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R. Jakobi

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Preface

This book is dedicated to all scientists and engineers who want to risk a look over the borderline, to the marketing of chemistry. Marketing means the transformation of skills into money—money to reinvest into research for new products.

The book has also been written for those who want to advance their careers and avoid belonging to either of the following two extreme groups:

The Experts, who specialize more and more until they know everything about nothing; and the Generalists, who expand their skills more and more until they know nothing about everything.

For scientists, who do not like long sentences:

$$|E \times 0| + |0 \times G| = 0$$

The book is not on market research, rather more a guide to help scientists to understand the world of marketers and be able to communicate in their language.

I hope that this book will evoke interest for the fascinating field of marketing and may encourage mutual understanding of different disciplines.

Zurich, October 2000

Rolf Jakobi

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1 The “Main Group Elements” of Marketing

1.1 Understanding Marketing

For natural scientists and engineers, it sometimes seems to be difficult to become familiar with marketing, namely entering a world with only very few formulas or precise construction plans. Therefore at the beginning of this book a few fundamental tools and vocabulary are given in order to quicken the approach to this fascinating field.

Scientists may have special problems with marketing because often they have a real “love affair” with their products and do not understand that others are not so enthusiastic about their favorite. Of course it is the fault of the customers not to recognize immediately the intrinsic value of the machine or product, and anyway it is a waste of time trying to convince such people who are far behind their times. In some cases the scientists may be even right. However, there are examples that a product was invented, such as polysulfone, which slumbered in a drawer for years and then suddenly proved to be exactly the solution for a developing problem. It may console chemists to know that they have solutions for problems which still do not exist. Sometimes from “above” an order is given to suspend research because there is no result in sight; scientists in a small, secretive group continue their work because they believe in their product. It is claimed that polycarbonate for the compact disk was developed in this way. Mr. Gore, a former employee of DuPont, spoilt a very thin film of skived polytetrafluoroethylene; the film afterwards contained many tiny holes. Gore saw an application for this “spoilt” material and offered to develop a new kind of semipermeable material for his company. However, this time the company, so innovative and successful with other products like teflon and kevlar, did not see the potential. Therefore, Gore established his own company, which now fabricates in some dozen firms worldwide the well-known textile material goretex and others based on fluorocarbon polymers made by Gore’s advance.

Scientists are artists in their field and often do not care what will happen with their results. The purity of science, and the hope that one day the Nobel committee will finally compensate them for all the frustrations, supports the hard-working scientists

and keeps their morale high. However, beside fundamental research—which without any doubt is essential—developments and inventions are only of any use when they can find a market and be sold, otherwise they are curiosities and should be exhibited in a museum. In addition, basic research is only possible if there is something else that can be sold to create a surplus of profits with which to finance and subsidize this undirected research.

We have just reached the central task of all marketing efforts, namely to find a market—we do not say to sell a product, which is only a part of marketing. Marketing means, described in the most simplest way, a logical sequence of actions: Attract attention, make the product or service interesting, stimulate desire for this product, and make the customer buy and pay. This is the “AIDA” concept.

- Attention
- Interest
- Desire
- Action

The first elementary step, attracting attention for the product or the service, means to make the product’s existence visible and show that there is something new or at least a new supplier. People are overloaded with daily stimuli of all kinds and have developed, with time, a filter mechanism. This is a quite natural behavior and necessary to survive. Imagine a person that would store every stimulus in mind—he or she would go crazy within a very short time. So, everybody has developed an individual filtering system; you can prove that by checking your daily mail. Normally, bank statements, bills, or mail from your friends find immediate attention and gain reading priority. However, most probably a part of your mail goes directly into the waste basket. Therefore the task is to find the right media to make a product or service known to the public, in this case the people who might be your future customers.

To realize that a product and a supplier exist is not sufficient. There must in addition be interest, otherwise the public will simply forget about it after a while. Interest is achieved when people feel a need for such a product and when a public relations campaign succeeds in putting a marker in your memory. A marker is like a messenger molecule that finds the right place to dock onto. If, after a few days you remember what “AIDA” means in marketing, you have got a marker in your memory. In this phase, a client may ask for more information about the product and compare it with competitive products.

Let us assume that your product is truly extraordinary and the potential customer feels an urgent desire to have it; the marketer is near to success. The best situation is when the customer would feel uneasy not to have the new product. Famous brand names and logos designed by experienced marketers help to provoke such a feeling. When there is a reason to belong to a group of people wearing t-shirts with a certain label, you simply have to buy it if you do not wish to be an outsider. To make you pay a premium price for a t-shirt and for you to be happy nevertheless—this is the highest art a marketer can achieve. Alternatively, wrapping polyethylene film

around a catwalk model and selling this costume at an exorbitant price is a return on investment of which even bankers dream.

Action is the ultimate and decisive step. Where there is no money, there is no market. The desire to have the aforementioned model's costume is of no importance if there is not enough purchasing power behind it. Further, to employ the model to wear the film itself also needs, besides money, knowledge in marketing, specifically self-marketing. Markets only exist where purchasing power exists. When money flows, marketing has been successful.

1.2 Identifying Markets

I said that finding a market is the principal goal of all efforts. However, what is a market? Is it all inhabitants of a town, all citizens in a country, the wealthy only, the young, the old? The answer to the question is: It depends—an answer a scientist does not like. Nevertheless, it depends on the product and the different needs of customers. The need for housing is an intrinsic need for everybody and a potential market for people all over the world. There is also an urgent need for food. However, for the product “bread” there is no general market because babies do not eat bread and other cultures have alternatives.

A chemical engineer finds at least six different products of carbon (see Figure 1-1) and some products certainly have different potential customers. Therefore, a reason exists to segment a market according to the needs of customers for products and/or services (see Figure 1-2).

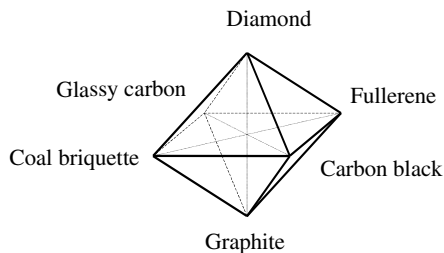


Figure 1-1 Market segmentation of carbon

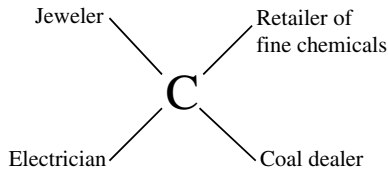


Figure 1-2 Target groups for carbon products

Market segmentation defines target groups to which the efforts of marketing are focused. A target group is defined as a homogeneous group of consumers or users with equal, or at least similar, needs and interests. Different products nevertheless may go into the same target group, for example fullerenes, glassy carbon, and carbon black may be offered by a merchant of fine chemicals or a laboratory equipment distributor. Advertising for diamonds certainly is different from that for graphite fibers or coal briquettes. Segmentation therefore is also a tool to increase the efficient use of the marketing budget. As the saying goes, half the marketing budget is money thrown down the drain—the only problem is that nobody knows which half. So it is evident that segmentation in marketing is somewhat equivalent to the efficiency factor in thermodynamics.

The marketing efforts can focus either on the needs of the customer or the product itself (see Figure 1-3). Both ways to achieve a market segmentation are possible but nevertheless there is an important difference. There are different market segments for writing instruments such as pencils, ballpoint pens, chalk, fountain pens, note books, and computers. Simultaneously, for fountain pens there are market segments for both cheap ones and luxury versions with famous brand names.

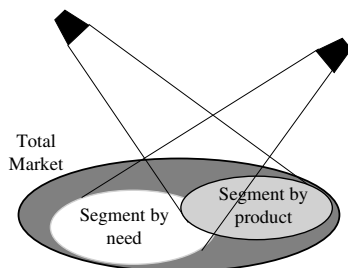


Figure 1-3 Different ways of segmentation

1.3 Positioning

After initial reflections about markets in general, the question now arises how the products can be marketed in the different segments. In practically every market segment there are many different suppliers, otherwise a monopoly arises. These suppliers usually can be ranked in a price/quality scale, with products offered for high prices in the premium sector and the lowest prices in the discount sector. Of course, there are also items in the middle between these extreme positions. From the point of view of economics, it is evident that highest quality and service cannot be offered at discount prices (unfortunately, some purchasing departments may view that differently and think that they can change the laws of economics). In general, products can easily be positioned in a price versus quality matrix (see Figure 1-4).

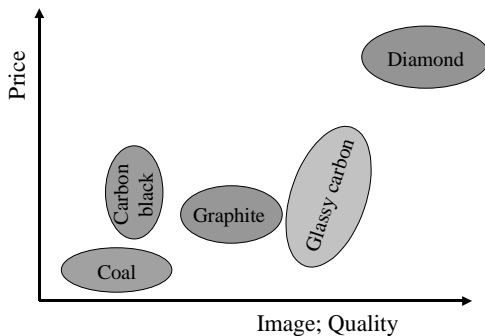


Figure 1-4 Positioning of carbon products

Positioning, therefore, is also a part of the product strategy. A company has to decide whether it will offer products in the discount or premium sector, and purchasing firms have to decide whether they can afford a no-name product, a luxury brand, or find a compromise between the two. The strategy of positioning has to be chosen carefully. By definition, a strategy is a long-term management decision. Management cannot just switch a product from the premium position to a lower-price position because the image of the luxury product would suffer. If the switch occurred, customers may ask themselves if they were cheated upon later finding the same product at a significant discount. The decision is either one or the other. In the case that there is not enough volume in the premium sector, a second product line with a different brand name can be created.

In business-to-business (B2B) marketing, luxury goods do exist and not only in consumer marketing. In the context of chemical marketing, luxury means outstanding performance of the producing company with excellent service and

quality. The good image of a company and their products is important and justifies a premium price. On the other hand, there are suppliers following the strategy of cost leadership and offer an acceptable quality at the lowest prices. This is also clear positioning and finds its customers. Of course, low prices never justify bad quality.

1.4 Differentiation

Price and quality are essential elements of differentiation. However, these marketing tools decrease in importance because low-quality products cannot exist for long in the market. Prices usually are under pressure and are calculated with similar accounting procedures. Therefore, differences often are only marginal. Nevertheless, the credo in marketing is

Be different, or die!

In most cases, there are dozens, even hundreds, of suppliers for the same product or service in the market. To be successful, a business has to find ways how to convince a potential customer to buy something from their company and not from the competitor. The commodity products—items sold in large quantity and are often raw materials for a successive product or process—are especially difficult to differentiate. A supplier of thawing salt has certainly few possibilities for differentiation: Salt is just salt, and the price for sodium chloride is expected to be also the same. The only chance for differentiation is in the time of delivery, the granulation form, or the size of the lots. In principle, there is always something which may be made different, and that can be decisive. Today, speed and service are the most important tools for differentiation, and increasingly the “logistic package” is also of importance. If there is no natural differentiation, one must make it different so that the customer finds the product more favorable than others of the same class.

1.5 The Marketing Mix

The term “marketing mix” has something in common with a mixture of different substances, which—under the right conditions—react to give the desired product. The components of this mixture in marketing are Product, Price, Place, and

Promotion (see Figure 1-5). In the right composition, the four Ps enable the marketer to reach an optimum in the market.

Product means the assembly of the physical properties, quality, design, brand name, service, warranties, and options.

Price includes the combination with payment conditions and rebate systems.

Place is not the position in the shop but the place of the product in a purchaser's mind, connected with distribution channels and locations. It is strongly connected with an individual's perception of the product. This perception, in turn, is subject to brand culturing.

Promotion is the combined effort of personal selling, advertising, and public relations.

From the four Ps, product is the most inflexible tool in marketing. A product is often difficult to change or to modify when once approved and in production. It can be a costly affair if such an event is enforced through mistakes. Place is a long-term strategic decision as already mentioned. Promotion and price are the most flexible tools and can easily be modified and adapted to changing market environments.

