitants per engineering institute.

d. Environmental regulation

Stringent environmental regulation in Western Europe sometimes hinders value creation. The importance of environmental care has been growing and has become a distinct business issue, while chemical companies are spending billions of dollars on environmental protection and regulatory compliance. When evaluating national environmental regulation in a number of countries across the globe, it is essential to take regulatory stringency, 'green' incentives and environmental law enforcement into account. Based on the ERRI index, Belgium, the Netherlands and a number of Nordic European countries prove to have the strictest environmental policies of all, ahead of the US, the Middle East and South-East Asia, in that order. The European Commission's directive on the use of chemical substances (REACH) further increases dramatically the cost of compliance with environmental regulation in the European Union. According to a recently published Arthur D. Little study, REACH might even further affect the competitiveness of the European chemical industry.[2]

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Strict guidelines are required to ensure the industry's sustainability, but some European countries have simplified permitting procedures insufficiently. This has a considerable impact on the quality of the operating environment and hence companies' ability to create value. In a recent client engagement, we compared the financial attractiveness of setting up a large-scale investment project at different locations across the globe. At one of the Western European locations, it was estimated that permitting procedures resulted in a six-month delay in getting the plant operational. The corresponding loss in revenues had a major impact on investment return, prompting the company to select an alternative location. However, this does not imply that developing countries are necessarily lax about environmental regulations. They often adopt Western Europe's most advanced laws.

[2] C. Weigel, R. Baron 2003. New Proposals for Chemical Policy: Effects on the Competitiveness of the Chemical Industry.

The Impact of Cost Levels on Regional Competitiveness

The above considerations show that, by and large, the chemical industry's operating environment in Western Europe can offer the right conditions to support manufacturers' competitiveness. Now we will look at the factors related to the costs of running a chemical business in a given region. First we will present an approach that provides a thorough understanding of all aspects of the cost attractiveness of different regions for the manufacturing of base or specialty chemicals. Then we will illustrate the approach with two specific case studies.

As far as the approach is concerned, start with the evaluation of the main OpEx (operating expenditures) and CapEx (capital expenditures) drivers at different locations. Separately analyse the various OpEx components: feedstock unit costs, manpower unit costs, utility unit costs and logistics unit costs. Then compare capital efficiency levels across locations. The capital efficiency ratio relates net capital investment to total plant capacity. Plants are capital-efficient if they have a high utilisation ratio, or if output capacity is steadily increased with minimal additional capital investment effort (often called “creeping”).

Since the importance of customer proximity increases with the degree of functionalisation of the product, it is important to compare different types of manufacturing units across the value chain.

Even if the initial analysis leads to large differences in unit cost, avoid moving towards delocalisation too quickly. The unit cost analysis should be complemented with an evaluation at plant level. Since the importance of customer proximity increases with the degree of functionalisation of the product, it is important to compare different types of manufacturing units across the value chain. Select the manufacturing of one upstream and one downstream product, and outline the technical project definition of the plants. Involve the corporate engineering department in this process in order to capture all physical and technical specifications.

In the last step, link the unit cost information with the technical specifications into a model. The model should be based on discounted cash flow (DCF) methodology to gain insight into the financial performance of a manufacturing project on a cash-flow basis. The model should calculate the manufacturing cost per ton of finished materi-

al, to enable easy comparison across all locations. In addition, a pure-play delocalisation decision brings along the requirement to transport finished goods to developed destination countries. This comes at an extra cost, namely transport expenditures and costs related to import and export duties. In other words, compare the manufacturing cost in a developed country with the landed cost in a developing country.

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We have applied this approach to multiple clients in the chemical industry. We will illustrate the approach with two case studies: the manufacturing of polymers and the manufacturing of specialty monomers. Although the conclusions are specifically valid for these two product categories, they are also more generally valid for base chemicals and specialty chemicals respectively. Moreover, the approach can be applied to any chemical product that is available on the market.

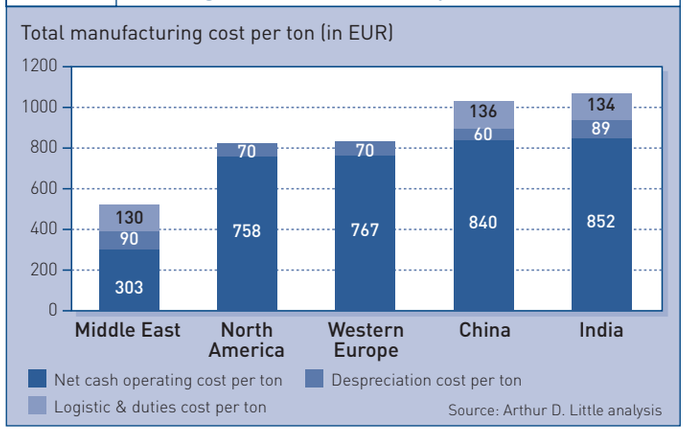
Case Study 1: Manufacture of High-Density Polyethylene

The first case study deals with the manufacture of an upstream product, namely high-density polyethylene (hdPE). The product is mainly used as a raw material in blow moulding applications such as milk bottles, packaging containers, car fuel tanks, etc. HdPE is currently produced by processing naphtha or ethane into ethylene, followed by a second step of ethylene polymerisation in either slurry, solution or gas phase reactors.