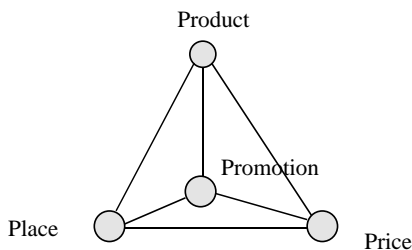


Figure 1-5 The P₄ model of the marketing mix

1.6 The Demand

The marketing mix presents tools to influence the market into a desired direction, within limits of course. Efforts to increase demand are essential because we live today in a glut. With very few exceptions there are no shortages in the Western world, and the market power is in the hands of the customers. Some products or services can be sold only with extreme difficulties: Neither intensive promotion nor discount prices will increase the demand for wisdom teeth extraction. This example

may be a bit macabre, but nobody can deny that a market for this service exists—albeit undesired by all, excepting dentists. Remaining in the medical sector, preventive medical examinations are useful for individuals and expensive treatment later may be avoided. In spite of all arguments in favor of such examinations, a real demand does not exist. What can a marketer do in such a situation? In contrast, the market for cigarettes or alcoholic drinks is booming; consumption is too high in the opinion of the health ministries. Again, what should a marketer do?

Marketers have developed a scale to describe the state of demand and also measures to be taken in these situations (see Figure 1-6), from converting customers to the new product, developing new products to fill an as-yet unfulfilled need, or suppressing the image of the products when demand is unwelcome.

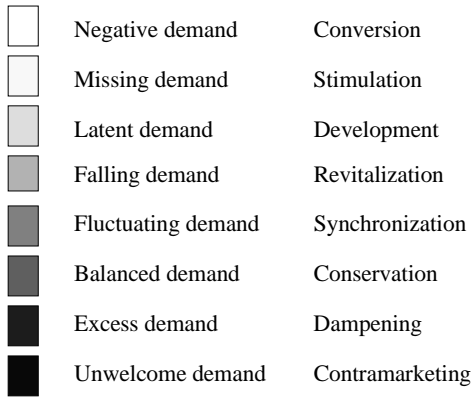


Figure 1-6 The “litmus scale” of demand

However, demand is not fixed and depends on many factors, from the general economic situation in a country, the populace’s income distribution, purchasing power, and so forth, and not least of all from the product itself. The product, in turn, has a certain lifecycle, that is, a new and still unknown product faces only a small demand, which increases with publicity before its decline and disappearance when the product is out-of-date or a newer technology arises. The demand function (see Figure 1-7) may also face a revival after the decline; an outstanding example for such a revival is indigo. A decision to cease fabrication of this dyestuff had been made when the fashion leaders presented stone-washed jeans and so caused a jump in demand for indigo. Similarly, synthetic rubber had already replaced natural rubber for the most part when the rise of HIV/AIDS caused a revival in the demand of this material.

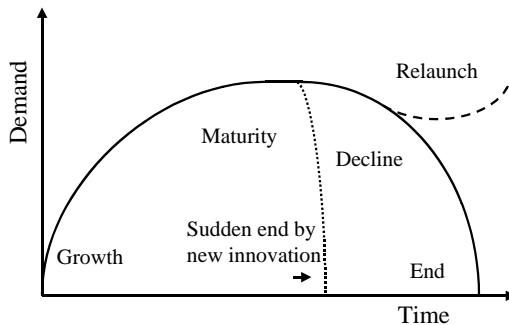


Figure 1-7 A product's lifecycle

The lifecycle curve is only an idealized model but nevertheless useful because in the different states of demand the marketing mix has to be modified. There are also curves which never end, such as for products with a permanent demand (food) or a fluctuating demand (heating oil). Before a product's lifecycle ends with a more or less steep decline, a producer can modify the product and attempt a relaunch.

1.7 Analyzing the Market

A good marketer has to observe primarily four areas:

- Customers
- Competitors
- Channels
- Company

Usually the priority follows the above sequence. The most important people to the seller are the customers: They are the only people who give money to a firm. The salaries of all employees are ultimately paid by the customers and the company acts only as distributor. Unfortunately this simple fact is not sufficiently known but it is the main reason why so many firms collapse. Companies with poor performance often try to sell products—successful companies realize their customers' wishes and dreams. Analyzing markets does not mean "number crunching" but rather collecting information about the customers' needs and of course about the activities of competitors. Know your customers and you know what to sell.

Knowing what the competitors are doing is essential; knowing what they are planning is decisive. In order to get an initial overview of a market, one can consult the common market publications and use the service of professional market analysts. Producing data, however, is not the same as having information, and information is not the same as knowing how to act. Specialized consulting companies may help in gathering primary market information and assist as a neutral adviser. Together with these experts, a company can develop different scenarios for strategies depending on the competitors' most likely market behavior. However, the critical point in chemistry-related marketing is to find a consulting company familiar with the chemical markets. Unfortunately many pretend to know everything and advise a factory for vegetables today and try their luck with a high-technology manufacturer tomorrow. Only very few companies can afford their own market research department with an extensive database. Therefore, for companies that do not like consultants or spending too much money, secondary market research, namely reference to already published data, is the only possibility. However, the nearest source of primary research—the company's own sales team and discussions with existing and potential clients—is often not used.

Marketing channels are subject to major changes today. Already most of the local shops have disappeared, substituted by centralized supermarkets or exclusive boutiques. The general trend behind this effect is that the customer is no longer willing to pay excessive transaction costs, and the importance of intermediates in the value-increasing chain has decreased. Logistics specialists have taken a significant part of that chain, from storage, commissioning, and of course shipping, in following the concept of the “merchandise hotel”. Even peripheral tasks, such as insurance, export credits, and customs clearance, are sometimes offered. For a marketer, the choice of the right distribution channels, not only by reasons of outsourcing but also by image reasons, may be very important.

Sometimes it can be useful to peer into the mirror and analyze one's own company. Strategic marketing plans can be realistic only when strengths and weaknesses are known; however, this knowledge is solely of use in comparison to the competitors. A good method of comparison is benchmarking, in which a company determines the competitor with the best performance in the market and measures its own properties against it (see Figure 1-8). From this analysis, opportunities and threats can be discovered. This tool is named a SWOT (strengths, weaknesses, opportunities, threats) analysis. The critical difficulty in benchmarking is gathering appropriate data about competitors. Beside the obligatory legal publications, a good source of information are the competitor's customers, trade exhibitions, fairs, and the like.

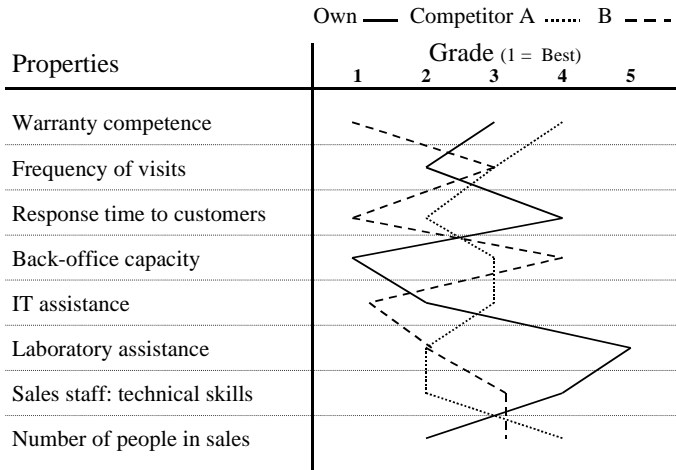


Figure 1-8 Critical benchmarking factors in relation to chemical marketing for three model companies

1.8 Developing Marketing Strategies

A strategy is by definition a long-term business policy, in contrast to tactical market operation. However, what is the value of a strategy when the economic environment is changing ever more rapidly? Sometimes there is no strict border between strategy and tactics. Nevertheless, some general guidelines and a framework are necessary for all kinds of business. Without a strategy, a company has no orientation in the market. A market strategy is mainly based on attributes of the product, connection with the customers, the market structure, and the style or culture of the company. Style and culture means the manner in which a company acts on the market, such as an aggressive innovator, a niche defender, or a branch leader. There are some classical behavioral patterns of companies, perhaps in an analogy to individuals. A big company for instance may tolerate the attacks of minor competitors on niche segments but furiously retaliate against an attempt to attack its core business. This is a part of a company's image.

The staff of course are another decisive element in a market strategy. Uninformed and unmotivated employees make each market strategy obsolete, however sophisticated it may be. It is important that every member of a company, from the entrance information desk to the senior managers, know the goals and strategies and

act according to these guidelines. Many senior managers spend a good deal of their time in meetings developing market strategies. For a typically hierarchical top-down process, once the strategies are chosen the decisions will be forwarded to the marketing departments and the sales staff without informing the rest of the employees. This is a complete waste of time and resources if not everybody in the firm pulls together.

The market structure has a significant influence on the strategy. In some cases, however, mergers of large companies also in turn influence and change the market structure. Competition from a strategic point of view has three main alternatives: expansion, withdrawal, and holding a position. The belief that only “expansion” is a successful strategy is a persistent misunderstanding. There is nothing on earth that continuously expands, and a company can be very successful and stay profitable through a continuous flow of innovations while eliminating old products.

Strategy, as a function of monetary aspects, is only one dimension of the overall strategy. In connection with market globalization, the geographical dimension has to be considered. Expanding business to other countries is one of the issues for survival in international markets. Step-by-step expansion, such as from a familiar business surrounding to foreign business cultures, or expansion on a large scale, requiring significant resources, are two options.

The third dimension in strategy is time. We have already mentioned the lifecycle curve of products. A strategy must be flexible enough to allow modifications with time, otherwise is not strategy but dogma. Other cycles, for example a country’s economic or political situation, may enforce the adaptation or even a complete change in strategy. It is the noble art of management to realize that strategy is not the optimization of only one—mostly the financial—dimension but rather a multidimensional optimization process.

1.9 Implementation

All activities within a company have to be focused on the customer. Therefore the objectives of a strategy must concentrate on the customer’s needs and wants. The employees should learn to observe their own activities through the eyes of a customer. They should imagine that a customer would go with them through all departments in the company and look over their shoulders. The employee would then see factors such as how long material remains without any processing work done or how long an incoming order waits until forwarded to production, situations the customer, who pays for this inactivity, would not wish to see. The primary objectives, once again, are to satisfy the customer’s needs and not to sell the products. Products must primarily present solutions to problems, especially in B2B marketing (see Section 2.1). This is the main difference between strongly pushing a product onto a saturated market, and reading and interpreting the customer’s wishes

and offering the appropriate solutions; you may decide what strategy is more successful. If the customer is satisfied with the solution offered, profit comes.

The conclusion is that the total organization must reflect a customer-oriented design. This is a real challenge, especially to hierarchically organized systems. It is not only a question of speed in so far as many companies react slowly and therefore fail. Many organization structures in firms are built around products and do not reflect workflow processes. Unfortunately managers seldom think that marketing strategies can be only effective if backed by an appropriate organization structure. Appropriate does not mean a universally valid structure but an individually designed one.

The product outlets are connected with both the strategic positioning and the organization of the distribution system. There are several possibilities to design the outlets. A company can build and maintain their own distribution network or leave it to a wholesaler. The decision variables are financially or marketing driven. It can be more cost-effective to outsource the distribution, with the loss of direct customer contact however. Entering a foreign market is a risky enterprise and therefore, as a first step, an outlet through a locally commissioned agent may be advisable. A second step could be a sales office or a joint venture with the agent, and eventually a complete foreign production unit.

The market occupants and the objects of marketing efforts have to be analyzed long before a product is designed. This is the only procedure which is worthy of being called a strategy; the inverse procedure is called wishful thinking and hope. A common mistake is to think that products will be developed in laboratories under strict secrecy in order to outpace competition and then presented on the market with a big bang. The real big bang is often the surprise that customers do not accept the product. The implementation of a company's market strategies and their products would be much easier, and most probably more successful, if customers had been interviewed first. An even better implementation would be possible if the secretive developers could overcome their own natures and involve the potential customers in the earlier stages of design. The Japanese automotive makers have used this strategy on European markets together with target costing; their overwhelming success is clearly visible.

Individual occasions have more a tactical aspect than a strategic one. However, in the background measures can be implemented to provide sufficient resources and necessary flexibility to react immediately to the marketing occasions as needed. This requires growth and maintenance of marketing potential in order to outpace a competitor in tactical operation.

1.10 Two Marketing Assistants for the Engineer

Here, some key elements of the marketing terminology are condensed in the form a periodic table (with apologies to Mendeleev and Meyer) in order to fix it in an engineer’s or scientist’s memory. Figure 1-9 shows the basics already mentioned and a few other terms to be covered in Chapter 2.

| | | | | | | | |
|--------------|-----------|----------------|-------------|-----------|-----------|----------|--------------|
| Organization | | | | | | | Company |
| Objectives | | | | | | | Individual |
| Outlets | Attention | Identification | Customers | Price | Style | Benefit | Employees |
| Occupants | Interest | Segmentation | Channels | Product | Skills | Image | Authorities |
| Objects | Desire | Targeting | Competitors | Place | Staff | Rights | Shareholders |
| Occasions | Action | Positioning | Company | Promotion | Structure | Services | Stakeholders |

Figure 1-9 The main group elements in marketing

A further comprehensive approach is the engineer’s or scientist’s “marketing benzene” (Figure 1-10), which contains the most important principles in marketing. In the center are the six “ π -electrons”, of which four are already known to us. The additional two Ps introduce People and Politics into the marketing mix. In future, the idea of the individual as the target of all marketing efforts will gain more importance. This is fully the trend in electronic (e-) commerce and how the individual approaches potential customers. Politics will become increasingly important for branches and categories of goods when analyzing the business environment (such as PVC or biotechnology). The corona of “hydrogen atoms” of the benzene ring asks the necessary questions in order to develop a comprehensive marketing strategy, represented by the six “carbon atoms”.

When do we have the best occasions?
What objects are our targets ?
Where are the product outlets?
Who are the market occupants?
Why do we chose these objectives?
Which form of organization seems to be the best?

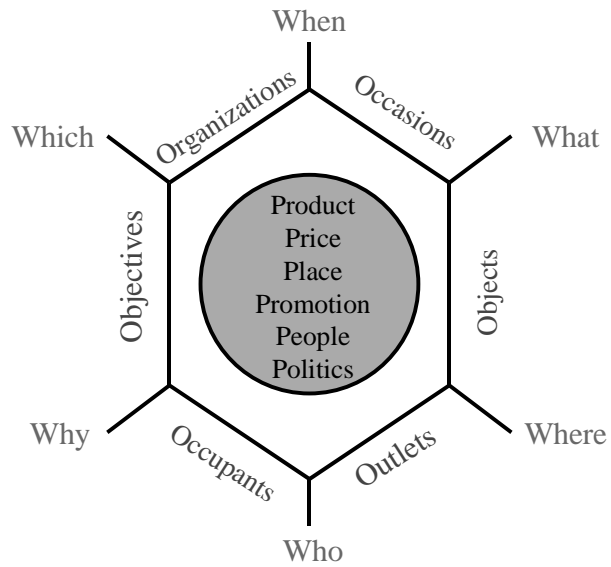


Figure 1-10 Marketing principles for engineers and scientists

2 The Principles of Business-to-Business Marketing

2.1 Definitions

There is no uniform term used for what is meant with the special part of marketing dealing with transactions between industries. Sometimes the word “industrial marketing” is used, or “marketing of investment goods”, or even “production marketing”. As all these terms are not clearly distinguished, it seems to be better using only the term “business-to-business marketing” (B2B) herein. This shall comprise everything that does not belong to the area of consumer marketing, that is, marketing transactions where only organizations, rather than individuals, are involved. Organizations are production companies, sales organizations, private and public institutions, and other legal entities. This definition is kept purposely fuzzy. However, this definition has the advantage in that overlapping areas, especially with service marketing, are included. Today, service is regarded as an integrated and competitive factor of any industrial product, and therefore the other disciplines in economic science, service, and consumer marketing are covered as required.

As scientists and engineers are normally patient people, I dare add a second definition—the last in this Chapter—and define what a “product” is according to marketing requirements. Let us take a short look at a general chemical product and analyze its structure without however using chemical formulas. We will learn that in a first level of analysis the product is composed of a physical and a nonphysical part (see Figure 2-1). The former can be a chemical compound, equipment, or even a whole production plant, while the latter, the intangible one, can be further divided into the connected services and certain legal rights and obligations. In some cases, even a third part, a virtual one, exists, namely a company’s reputation or brand name. The equivalent in consumer marketing is called the product’s “image”. Although this part of the product is virtual, it touches your wallet in a very realistic way when you buy it. For luxury goods, one pays a premium price for the brand name. Sometimes the producer tries to make this intangible part visible through a logo, a commercial trade mark.

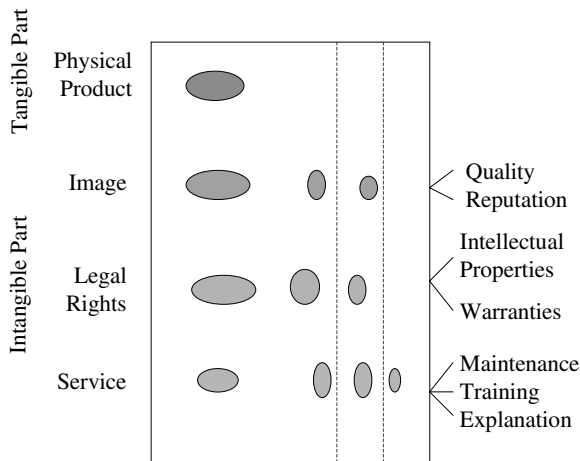


Figure 2-1 A product's "marketing chromatogram"

These definitions are also different from those for other marketing areas. Fundamental differences between business-to-business marketing and consumer marketing can be easily recognized. There are certainly no discount prices when a customer orders an additional hydrocarbon-cracking plant according to a common consumer marketing device of "Take three—pay for two", while a customer cannot purchase a batch of potassium cyanide from any local shop. The products, especially in the chemical industries, and the associated market structures are very different from a more usual consumer and service marketing. The communication channels, such as advertising, are also completely different: No bikini-clad beauty tells you to buy diallylphthalate right now.

2.2 Differentiation from other Marketing Areas

As already mentioned, in B2B marketing there are many factors which differ from consumer and service marketing, in spite of the fact that they may be also a component of industrial marketing. The main differences, beside the market structures covered in Chapter 3, are in the:

- nature of products
- nature of customers
- buying behavior
- transaction channels
- communication
- price policy

The following factors shall be examined in more detail and some key factors for B2B marketing success will be outlined. A better understanding will be achieved when the general business environment is described. In comparison to consumer marketing, we have in B2B marketing fewer suppliers and customers. In some cases, they are even concentrated into specific geographical areas. Consequently, fighting for industrial customers is much tougher than for numerous consumer clients. Sometimes, for the cases of the aviation industry or car manufacturers, there may only be a few customers within an entire country. The extreme case is also possible, where one customer—the State—exists. In the above-mentioned cases, we have oligopolistic and monopolistic market structures, respectively, from the buyers perspective. The sellers, of course, can also develop such structures. However, the antitrust authorities continuously observe and intervene in cases where they feel such a danger exists for the free market. Nevertheless cartels still exist in the world, and DeBeers still dominates the diamond market with its Central Selling Organization (CSO), which, contrary to all economic theories, has guaranteed relatively stable market prices for diamonds. In the consumer market, oligopolistic structures are effectively impossible because there are too many producers and millions of customers representing the market forces.

Another important difference from the consumer market can be seen: The market segmentation in B2B is much more distinct. Market segmentation (recall Figure 1-3) means that the total market of all potential consumers is subdivided into smaller groups with more or less homogeneous tastes or needs. Segmentation is one of the most important tools in marketing because it allows the marketer to focus their efforts and dedicate resources to smaller target groups. If the marketer meets the customer's requirements and needs more precisely, the probability of success is much higher and money for public relations can be saved. In industry, the segmentation must be higher because the requirements often cannot be met by universal standardized products but instead by products specifically designed for the customer. The buying motive also is not subject of taste or fashion but governed by technical and economic reasons.

2.2.1 The Nature of Products

In contrast to consumer products, industrial products or services often are very complex in nature. Consumer products are normally standardized and may fall under the control of official authorities. One cannot sell food without a license, and strict hygiene regulations exist for the products and the people selling them. Automotive manufacturers, as another example, present at first a model and later receive a series approval for this type of vehicle, which is only then offered to their customers. Standardization in production is a prerequisite for economies of scale. Fabrication in large quantities reduces the production costs and makes goods available at a relatively low price. Producers who realize economies of scale can hold a strong competitive advantage.

For many industrial products this is not the case. Many products are especially designed for a customer and thereby unique or at least represent a modified version of a basic model. This can be found in chemical engineering and plant manufacturer's businesses. Plants and equipment are built according to the customer's specifications. Chemical products themselves are of course "standardized" in a certain sense by their composition. A chemical producer will present a sample of material and then specify for the customer the physical properties, such as purity or particle size. In many cases, however, chemical products are produced in much smaller quantities than consumer products or made on request. Customers also sometimes ask for special forms, as powders, tablets, or solutions for example.

The users of the products and substances do not always possess sufficient experience to handle the material and may need additional explanation or even training. Therefore, the marketing components "explanation and service" may be substantial. Due to the risk connected with the handling of toxic, inflammable, or otherwise hazardous materials, it becomes immediately evident that there is a significant difference to consumer products. This additional intangible part of the product has to be paid by the customer and represents an important competitive advantage for the producer—often the only one. In a strongly competitive situation where production prices are about the same, these additions are decisive elements of success or failure. In this connection, the recycling services also have to be mentioned. The trend in Western countries is progressing to a legally obligatory closed-loop system, forcing companies to offer this kind of service.

In chemical engineering the "product" may be, for example, a refinery plant. However, the product also comprises training the staff and the start-up of the plant as an important element of the contract. Therefore one speaks of "turnkey" operations: The project has been completed only when the plant has been tested, the staff trained to run it, and regular operation can commence.

Very complex specialty products are pharmaceuticals and biochemicals. Here extremely strong regulations exist before a product is allowed to be sold. In the pharmaceutical industry, the entire testing procedure before approval sometimes costs as much as the development itself. In addition, only licensed people are

allowed to handle them, such as scientists, doctors, and pharmacologists. For safety reasons these products also are only submitted in controlled quantities to the users.

In the literature of B2B marketing, there are three classes of goods, to which a fourth, scientific services, will be added.

- products
- systems
- manufacturing plants
- scientific services

Each of the different classes has distinct characteristics. By “products” I mean goods like soda, isopropyl alcohol, unsaturated polyesters, and so forth, which may be commodities but also fine chemicals. Both types can be sold as standardized compounds (physical and chemical properties exactly defined). The customers use them for further processing, while for some applications additional service may be needed. Other chemicals certainly can be sold only with the usual product data and safety sheets. The customers buy the product and have no further relationship with the producer; if the customers are content with the quality, price, and delivery time, they will place another new order in future as repeated purchase without modifications to the terms of delivery, otherwise they shift to a new supplier without difficulties. As the product is standardized, quality is regarded as self-evident and not an element of differentiation in competition. Competition takes place in terms of delivery time and strongly by price. Due to the high pressure on commodity prices in the market, the producer is normally reluctant to offer additional and costly service. Furthermore, prices fluctuate and correlate more or less to the prices of crude oil and its derivatives. An exception to this rule can be observed in the field of fine chemicals, where the achievable purity, for example, of the substances represent a decisive element of competition and may be copied only with difficulty by other producers, such as in the cases of ultra-high purity chemicals for chip production or spectroscopy. Nevertheless, such products are normally manufactured by several competitors and the user can change the supplier without major difficulties.

Systems refer to a combination of products and services, representing a whole family of goods with a mutual relationship. Systems usually are subject to continual development, modification, and expansion; an outstanding example is in computer software. In chemistry an analogous example is analytical hardware together with high-purity diagnostic chemicals. The equipment is calibrated and in practice runs optimally only with chemicals from a certain producer. Of course training and service (maintenance, repair, and a service hotline) are requested by the customer. Normally the customer buys a package of the product and service together. Of utmost importance for competition therefore is the competence of the producer, the function of the service, and the ability to keep pace with the latest technology. Once again, quality is a must and not a competitive advantage. The confidence of a customer in the supplier’s potential therefore is decisive. When the supplier satisfies their customers, subsequent sales and upgrades will generate additional profit.