We started by calculating the manufacturing costs per ton for hdPE (including logistics costs and export/import duties) sourced from alternative units in Western Europe, the US, the Middle East and South-East Asia, for customers located in Western Europe or the US.

Naphtha-based manufacturing costs in Western Europe are currently comparable to ethane-based manufacturing costs in the US (see exhibit 3). But naphtha-based manufacturing in South-East Asia proves to be significantly more expensive than in Western Europe on a per-ton basis. This is in sharp contrast to common opinion, which is often based on an isolated view at individual unit cost

Exhibit 3 **Sourcing hdPE to Western Europe**



For a number of polymers, the Middle East must be considered as the sole region that is more competitive than Western Europe.

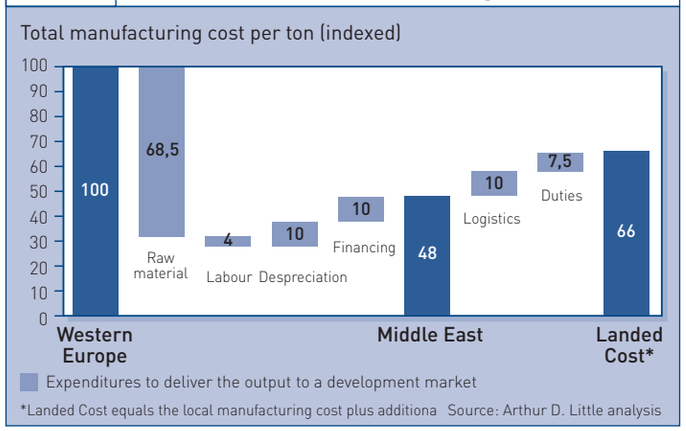
level. A holistic approach that combines all the quantitative cost drivers into one model clearly disproves the view that South-East Asia is a competitive performer. In recent years, Asian countries such as India and China have suffered from rising net feedstock costs. Upward pressure on ethylene prices due to the current imbalance between demand and supply cannot be offset by low-cost manpower.

For a number of polymers, the Middle East must be considered as the sole region that is more competitive than Western Europe. We estimate that the cost of sourcing hdPE from the Middle East to Western Europe amounts to 66 percent of the per-ton manufacturing costs in Western Europe. Since cheap ethane is the preferred feedstock in the Middle East, the bulk of the cost advantage is generated by low raw material prices (see exhibit 4).

Managers of European companies have a number of levers they can use to react to this threat and remain competitive. Firstly, European hdPE manufacturers should further develop product specialisation to protect their margins. Increased product specialisation enables European hdPE manufacturers to keep prices at current levels, while Middle Eastern producers lack the knowledge and speed to fine-tune their basic polymers.

Secondly, we estimate that a 10 percent change in capital efficiency can potentially yield a 40 percent increase in

Exhibit 4 | Raw Material Prices & Cost Advantage



net present value (NPV). Hence, managers must work to enhance capital efficiency, making use of the highly educated workforce available in Western Europe. Untapped creep and de-bottlenecking opportunities should be seized to satisfy demand without additional net cash investment.

Thirdly, a 10 percent downward change in ethylene prices can double project NPV (at equal hdPE sales prices). The manufacture of hdPE thus proves to be even more sensitive to changes in feedstock cost. Increasing the number of cracker connections via pipeline networks could improve efficiency in the European market by reducing these feedstock costs. At present, the ARG pipeline network connects only 40 percent of total petrochemical capacity in Western Europe. By contrast, about 90 percent of US ethylene capacity is integrated in a pipeline network.

We found that ethane extraction costs for Middle Eastern producers will increase, putting upward pressure on the price of ethylene, thus diminishing their raw material cost advantage.

Lastly, multiple sources have indicated that ethane extraction costs in the Middle East will significantly increase. Consequently, producers will have to utilise heavier and less attractive streams, requiring new investments. In other words, ethane extraction costs for Middle Eastern producers will increase, putting upward pressure on the price of ethylene, thus diminishing their raw material cost advantage.