The difference with normal products now become evident. For marketing simple standardized products, in which producers may be easily substituted, the dependence

of the customers on the supplier after buying a system is stronger. Without the supplier's service, a permanently functioning system cannot be expected. If the customer is unsatisfied with the product or service, it will be costly to change the supplier because a whole new system must be bought. Only in the case that the supplier offers open systems, in which products of a competitor are compatible with his or her own equipment, is the customer better off. The market participants therefore try to pressure the producers to open their systems, however that is not in the interest of the producers themselves. By this method, large computer companies have achieved a practically oligopolistic market structure.

The highest degree in complexity is connected with the construction of manufacturing plants, which will be described in more detail in Chapter 5. Usually a customer orders such a plant once. Nevertheless the customer has to consider that all equipment has a limited physical lifetime, either due to technological progress or demands of modernization. The experience of the supplier and the list of references from similar projects is important for gaining an order. The extremely high investment forces the purchaser to minimize their risk. Newcomers in the business of construction and installation of plants unfortunately have very little chance and therefore only big consortia are on the market. For this kind of "product", it is important that the offering company has the appropriate capacity for project management, and can coordinate a hundreds of secondary suppliers and complete the plant within the time and budget framework.

Research and testing becomes more and more expensive because research staff and laboratory equipment are cost-driving factors. Smaller companies, as well as private and public institutions (such as in healthcare), tend to outsource these tasks either partially or totally. The nature of scientific industrial services also has certain specific characteristics. Beside offering scientific consulting, a company has to demonstrate that it has sufficient potential to meet the customer's requirements, which in turn means the most modern analytical equipment, best educated scientists, and sufficient capacity. Timely and precise results are the competitive elements. In the case of a laboratory, high overheads means remaining on standby is costly and the laboratory is profitable only as an ongoing business. In the case of contract research, intensive communication with the customer is a necessary and key factor for success. For the categories mentioned above, the position lies somewhere between a product business and a system business—the client has no longer a binding relation to the service provider after the task is completed and they can change to another laboratory, while in the case of contract research, an interruption causes considerable time and money losses. The nature of the different categories of products therefore is connected with different degrees of risk in which a client is involved (see Figure 2-2).

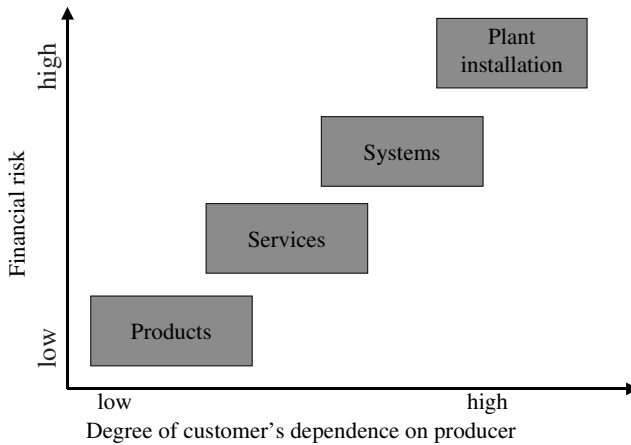


Figure 2-2 The customer's risk

Deviating from the usual marketing literature, we therefore add a fourth category of goods—scientific services. Branches with a strong scientific background heavily depend on research and development activities. The shortening of product lifecycles and the acceleration of technology steps increasingly makes efficient research and development (R&D) a question of survival in international competition. However, shorter product lifecycles simultaneously mean shorter amortization periods and therefore smaller profit margins, but on the other hand R&D becomes more expensive. The outcome is that even big and especially medium-sized companies find it difficult to afford the rising R&D costs and, for this reason, R&D activities will be at least partly outsourced or performed in collaboration with other firms as a joint research program or with independent research institutes. R&D as a service function will strongly increase in future and therefore represent a new form of “goods”. Research implies unforeseeable results, if any at all, and is connected with high financial risk. Development is based more on existing findings but also involves risk. Therefore, similar characteristics can be found as in the category of systems and manufacturing plants. For a customer, it is not possible to switch from one supplier of scientific results to another one without significant time and money losses. A careful selection of the collaboration partner is clearly decisive.

2.2.2 The Nature of Customers

Unlike average consumers, customers in industry are much more aware of risk and more careful when buying. In the previous section we regarded industrial goods

more from the producer's side. However, the view of the customer is different. There is another distinction by which products can be classified in B2B marketing which is important to mention:

- inspectable goods
- experiential goods
- confidence goods
- virtual goods

According to Figure 2-1, we can split goods into tangible and intangible parts. The tangible, physical product in most cases can be inspected or even tested against a previously delivered sample. Especially when the product is tailor made for one customer only, comparative sampling and testing is necessary; for the customer then afterwards there is only a little risk.

Experiential goods are intangible goods which cannot be tested before an order is given by the customer. Contract research or laboratory testing falls into this category, as does plant manufacturing. The reputation and the company's record in the market is the only real indicator when a client has to make a choice between several competitors. Only afterwards, when the product or service has been delivered, can the client work with the machines, the plant, or use the research results. Considerations on price alone, as the most important decision criterion, is very dangerous. The customer relies on the experience of others or their own in providing a subsequent order.

Confidence goods, in contrast, cannot be judged or tested neither before nor after the order. Life insurance is an example, since the policy owner does not benefit from the insurance payment. In industrial businesses, however, there are less macabre examples. Maintenance of machinery, plants, and equipment normally cannot be judged. One has to trust the performing company that it had worked well. Only a breakdown or an accident may expose shortcomings, and it still need be proved that insufficient or poor maintenance were responsible. Rights, patents, or licensing are also confidence goods. A buyer must trust the seller and hope that a patent has the promised intrinsic value and that it will create profits; furthermore the value of these rights cannot be calculated exactly, only estimated.

Virtual goods, as a new category in this connection, designates skill and experience in its most general form. In technology and science especially are these attributes of utmost importance but their application to markets should not be underestimated. It represents a form of potential, of market power, and possible future value. There is a significant difference to the categories mentioned above. The first three examples represent activities that have been performed in the past. A virtual product is defined as a product in future that could yet be realized. A second difference arises in the way that the virtual product is inevitably connected to individuals: It only exists in their heads. The other three types of products or activities, once performed, are separated from their originator and continue to exist with all their consequences. Nevertheless, sometimes huge sums of money are paid for virtual products, such as for potential market power. Money for individuals as employees is paid in exchange for their skills. To companies it is paid as the

intangible asset goodwill, a premium paid in addition to the physical aspects of a company as a part of the price of a takeover. It is certain that the importance of virtual products, in connection with increased self-employment and part-time jobs, will considerably increase in future.

The nature of the customers has been described above under the consideration of purchasing risks. In contrast to consumer markets, industrial buyers are much more rational, involve more people, and normally buying is a process rather than a spontaneous decision. The purchasing department contributes in a significant way to the company's overall financial result. Therefore the sourcing policy is of considerable importance and also a part of the corporate strategy.

2.2.3 The Transaction Channels

The term transaction channels shall designate all marketing and logistic activities to exchange goods or services. It makes little sense to put too much emphasis on the distinction between distribution and sourcing channels because it is more or less the same, only regarded from different points. Transaction channels in consumer marketing are widespread, in order to reach all inhabitants of a region, a country, or even supranational areas. These complex logistic tasks need a sophisticated system of distribution levels, from the producer to a major distribution company, wholesalers, and the retailers. Between these agents, transport agents form the links of the chain. The availability of practically anything at any time represents a significant part of the final price of consumer goods. Whether to distribute merchandise from a central store or geographically decentralized stores is also a question of costs and services offered.

In comparison, the network of transaction channels in B2B marketing is less dense and the contact between seller and buyer is more direct. There are no or only a few intermediates, and sometimes companies even have their own transportation fleet. This sometimes happens when the transport of chemical substances needs special experience or transport vehicles. Furthermore, it is obvious that tailor-made products cannot be made when too many intermediates stand between producer and customer: There must be direct communication. For commodities and standardized products, where no additional service is necessary, outside distributors may be useful if there is a cost advantage for the producer, otherwise producers can go directly to the customers. A special situation arises when goods are transported in pipelines, such as industrial gases or oil.

In B2B marketing, in contrast to consumer goods, the delivery method is different and subject to negotiation. While consumer goods normally are bought in shops or ordered and delivered by a parcel service, for industry special packaging, transportation, and insurance can be costly and is not included in the final price. In order to avoid misunderstanding and later quarrels, the terms of delivery have to be specified beforehand. For this reason the most common terms of transport and delivery have been standardized by the International Chamber of Commerce in

1990. A selection of thirteen International Commercial Terms, “Incoterms”, are listed with their definitions in Table 2-1.

Table 2-1 Examples of Incoterms

| Abbreviation | Full Text | Definition |
|--------------|--------------------------|-----------------------------------------------------------------------------------------------|
| EXW | Ex-works | The producer makes the product ready for collection by the customer from the plant |
| FOB | Free on board | Free delivery to loading the ship; the main transportation costs are not paid by the producer |
| CIF | Cost, insurance, freight | Main transportation costs are paid by the producer plus the insurance fee |
| DDP | Delivered, duty, paid | The seller carries all costs until the goods arrive at the destination |

Finally, the manner of transportation plays, at least in the chemical industry, an important role. As already mentioned, chemical and pharmaceutical products form an exception in industrial goods, and not only due to their possibly toxic or dangerous characters. For pharmaceuticals, for example, the distributor or producer has to guarantee a very high degree of service because the consequences of a hospital dispensary running out of a certain drug due to late supply are severe. Of course, this drives the costs of pharmaceuticals up because a functioning logistic network has to be paid. Furthermore, pharmaceuticals are subject to strong prescriptions and regulations, and only authorized persons are admitted.

The transportation of chemical substances is, in contrast to other industry branches and of course to consumer goods, subject of numerous regulations and laws. Due to the specific nature of chemical products, special precautions have to be made and are obligatory by national and international law. Details can be read in the “Orange Book”, a publication of the United Nations with the title “Recommendations Prepared by the Committee of Experts on the Transport of Dangerous Goods”. Table 2-2 lists the most important international institutions dealing with questions of transportation.

Table 2-2 International organizations for the standardization of transports of hazardous goods

| Organization | | Location |
|--------------|--------------------------------------------------------|------------|
| ICAO | International Civil Aviation Organization | Montreal |
| IATA | International Air Transport Association | Geneva |
| IMO | International Maritime Organization | London |
| CCNR | Commission Central pour la Navigation du Rhin | Strasbourg |
| ITC | Inland Transport Committee | Geneva |
| OCTI | Office Central de Transport Internationaux par Chemins | Bern |
| IAEA | International Atomic Energy Agency | Vienna |

The products themselves are described according to seven different properties and grouped into nine risk classes. The properties are:

- explosive
- inflammable
- fire supporting
- poisonous
- radioactive
- caustic
- infectious

The classification of substances is shown in Table 2-3.

Table 2-3 Classification of hazardous goods

| Class No. | Content | Status |
|-----------|---------------------------------------------------------------|--------|
| 1 | Explosives and products containing explosives | Only |
| 2 | Gases | Free |
| 3 | Inflammable substances | Free |
| 4.1 | Inflammable solid substances | Free |
| 4.2 | Self-igniting substances | Free |
| 4.3 | Substances developing inflammable gases in contact with water | Free |
| 5.1 | Oxidizing agents | Free |
| 5.2 | Organic peroxides | Free |
| 6.1 | Poisonous substances | Free |
| 6.2 | Infectious substances | Free |
| 7 | Radioactive substances | Only |
| 8 | Caustic substances | Free |
| 9 | Different dangerous substances and items | Free |

The status "Only" means that only these substances are admitted for transportation and the listing of substances is definitive. To the classes designated "Free" other substances may be added.

It should be pointed out that for chemical and pharmaceutical products a considerable part of the value chain is—in contrast to other industry branches—dedicated to the distribution and transportation services.

In the marketing literature, the sales chapter in most cases ends with distribution. Only very seldom is the term redistribution used; the authors obviously consider that the marketing job is done after selling. However, and especially in the modern chemical industry, redistribution in the sense of recycling and waste management is of utmost importance, a strong argument in competition, and an important element in the value chain (see Figure 2-3).

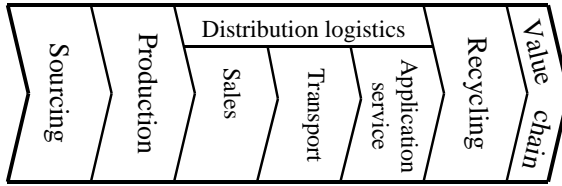


Figure 2-3 The value chain in the chemical industry

Consumer goods need their packaging recollected, in turn the subject of numerous laws. Together with transaction channels in the chemical and pharmaceutical industry, the return path therefore comes into discussion. The returning products can be the original ones as distributed, only partly used lots, or converted products, residues, and waste. When pharmaceuticals have exceeded their shelf life or their packaging is damaged, they have to be returned and destroyed for safety reasons. Any waste produced by chemical reactions may be intractable for the transforming company itself because the knowledge and the equipment is not available. Therefore the substances are collected by waste management companies or recovered by the producer and treated as necessary. Principally, distribution should be regarded only as a part of a cycle and not as a one-way process. In the same manner as the intermediate steps (wholesalers, retailers, forwarders, and so forth) are regarded for distribution, the equivalents for waste transport and management have to be considered.

From the buyer's side, it is important whether purchases are centralized or decentralized to subunits of the company. Advantages and disadvantages of (de)centralization are closely linked. Concentrating all buying activities in one place allows also a concentration of experience and provides a good market overview, as well as providing more buying power if orders can be bundled into large quantities and discount prices negotiated. On the other hand, if the products needed by some department are very specific and the local engineers know better what they want or when experts must be involved in the buying process, a decentralized method is preferable.

The transaction channels in B2B marketing contain four logistical flows, which are the flow of goods from the producer directly to the user or through an intermediate, the inverse flow of payments, the reciprocal flow of information on applications, and, often in conjunction with the latter, an exchange of technical experts. Figure 2-4 demonstrates these flows.

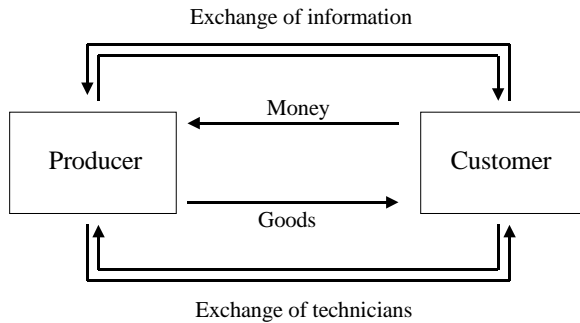


Figure 2-4 Transaction channels

2.2.4 Communication

The goal of a company's communication process is initially to make a product or service known in the market, to provide the necessary information, and then to encourage the potential customers to sample the product. The second goal is to nurture the client's familiarity with the product and, should that the product satisfy, to foster their loyalty. This process necessitates an intense communication between client and supplier. In consumer marketing, there is only a one-way communication from the seller to the consumer, and the kind of information is of a quite different nature. Whereas the "message" in consumer marketing mostly is based on an emotional and psychological level, in B2B marketing arguments are much more rational and contain factual information, as the possibility for emotional influence is very limited. Another difference is that in industry a personal approach is vital; the few exceptions where no people are involved typically involve repeated sales of the same item, which can be managed automatically by an electronic order. A longer-lasting business relationship between producer and client is a prerequisite. As there is, in most cases, only a very limited possibility for differentiation in quality or price (it is assumed that low-quality products will eventually disappear from the market), the decision is governed by delivery time and service. There should be no doubt that for some producers and industry branches these developments are most threatening. On the other hand, new business chances for commodity brokers in e-commerce will arise.

Communication is achieved in several channels: Beside personal selling, there is a mass of written documentation, such as brochures, data sheets, company journals, publications in scientific journals, and electronic mail. There is no doubt that virtual marketplaces and electronic commerce will rapidly increase in importance. However concerning B2B marketing, such virtual environments will most probably be restricted to market research and the physical exchange of commodities (standardized products). The London Metal Exchange is an example of such an existing forum, and the German Metallgesellschaft has just established a new electronic trading system. When competition further increases, the margins will be driven to the limit of profitability because the competitor is only a mouse-click away. However, concerning e-commerce, there will be a secondary kind of communication between users and clients. A chat forum allows customers to exchange their experiences with special products. Modern enterprises use these new possibilities and can establish such a chat forum in order to gain additional information. In this way a company's reputation rapidly spreads among clients—hopefully in a positive way.

Again, the instrument of communication can be regulated by law for special products. On one hand there are certain obligatory pieces of information, such as safety sheets for hazardous products; on the other, certain media are not allowed for publication. There is, for example, no public-relations campaign for ethically developed drugs in the daily newspaper, only in scientific publications.

Furthermore, an important element are seminars, congresses, and fairs. Oral communication has the advantage that delegates of the companies are present and can make direct contact immediately, which is why companies spend a lot of money in sponsoring these events. From the buyer's side, visiting congresses can be more cost effective than long-term market research.

Beside the task to make a product known in the market, all communication processes have also the goal to achieve an enduring customer loyalty. This makes a continuous communication process necessary. An approximate guide suggests that it costs about four- to five-fold more to gain and convince a new customer than to keep an old one. The marketer's ultimate goal therefore is to create a unique selling position (USP), essentially to create a brand name as a symbol for quality and service. This USP practically forms a benchmark and is one of the best arguments for a buying decision. In B2B marketing a good example for a USP is Michelin's "Bibendum", the little figure formed from tires.

However, communication about the product alone is not sufficient. For the chemical, pharmaceutical, and biotechnological industries, communication with the public is of decisive importance more than for other branches. The acceptance of new technologies and its connected risks to the population has very strong impact on political decision makers. In the past, unfortunately, these industry branches have neglected to efficiently communicate with the public. As a result, strong opposition arose in some countries against these industries and technologies. Furthermore, handling hazardous substances—in spite of all precautions—sooner or later leads to accidents, fortunately seldom to really big ones. But also in this critical case, honest and trustworthy public relations (PR) is of utmost importance. Companies which have their "lesson learnt" have meanwhile developed a code of honesty and fixed

special behavioral procedures for emergency cases. This seems to be more an indirect way of marketing, because it obviously is not directed to any sales, but it is nevertheless a necessary one.

Efficient PR helps to communicate a company’s mission and culture to the public. Modern companies are increasingly asked for what they stand. Management has to give answers to why a company follows certain research stream and what would be the benefits. There are examples of excellent PR work, in which for example Bayer’s “green leaf label” fixed its position in people’s mind as a sign for environmentally friendly plant protection. Another example for excellent PR is the Hoechst magazine “Future”, communicating Hoechst’s new lifestyle concepts and corporate culture, or even broadcasting on local TV, as BASF does.

Other tasks of PR are dedicated to suppliers, banks, shareholders, and public authorities. All these stakeholders have different interests but have to be supplied with information about the enterprise and their important products. Investor banks closely follow research by the pharmaceutical companies. For investors it is important to know if promising drugs are in pipeline or costly flops will reduce the shareholder value. The Swiss Vontobel Bank analyzes in their equity research group the chemical and pharmaceutical industries to provide their clients with valuable hints on where to invest. Especially for young firms, it is important to gain and maintain the confidence of their shareholders.

The communication process mainly goes into two different directions, similar to a mirror image. The process focuses on stakeholders, shareholders, and public authorities on one side and to the companies and individuals as direct or indirect users on the other (Figure 2-5).

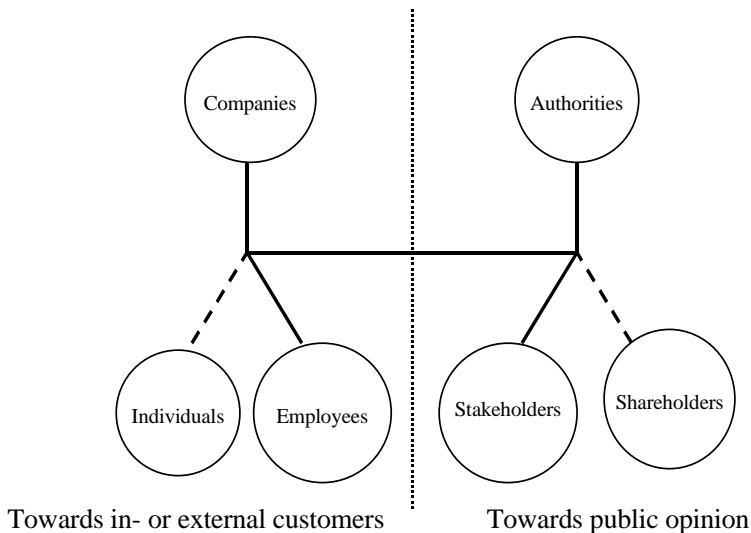


Figure 2-5 Communication processes

2.2.5 Price Policy

For consumer goods, prices are known to everybody. Prices and differences are presented in numerous journals, newspapers, and TV. In shops, prices must be indicated for every item and prices may even be indicated twice, for both the quantity packed and per unit mass, in order to facilitate comparisons. Once fixed by the shop manager, prices for standard products are not negotiable. PR campaigns sometimes outline discount prices to stimulate sales.

In industry, price policy follows an contrary path: Normally there are no price labels on the products. Prices are a matter of negotiation and a complex system of deductions, rebate systems, or payment conditions make direct comparisons difficult or even impossible. Whereas in consumer markets prices follow directly a function of the elasticity of demand, in industrial markets prices refer to derived demand. That means the B2B market also serves the production of consumer goods but only indirectly. Therefore prices also show a different behavior, and the range of price differences in the market sometimes may be smoother than in consumer markets. Corrections by market forces to the prices of industrial goods therefore happen later than for consumer goods. Sometimes prices are subject of (mostly prohibited) agreements between market participants. In addition, prices were often fixed earlier for long-term contracts and cannot be adjusted immediately when changes in the market occur. The supplier adheres to the price, at least when no sliding scale has been agreed upon.

There are some principal methodologies in finding a price. At first, a company has to fix their product strategy and determine in which market segment it wants to be present; the main alternatives are the low-price discount segment or the high-price premium segment. Of course all grades between the two extreme positions are also possible, albeit with certain restrictions. A third possibility arises with the “as well as policy”, a hybrid market approach. It is evident that high prices can only be achieved with a corresponding quality and service and that discount prices cannot justify extraordinary service. Nevertheless in all segments strong competition is expected and a company has to determine its price policy. The process of finding a price can be done in different ways.

- by estimation
- by comparison
- by calculation

The first method, often used by small firms without any market research, is very risky and requires extensive market experience by the estimator. The second at least considers the competitors and focuses on a price in the statistical middle range of all competitors. It is risky as well because it does not reflect the company’s own cost structure. The third method seems to be exact because it is based on calculation. However, this security is only superficial because in cost accounting every desired result can be achieved by “exact” calculation only by modifying the operation assumptions. As the economist’s saying goes, “There is nothing a controller cannot

immediately identify as unprofitable". For the same product, there are significantly different prices, whether one chooses the method of direct costing, full costing, contribution margin, or modern methods of target costing and activity-based costing. The answer to the question, which method should be used, is that it depends—from the market, the production process, or the business policy. A turnkey operation in engineering has to cover the full cost of the project because normally there is no follow-up business in the near future. The first bid for a chemical substance, however, can be nearer to the manufacturer's cost if a promising new customer can be gained with further future buying potential.

In some cases prices are already given by the client. Public institutions especially work with a fixed set of regulations for purchases. In an invitation for bids, companies are asked to hand over a formalized offer and indicate price and service. Due to often very limited public budgets, the cheapest firm usually gets the order. An alternative situation arises when a community publishes the price it is willing to pay as a maximum limit and asks for the corresponding product package and service; here the firm with the most comprehensive service and rebate systems will succeed. Sometimes the formalistic procedure of bidding may be tiresome and not very profitable for a company.

Price is the most flexible tool in marketing. It can (and must) be changed in time without difficulty. In practice, prices differ greatly in the course of time and are not at all fixed. This is true for all marketing areas, and I except only the diamond market governed by the quasi-monopolistic DeBeers holding, which has kept the price of diamonds relatively unaffected by the markets for several decades. The price, as a part of the marketing mix, allows for different strategies on how to enter a market and how to find the right price.

There are a two main possibilities of price policies, short- and long-term policies, each with several subgoals.