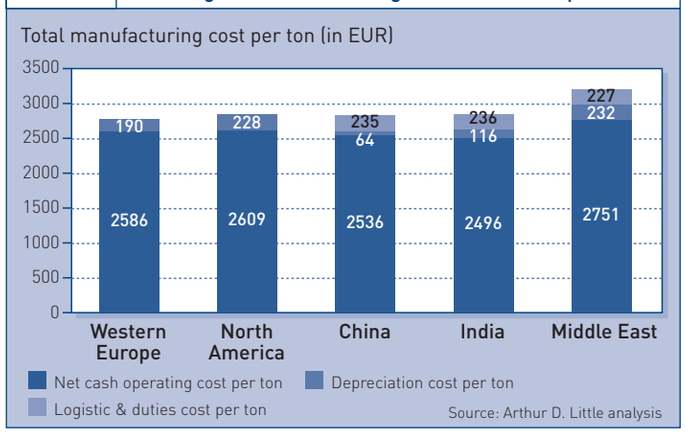
Case Study 2: Manufacture of a Coating Resin

The second case study examines the manufacture of a downstream product, namely a specialty monomer. The specialty monomer we selected is a coating resin currently produced by a number of global players. The production process uses acids and alcohols as raw materials. The resins are among others used in the coating industry. Their main applications are the protection of electrical equipment, metal furniture, window and door frames, etc, and new developments such as UV curable powder coatings are opening up applications in the non-metal industries. Our analysis demonstrates that producers of such resins cannot gain significant cost advantages by delocalising their manufacturing operations for this product to developing countries.

Western Europe proves to have the lowest per-ton manufacturing costs for resins for coating (see exhibit 5). High capital efficiency is the main lever of Western European cost efficiency. However, all things considered, total per-ton manufacturing costs are approximately the same in Europe, the US, China and India. Manufacturing costs in the Middle East exceed European cost levels by 15 percent.

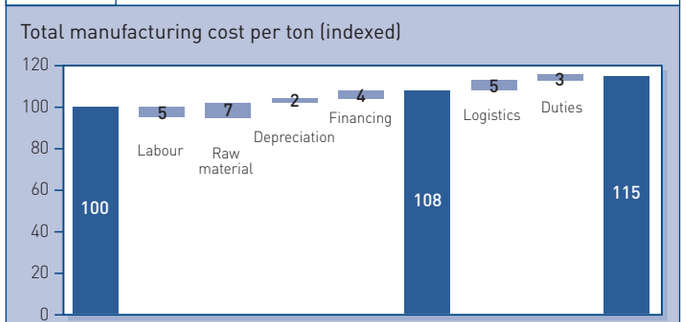
Compared to the previous example in the upstream segment, the impact of raw material prices on overall cost attractiveness proves to be very limited. As a result, South-East Asian countries perform relatively better in the

Exhibit 5 | Sourcing Resins for Coating to Western Europe



downstream segment compared to the upstream segment. But, even with the lowest net cash operating costs per ton, China and India still cannot beat Western Europe due to logistics costs and duties that raise the landed cost significantly.

Exhibit 6 **Raw Material Prices & Cost Advantages**



*Landed Cost equals the local manufacturing cost plus additiona Source: Arthur D. Little analysis

By the same token, Middle Eastern producers cannot valorise their feedstock advantage due to the more limited impact of raw material prices in the downstream segment. Hence, the cost of sourcing resins for coating from the Middle East to Western Europe is estimated to be 15 percent higher than per-ton manufacturing costs in Western Europe (see exhibit 6). Clearly, the Middle East's advantage in cheaper manpower is washed away by more expensive raw materials, higher net capital investment and lower capital efficiency.

Insights for the Executive

According to our study, chemical manufacturing facilities based in Europe are particularly well positioned for the global fight for leadership, contrary to continuous news about potential delocalisation. We found compelling evidence that Western Europe is one of the most competitive areas to manufacture chemicals.

Firstly, focusing on the industry's operating environment, chemicals manufacturers in Western Europe do perform strongly when it comes to production integration and the level of technological advancement. The Benelux countries, for example, contain a significant number of companies located in well integrated (petro)chemical clusters, reducing overall production expenditures. Highly educated workers further contribute to strong capital efficiency. Enhanced capital-efficiency levels prove to have a direct impact on the bottom line. Further optimisation can enable Western Europe to reach unprecedented levels of competitiveness.

Secondly, assessing the cost attractiveness of delocalised manufacturing provides evidence that Europe significantly outperforms South-East Asia for upstream manufacturing. Low labour costs in South-East Asia do not compensate for key European capabilities. Only the Middle East, currently benefiting from a significant feedstock cost advantage, proves to be more cost-competitive. Middle Eastern producers benefit from a 30-35 percent landed cost advantage compared to the Benelux area. We identified product specialisation and enhanced capital efficiency as key levers that could enable European players to quickly catch up with current Middle Eastern cost levels.

Beyond a limited number of base chemicals, Western Europe holds its strong competitive position in downstream manufacturing. Raw materials have a significantly limited impact on per-ton manufacturing costs for downstream manufacturing, while high European capital efficiency largely compensates for lower labour costs. The smaller the share of feedstock expenditures in the total cost structure, the lesser the need to delocalise chemicals manufacturing to developing countries.

Hence, CEOs in the chemical industry should not take popular beliefs about Europe's lack of competitiveness for granted. Each delocalisation decision should start with in-depth analysis of all the factors discussed in this article, tailored to the specific chemical products considered.

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