- short term policies: maximization of profit
 maximization of turnover
 skimming strategies

- long term policies: market penetration
 quality and service leadership
 cost leadership

Maximization of the profit, cash flow, or return of investment seems to be the most attractive way to do business. This policy depends on the kind of business branch and product. If there is no follow-up in the business and if full-cost calculation is a must, in this case it can be advisable to price near to the maximum. However, in most other cases it can be a very short-sighted policy. A customer, even if not dissatisfied with the product, probably will try to find a cheaper supplier in future, which creates difficulties for sales people trying to create a loyal clientele and increase market share.

The turnover as criterion can be taken in the case of complex cost accounting, for example in joint developments where an exact division of cost between the partners

is difficult. For reasons of simplicity, the turnover is the goal and measurement of success. A boost to sales figures can also be motivated by a planned sale of the whole business in order to impress a future buyer or to gain additional funds during the internal budgeting process.

A very sophisticated strategy is “skimming”, where a company tries to achieve the highest possible price in comparison to competitors. They estimate the highest price a customer is still willing to pay in comparison of the total value of a product with the competitor’s product. Only when sales slow will the price be reduced. This strategy can be successfully applied by high-technology companies, which possess a technological leadership with a certain product. It is reported that DuPont followed such a strategy with their outstandingly innovative fibers, such as nylon, kevlar, and the teflon resins, and only when competition arose on the market or cheaper substitutes for the same application became available did their prices decrease. Companies with very innovative products have for a limited time the status of a quasi-monopoly and can therefore follow such a policy. However, this policy works only under some specific conditions. First, the product must really have extraordinary properties which can overcome an urgent problem of the users. Second, the technology of production must be very complex and associated with significant investment, otherwise competitors will become attracted and try to establish their own products. Third, there are a sufficient number of users and the high profit margins are, in total, sufficient to cover the cost.

Market penetration is a classical approach to develop a market in the long term with low prices at the beginning. Of course that does not mean dumping prices, which is not allowed. The reflection behind this strategy is that a customer, once convinced and satisfied, tends to remain with the product. However, this is not always true in consumer markets. Furthermore, a satisfied client is more loyal to the supplier. A company which arrives as the first supplier of an innovation on the market can gain, in combination with excellent service, important and attractive customers as trendsetters. Other potential competitors arriving later encounter these contented customers already “occupied” and find it difficult to convince them to change.

Quality leadership means that prices are in the price/quality relationship in the premium and luxury segment: High quality is not available at discount prices. However, high profit margins can only be achieved when the fact and impression of quality is efficiently communicated to the customer. The mere fact that quality is produced is insufficient. The best way to communicate quality is a trade mark, such as Merck’s “p.a.” label. Contemporary total quality concepts make it ever more difficult to convince a customer to pay a premium for extraordinary quality. Quality is a prerequisite and less a tool for differentiation. Service leadership, especially in combination with outstanding quality is a more suitable support for the price policy. The more complex a product is, the more urgently customers need service. For this service they are prepared to pay a significant premium.

Cost leadership can be achieved by economies of scale. Economies of scale means that, following a learning curve, a substance can be produced at a lower price with increasing process experience. Furthermore producers assume that by increasing the sales volume over the long term they will—in spite of low prices—create sufficient

profit. This policy works when the market is rather price sensitive, such as for inorganic or organic fine chemicals. In addition, very low prices have a similar effect as very high prices: Possible competitors find this market segment unattractive as they may not realize the same economies of scale and produce at lowest cost, thereby providing too low a profit margin or an unfavorable internal cost structure. There seems to be some kind of formula for profitability, either high margins and low volume or low margins and high volume (Figure 2-6).

$$\frac{\left(\text{High margins} \right) \left(\text{Low volume} \right)}{\left(\text{Low margins} \right) \left(\text{High volume} \right)} = \text{Constant}$$

Figure 2-6 Volume-price relationship

As shown in Figure 2-7, there is a barrier between the low- and high-price regions, whereas a shift from short- to long-term policies is possible. This is obvious because a low-price product cannot be elevated in price without any significant improvement, which in turn would cause additional production costs. Cases of unexpected shortage on the market shall not be considered in this connection. However, it is always possible to switch from a short- to a long-term policy, as indicated for both price levels.

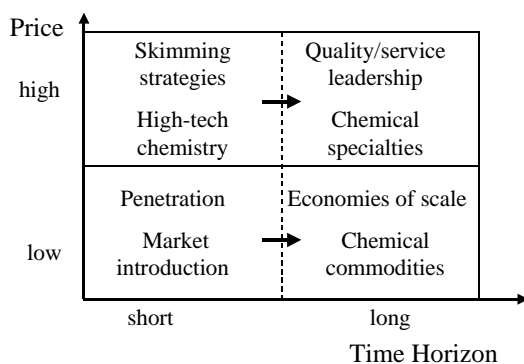


Figure 2-7 Price policies

Another fact in price policy should not be neglected. Due to different economic developments of countries in international business, different prices can be necessary. This means an expansion of the price policy to include geographical and political considerations. Big differences, however, may lead to reimports from nations with low prices to countries with high prices (Section 3.4), which can cause problems in the home market and make price policies obsolete.

2.3 Buying Behavior

In comparison to consumer markets, in industry the motive for buying is quite different (compare Table 2.4). Goods in industry are purchased only when needed for production immediately or in the near future. For speculative reasons however, certain goods are also bought in advance and stored; these goods are usually expensive and subject to major price fluctuations on the world markets. Typical examples are precious metals for catalysts, important alloying metals, or oil-based products. It is not necessary that these products are delivered immediately and stored but rather they can be purchased for later delivery at a fixed price. For the benefit of the fixed price a premium has to be paid, depending on the average range of price fluctuations and the contract's time span.

Table 2.4 Motivation for industrial purchasing

| Type | Motive |
|-----------------|-----------------------------------------------------|
| Normal supply | For running production |
| Gain experience | To learn about latest technology |
| Speculative | For resale and profit from future price differences |
| Storage | Precaution against rising prices |
| Emergency | In case of sudden breakdown |
| Substitution | Against superceded machinery |
| Bottleneck | Precaution against supply restrictions |
| Competitive | Remove from the market to disadvantage a competitor |

2.4 Reasons for Buying

There are also other reasons for buying, such as strategic considerations, especially when resources are in limited supply. Some important rare-earth metals, of vital importance for doping electronic chips for example, fall into this category. Furthermore, access to some products can be difficult because of political or legal restrictions. Nuclear material has no free market and cannot be sold or purchased by anyone, while most European countries require a special export license and registration—and therefore remain under state control—for nerve-gas precursors like phosphorus oxychloride or monofluoroacetic acid.

Key products or substance can play an important role in a company's production range. The purchasing price of such substances has a strong influence on the company's profitability and their shortage could endanger the firm. Therefore good market knowledge and good relationships with suppliers are of importance. Thorough market research and the development of alternative buying strategies are advisable.

Bottlenecks in supply can influence the motive for purchases. Should one of only a limited number of suppliers suffer a production breakdown, the sudden shortage in the market will lead to unusually high prices. This did indeed happen when a particular resin producer's plant was completely destroyed by fire, but unfortunately this company was the sole supplier for an automotive manufacturer. Only by mere chance could a competitor offer a substitute. Due to a good customer relationship the manufacturer was even given priority by reasons for strategic importance.

2.5 The Process of Buying

The act of buying takes place under rational circumstances, where spontaneous and emotional decisions are relatively rare. However, emotional elements in motivation can never be completely excluded because famous brand names could have an influence and also personal interests may be involved. Ostentatious PR normally has little or no influence on a buyer's opinion, as often several people, experts in their fields, are involved in the buying process. The time needed for decision making lengthens as more people become involved, while the number of participants in the buying process depends of course on the value of the investment.

It is important to have a closer look at the buying process in general. There are certain common procedures and processes, and there are also functions or roles the two parties, the buying as well as the selling side, have to play. One should be aware of a few fundamental psychological aspects, which aid successful negotiation. In the

literature, a few models of “buying centers” are described. As already mentioned above, in B2B marketing on both the buying and selling side several people are involved. Therefore it is important for both parties to gain—if possible—an insight into the communication and decision-making processes of the business partners. The composition of a buying center often reflects a part of the organization structure and company culture. Whether a company is dominated by engineers or by economists can easily be noted. However, it does not help very much to study the different models of buying centers; it is more important for the sales staff to identify certain psychological types in the negotiation team and especially to discover the decision processes and to identify the decision maker(s). It can save a lot of time and money to address the right people in the right way from the beginning. It is then necessary to learn what type of risk-takers the partners might be. As a general rule, one should never forget that, whatever product it is, at no time has a product been sold to a company—only to individuals, who are members of an organization.

The arguments of the sales people have to address the different levels of official and personal interests of the buying partners. In other words, it is important to meet the right wavelength in the argumentation for each of the participants (see Figure 2-8).

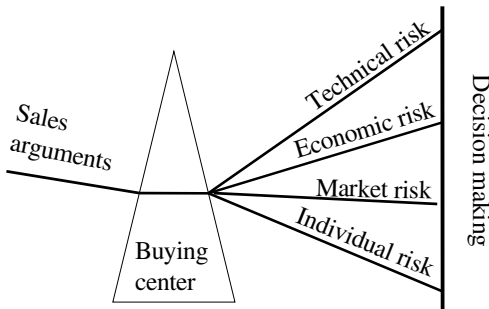


Figure 2-8 Buying centers diffract the purchase into a spectrum of aspects for consideration

Normally, in a buying center there are representatives from technology, finance, production, and perhaps also from the market research departments. Seldom from the beginning, but always in the later stages of negotiation, will a decision maker accompany the meetings. Now, in spite of the fact that all persons in the buying center are acting for the same company, they all see the product and the process of negotiation from their individual points of view. The representative of the purchasing department wants a product for the lowest possible price, the engineer wants a state of the art product, the member of the board perhaps likes a prestige product with a well-known brand name. Furthermore, sometimes there are also other influences, physically present or only in the background such as other customers or

users. The future customer may also directly ask for recommendations in the market. All these persons, institutions, and companies can be relevant and influence the buying process. In addition, there may be people present, with no recognizable function, who act as information gatekeepers in collecting, selecting, and forwarding information according to their personal interest. The worst kind of the latter group are the hesitators, who contribute nothing but have “concerns”. After a successful negotiation they have a “final question” and ask about the performance of the machine in the case of a meteorite strike. A well-prepared sales person keeps all these different characters in mind and identifies them as soon as possible.

2.6 Psychological Aspects

Beside the arguments mentioned above, there are other aspects to consider. People have different levels of risk awareness and behave differently in handling risks. In the buying process, it can be very helpful to estimate what type of risk taker a person is. An example may help to demonstrate a most common situation in marketing. Two machines, with effectively identical performance and additional service, are offered by Company A, a newcomer in the market and therefore offering the product at a significantly discounted price, and Company B, a well known and reputable manufacturer which sells its product at a premium price. A risk taker or perhaps a frugal buyer may choose the cheaper offer, a risk avoider may select the well-known brand. In the end, it depends on what the company is willing and able to pay. Now consider trouble arises with the cheaper machine. A senior manager would demand in the first case—the achieved savings are quickly forgotten—why the machine was bought from an untested company and thereby risked a complete production standstill? The reply to the similar question from the risk-avoiding manager would certainly be that the purchase was the best available for the money. The situation could not be foreseen; it was just bad luck. Now, who of the two purchasers are better off—the one who saved money or the one who bought a “luxury” product?

It also needs a lot of sensitivity to recognize in good time the dynamic processes in the buying team. There may be secret conflicts within a company between the technicians and purchasing employees. Winning “points” against the other department is a standard game. Of course, this match will be fought only with rational and scientific arguments, at least on the surface. For the sales person then, it is important to know on which side the decision makers are. From the psychological aspect it is necessary to identify those promoting the purchase (either for technical or functional reasons) and their opponents. It is questionable if significant effort should be spent on convincing the opponents; a better strategy to gain favor with the promoters. This strategy holds under the presumption that some kind of democratic decision-making process may take place. In the case that it is an executive decision, efforts should be concentrated more or less onto the single deciding individual.

In the case of a subsidiary, attention should be paid also on the own sales organization of the mother company. Especially in bigger companies, several different technologies for the same application could be offered in the market. It has often occurred that, from a single company, different sales representatives visited the same customer at different times and, unbeknown to each other, told the customer that the other technology would never work for the customer's special case!

3 The International Market Structure of the Chemical Industry

3.1 Production Sites and Resources

Industrial development in Western countries from the beginning of the industrial revolution to today shows certain geographical patterns. A general observation is that industries always have developed along transportation lines—roads, rivers, or coastal areas, and later also along railway lines. Furthermore, specific branches of industry originate where the necessary resources were available or at least could be transported without major difficulties. Water, energy, and a skilled workforce were important resources for all chemical industries and therefore chemical plants were often established near rivers; the river Rhine is an outstanding example, with Sandoz and BASF, to name just two, situated on its banks. The daily consumption of process water for their chemical reactors exceed the quantity used by a major town. The chemical industries attracted other industry branches, such as suppliers, and of course also users of their products. Similar to the situation found for coal and iron industry or automotive manufacturers, the geographical industry patterns thus formed exist still.

Of course no company is fated to remain still, once it has chosen a site. Obviously, companies or special business units move into other regions of the world by reasons of tax policy, political climate, or for a cheaper workforce. Large industrial conglomerates in chemistry, however, are very densely integrated, which means there is a characteristic production network of coupled and combined products. Coupled products occur, for example, in a chlorine–alkali electrolysis plant or an oil refinery. For physical reasons, no single product alone can be produced, only chlorine, hydrogen, and caustic soda simultaneously, or several fractions of hydrocarbons, respectively. Combined products form a product family of related chemicals, made in a single process from appropriate reaction(s) or consecutively by further physical or chemical treatment. While physical laws and technical limitations determine the products and ideal production location for the given examples, the same considerations of products and production location are determined by

sociopolitical and economic reasons in the case of a geographical conglomeration. So we find, especially in the chemical industry, geographical concentrations in only a few areas. This is accompanied by the vertically and horizontally associated surrounding industries, namely suppliers and customers. For aspects of marketing, this means, among others, a huge concentration of market power. The supply and transformation industries for further processing which become attracted to the region in turn initiate a kind of self-accelerating process in skill concentration and mutual development. This is one reason why the chemical industry can be one of a nation's core businesses. Without any doubt, some European nations can be regarded as world leaders in chemistry, while other nations have core competencies in computer science, optics, or marketing.

Water, as a fundamental resource for chemical processes, serves also as a source of electrical energy. Where hydroelectric energy is available, namely in mountainous, rainy regions, one often finds, or found, industries which produce goods requiring energy-intensive methods such as electrolysis of bauxite to aluminum. Many of these original industries have since closed down due to ecological reasons or changed their production. In any case, with insufficient water and cheap energy, chemical industry is not possible or runs into economic problems.

The second essential resource is oil and natural gas, or alternatively coal for nations like South Africa where it can be mined at low cost. Hydrocarbons and coal serve as a basis of all organic chemistry and, of course, as an energy supply. Before and during the Second World War, fundamental processes were based principally on the chemistry of acetylene (ethyne), the decomposition product of calcium carbide when treated with water. Later, and with the cheaper sources of crude oil and natural gas, ethylene (ethene) took over this key position for conversion into other products. Therefore we have today a chemical industry largely based on ethylene and only a minority based on acetylene, which is in any case produced by cracking hydrocarbons and not from carbide decomposition.

For these reasons, chemistry, as a core competence of Western industries, is strongly dependent on oil and gas resources. As most of the supply comes out of regions with low political and economic stability, these industries are vulnerable. Of note for Europe are the pipelines from Eastern Europe, the Baku region, or from Libya can be the object of attack, can pass through regions experiencing civil war, or may simply break down through lack of maintenance. The pipelines for oil and natural gas are complemented by a further system of pipelines for industrial gases like nitrogen, oxygen, and hydrogen; other gases are transported in special high-pressure tanks. Beside these official pipelines, others do exist for military purposes. The "oil crisis" of the 1970s showed the necessity of increasing oil and gas storage, and in response artificial and natural salt caverns are used in some regions as huge gas-storage tanks. Other countries, lacking such caverns, have built underground steel and concrete tanks for the same purpose.

Another fundamental resource is salt, sodium chloride, to produce chlorine, without which industrial chemistry is not possible. Both the high reactivity of chlorine, and most of its compounds, and its simple electrolytic production makes chlorine—whether environmentalists like it or not—a key element in chemistry.

The most important resource—not only for the chemical industries—is intellectual, namely well-educated research and laboratory staff. Generally, one can find a high level of education in universities and technical high schools in Europe. However, performance is work per unit time, and the time required to study chemistry is very lengthy in Europe. Unfortunately, in recent years the attraction of studying chemistry and related sciences has declined significantly in some countries. The reason for the decline is due to the antiquated organization for education and training, for which the necessary reforms have been overdue for decades and compounded further by the reluctant employment policy of many chemical companies. The continual process of reorganization in many companies has led to many scientific employees being released from service, on account of management not knowing how to make other use of their employees' abilities.

However, there are other driving forces which may lead to geographical concentration. Small- or medium-sized high-technology industries, such as in the biotechnological sector or in gene technology, are more flexible in regard to their production site. They can more easily move into other countries, if they find the political climate too repressive or better working conditions elsewhere. So, the driving force is not a production network but the political and economic environment. In addition, the accumulation of complementary skills in a specific region is very attractive to scientists and other market participants. In this way, Ireland has within a relatively short time formed a nucleus for biotechnology. However, many scientists meanwhile have left Europe and joined research teams in the United States, where they found a better economic and academic infrastructure. Today, a nation's academic system is, more than money, a decisive factor for the establishment of industries. Funding high-technology branches is necessary but not sufficient, a fact many policy makers unfortunately do not yet know. A positive example for the cooperation between industry, politics, and science is the initiative "ChemSite" in the Emscher-Lippe region of Germany, where different efforts are combined to create innovative jobs and attract investors. The initiative is backed by an already-existing infrastructure and logistic network of chemical industries.

3.2 Fundamental Characteristics of Key Branches

It can be observed that the different branches in chemistry, especially pharmacy, biotechnology, and classical industrial chemistry, follow certain trends and develop their own characteristics. Actually a general trend is a disproportionation of the industrial structure (compare Figure 3-1). On one hand there is a shift to ever larger industry conglomerates, on the other hand to small and flexible niche specialists. This happens simultaneously with the aforementioned globalization processes. National European markets are still too fragmented and insufficiently large for existing production capacities, while overcapacities cause a significant erosion in

profit margins. Consequently, there are only two ways out of this dilemma: Fusions and mergers, in order to reduce cost by economies of scale, or create higher margins, through the production of specialties. Table 3-1 gives some examples of interesting acquisitions; these are the main reasons for industrial reorganization. Sometimes, however, the motives are difficult to recognize and mere size may be the driving force.

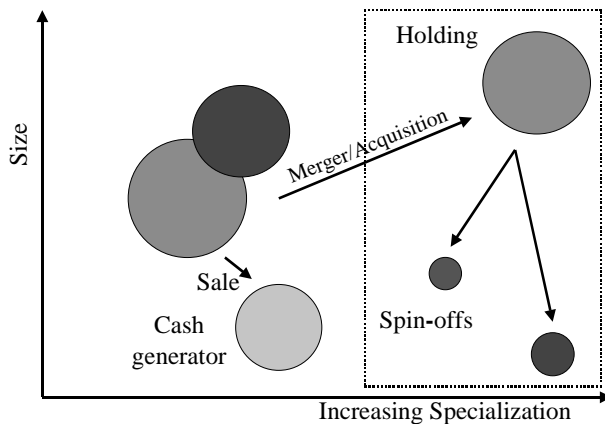


Figure 3-1 Disproportionation in industry, where the very large and very small flourish

Table 3-1 Selected acquisitions in the chemical and pharmaceutical industry

| Buyer | Object | Share / Price (% / Million Euro) |
|----------------------------------|-------------------------|-------------------------------------|
| The Boots Company plc | Hermal Kurt Hermann OHG | 100% / 250 |
| Degussa AG | Hüls AG | Fusion |
| BASF AG | Daesang | BU Lysin / 550 |
| Fresenius AG | Pharmacia & Upjohn Co. | BU Infusion / 420 |
| RWE-DEA AG | Hüls AG | BU Tenside, Solvent / 300 |
| Baxter Germany GmbH | Immuno GmbH | 100% |
| Elenac GmbH | Hostalen GmbH | 100% |
| Kohlberg Kravis Roberts & Co. | Herberts GmbH | 100% / 1500 |
| Bayer AG | Chiron Corp. | BU Diagnostics / 950 |
| Hoechst AG | Cargill Inc. | BU US Seeds / 550 |

BU = Business Unit

A really dramatic change in industrial structure has been taking place especially in the life sciences sector, namely pharmaceuticals and agrochemicals. Almost in a monthly sequence, acquisitions and mergers are announced and, consequently, the sales of business units that do not belong to either the newly defined core business or the restructured group through the formation of holdings. It seems that at the moment growth in this branch is mainly supported by acquisitions and not by intrinsic growth with new products.

3.2.1 The Agrochemical Industry

The world population is still growing at a dangerous rate. A substantial increase in food production is therefore urgently required. This can be in practice only achieved by an increase in agricultural efficiency, higher harvests per area. The increase of output through the recovery of desert land for agriculture is only possible in the long term and under stable political conditions in the countries affected. The transformation of virgin land, such as the Amazon jungle, into agriculturally usable areas is ecologically unsound. So, the efficiency can only be increased by the use of more fertilizers and/or the decrease in losses caused by plant diseases and parasites. This in turn means the application of more pesticides, fungicides, and biological methods. However, a clear shift can be observed towards smarter plant protection in order to avoid ecological damage as far as possible. Therefore a demand arises for highly efficient chemicals that rapidly and harmlessly decompose after application.

In order to avoid the application of chemicals at all, genetically modified plants have been created, which show resistances against different parasites. An example is the passionately discussed maize with an incorporated gene from *Bacillus thuringiensis*. However, it is still doubtful if this technology will be introduced on a broad scale in Western countries in the near future. Moreover, there is no need to increase food supply in these well-nourished states with their heavily subsidized agricultural overproduction.

As there is no shortage in the richer countries, the increasing demand for agrochemicals is based on the motive of convenience. However, increased ecological awareness has made farmers reluctant to use still more chemical products, and therefore the forecasted increase in agrochemical demand is not realized. The poorest nations do not have the money to buy agrochemicals, in spite of their starving population; where there is no money, there is no market. As a consequence, the concept behind life science companies may soon be revised because their agrobusinesses are not developing as fast as their pharmaceutical sector and thereby diluting the companies' profits. A further concentration of either pharmaceutical or agrochemical companies is therefore expected. Future investments in new technologies, especially in genetically modified foods, will strongly depend on the political environment and their popular acceptance. It can be assumed that most of the research in this field will occur outside Europe, most likely in the United States or even in China.

3.2.2 The Pharmaceutical Industry

In Western countries, life expectancy is increasing. However, the birth rates in industrialized countries are decreasing in direct relation with increasing wealth, in turn attributable to sociocultural change. The outcome is a disproportion in the distribution of age in the population, specifically less younger and more older people. This means that more medical care is needed—and this is growing exponentially. If money will be spent for something, then it is for personal health and welfare. Together with information technology, this is the most important global economic and marketing trend. The increase in demand for all kinds of services in healthcare will be one of the driving forces of the future economy. Unfortunately, the medical insurance systems in the Western world are not prepared for the corresponding explosion of costs.

The tremendous increase in cost for the development of a single marketable drug has meanwhile reached an average of about US\$ 500 million. Therefore it is not surprising that even big companies try to share risks and costs. In consequence, companies merge or find other ways for collaboration, such as joint development or joint marketing. The risk remains that, even after screening tens of thousands of substances for pharmaceutical efficiency and finally testing one of them in the clinical phase, this single substance may also fail in the end. It means not only the loss of hundred of millions of dollars but also loss to opportunity costs. Opportunity costs represent the money spent on an unsuccessful product is money no longer available for possibly more promising projects. Furthermore, if a substance has finally passed the admission procedures of the national authorities, its marketing is very expensive and also requires some hundreds of millions of dollars. For this reason, joint marketing in the pharmaceutical industry is common. Many big pharmaceutical companies have tried in the past to outsource their marketing activities or to reduce their own sales staff for reasons of cost. However, the forecasted savings calculated by some conservative controllers boomeranged and resulted in loss of market share. It is a different and decisive competitive advantage if a company places its focus on forming a highly skilled, academically trained sales team as discussion partners to the medical practitioners.

This particular cost structure in the pharmaceutical industry also explains why a certain selection of drugs for development is made, and in turn this means markets with a volume less than the development costs of about US\$ 500 million are not very profitable (see Figure 3-2). “Lifestyle” drugs, such as Viagra, or those against obesity are much more attractive and therefore all companies try very hard to launch a blockbuster on the market. (A blockbuster is a drug with a potential sales volume of more than US\$ 1 billion (used hereafter in the American sense of one thousand million dollars); Figure 3-3 shows some actual examples.) For the same economic reasons therefore seldom-occurring diseases do not garner the necessary attention and research for appropriate drugs is insufficiently performed. In consequence, the United States enacted the Orphan Drug Act in 1983. Seldom, by this Act, is defined as illnesses with less than 200 000 patients, and the US government decided on a package of measures, less taxes, prolonged patent rights, and so forth, in order to

promote research. Other national and international help programs try to create incentives for the research in this field. Furthermore the pressure of time in an extremely competitive situation is another criterion for the selection of a company's product portfolio.

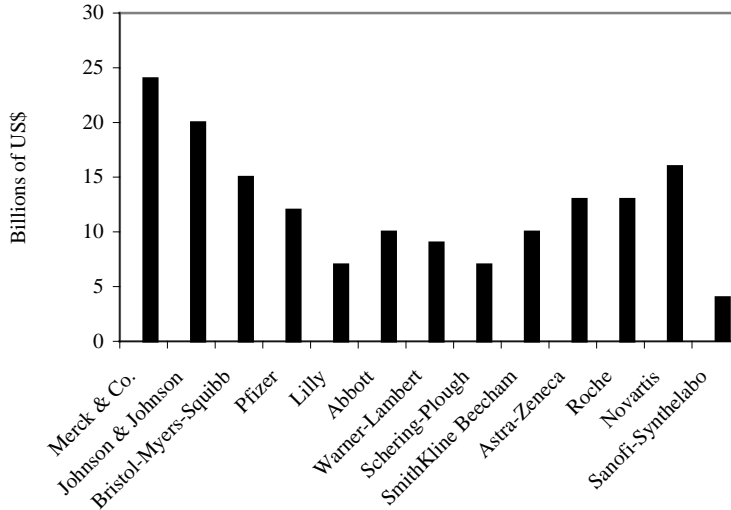


Figure 3-2 Pharmaceutical industry turnover

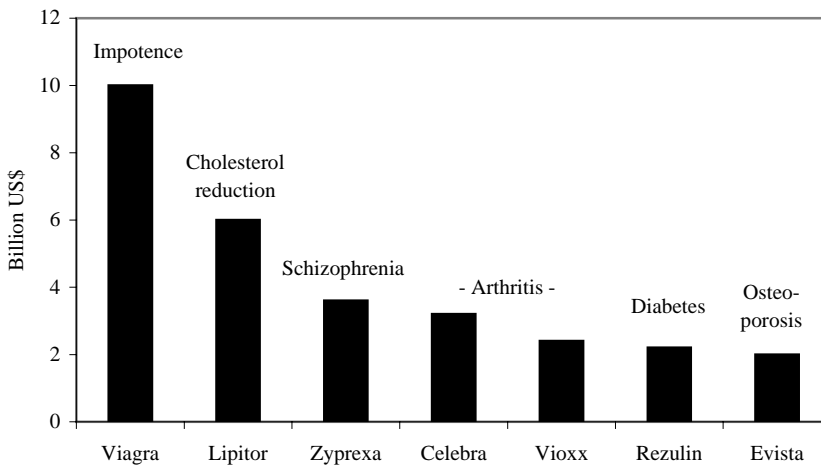


Figure 3-3 Blockbuster drugs and their applications

The pressure to create savings and to increase efficiency generates a new business branch—diagnostics, meaning companies which perform laboratory syntheses, testing, and screening of potential pharmaceuticals and other substances. The methods of combinatorial chemistry accelerates such testing of the reactivity and selectivity of chemical reactions. The reaction simulation and virtual syntheses available with computer systems show the trend. In connection with highly sophisticated analytical equipment, the diagnostics branch will show a significant increase and become a booming business. Each new diagnostic procedure, which allows a more rapid assessment of a disease and therefore earlier treatment, will help to save costs and reduce the load on our sick healthcare systems.

3.2.3 The Biotechnology and Gene Technology Industries

After the atomic and the information age, the next decades will most probably be named the biotechnological age. Biotechnology itself is a very old science. The fabrication methods of wine, beer, and cheese are based on technologies which are already some thousands of years old. Many new applications for biotechnological processes have been found meanwhile, such as for insulin, the treatment of polluted soil, or in leaching metal sulfide minerals. Biotechnology is a kind of higher chemistry with living, biologically active substances such as fungi, bacteria, viruses, cellular material, or enzymes. A lot of conventional chemical processes under high temperatures, pressure, expensive catalysts, toxic solvents, and undesirable byproducts might be converted into an ecologically gentler equivalent with milder conditions and water as solvent. Genetically modified material, like fungi or bacteria, will provide the chemical industry with new tools for syntheses. An outstanding example is the Reichstein synthesis for vitamin C (ascorbic acid), where one step in this synthetic method is reached through biotransformation in large fermentation vessels. Production capacities of several thousand tons per year have made ascorbic acid a cheap and useful additive for many food articles. Biotechnology will clearly be a very profitable business in near future and faces rapid growth. Nevertheless, biotechnology often is regarded with mistrust and even rejection in its aspect of gene technology. The different disciplines, biotechnology and gene technology, cannot be separated by a distinct border and are therefore subject to often unjustified criticism; biotechnology often uses the results of modified biological material.

3.2.4 The Commodities Industry

Dealing with the different aspects and outlooks of high technology could lead us to question whether “common” chemistry still has a future in westernized industrial

nations. When global players such as Hoechst determine life science as their future core business, and consequently try to rid themselves of their commodities, the decisions of other chemical companies are certainly influenced. The former “chemical grocer” Hoechst, under its CEO Jürgen Dorman, went through one of the most courageous metamorphoses in contemporary industry. Perhaps for this reason he was elected by a German economic review as “Manager of the Year”. However, it is quite astonishing that this policy strongly contrasts with BASF, which does just the contrary—and, so far, successfully. BASF, with its integrated production network of basic chemicals, sees the company’s market force among others just in these commodities. Covered by the title “commodities” are products designated to have an output of several hundred thousand tonnes per year. The company’s strength is defined as a vertical integration of several chemical product chains at a global scale. Product chains means, in the chemical sense, a family of connected products and, in the economic sense, a value chain. At the global scale, this means a significant market share with production centers all over the world. The global aspect of this strategy allows production capacities to be balanced with major price differences. Of course it has to be mentioned that the company also has many high-technology products. The former pharmaceuticals subsidiary Knoll AG has meanwhile been sold, however. The successful treaties with Gazprom, which allowed access to Russian sources of oil and gas, underline this policy. There are some interesting aspects in this approach, which may guarantee profitability also in future. As already mentioned in Section 3.1, the chemical industry is very dependent on oil and gas to supply both their energy and source of basic chemicals. Both categories of products are easily available on the world market—although susceptible to widely fluctuating prices. Therefore, companies which control the entire supply chain and, in addition, the transportation logistics such as pipelines have in the long term a significant cost and market advantage. This cost advantage in combination with economies of scale can lead to a most profitable leverage effect.

3.2.5 The Chemical Specialties Industry

The erosion of margins in commodities caused many companies to focus more on specialty chemicals, for example paints, pigments, ultrapure chemicals, or high-performance polymers. However, again the size of these business units and their global market share is crucial. Of course, profit margins are much higher but often market volume is rather fragmented and insufficient. Therefore in this field also acquisitions fit to the needs of the moment, either to concentrate market power by size or with complementary products.

In connection with large mergers and a reorientation of a company’s mission, business units are often sold which had created substantial profits before the merger. It is not true that only loss makers and commodity companies are subject to preferred sale. In addition the sale of chemical specialties business units contributes significantly to the finance of acquisitions. The technical experience, as well as the

market knowledge and the distribution channels, push up the sales price due to a very high degree of goodwill (Section 2.2.2). For this reason, it is sometimes difficult to find a buyer for these business units. In some cases an alternative strategy has been chosen, namely the foundation of a new and separate legal entity with its subsequent opening to the public.

In spite of the name “specialty” and smaller production volumes, this business is far from being a niche market. On the contrary, the market is highly competitive and is often confronted with the customer’s high purchasing power, thereby placing pressure on prices. The automotive industry has a significant purchasing power for varnishes, the textile industry for dyes, or the food and drug industries for vitamins. This represents an additional reason for mergers, as well as geographical diversification, in these branches as well. Customer-specific and tailor-made products are the key factors for success. Table 3-2 gives some examples of applications for specialty chemicals.

Table 3-2 Examples for applications of chemical specialties

| | | |
|---------------------------|-----------------------|----------------------|
| Agriculture | Diagnostics | Paints and varnishes |
| Adhesives | Electronics | Plastic and rubber |
| Building and construction | Flavor and fragrances | Surfactants |
| Biocides | Food | Textile dyes |
| Catalysts | Industrial cleaners | |
| Cosmetics | Lubricants | |

3.2.6 The Engineering Industry

Engineering in the chemical industry means, beside “turnkey” operations, the construction of new types of reactors. As time, before price, is a key factor of competition, batch production, with its consequent and costly downtime for cleaning and maintenance, is against the trend. Continuous reaction procedures are—whenever possible—preferred. Furthermore, flexible production facilities, multipurpose plants, are needed. Modular units facilitate both maintenance and substitution of plant components when a process has to be modernized. New engineering developments means also improved energy-saving processes. However before starting construction, clients increasingly ask for a computer simulation of the process, and only after will the definite design of the plant commence. That means an engineering company can achieve a competitive advantage in offering computer-aided simulations.

Customers often prefer a solution “from one hand”, that is a single engineering company acts as an overseer and subcontracts all of the work it cannot perform itself

to outside companies. However, the overseeing company must possess profound knowledge of construction and chemical technology as a prerequisite for survival. Additional skills in environmentally compatible techniques is often required. Understanding ecological processes is also another issue, and equipment applicable to environment protection represents a significant market. Further, while only the large companies can offer turnkey operations, this may not be restricted only to technical aspects: Training the operating staff and even financial management are often requested in the service package.

Simultaneously with the globalization of the chemical markets, the same trends are observed for chemical engineering. The construction of complete new plants in foreign countries forces the engineering companies to follow. This in turn pressures this industry branch into combining skills and strengths. More than for any other business, global mobility is a fundamental issue for engineering companies. One can expect that within a few years less than ten global players will be left.

3.3 Customers and Users

The earlier general comments in Section 2.2 on the differences between consumer marketing and B2B marketing are also true for the chemical industries. Their customers and users are limited and well known. Only in a very limited way can new markets for chemical products be created. This happens when new applications are found, such as in the automotive industry. Here, car bodies made of plastic can be used, where plastic substitutes for steel. Besides innovation, market shares can only be gained at the cost of competitors. In contrast to consumer marketing, chemicals cannot be spread among the population by stimulating consumer behavior. Only in an indirect way, when the consumption of cosmetics for example is promoted by retailers, will the producers of basic chemicals feel an effect. The derivative demand is among others a reason why chemistry is a cyclic business. When the global markets allow only limited expansion, it is obvious that the chemical demand correlates directly to the fluctuations of the general economy. Of course, consumer products are also subject—like anything else—to economic cycles, although the fluctuations are smoother. The demands for basic products and services, like food, housing, and safety, are relatively stable. In sum, that means marketing in the chemical industry is often a case of hard selling, especially when the general economy is sluggish. In such situations, the additional services offered are decisive for success or failure. Referring again to the customer's purchasing power, the credo of total customer care and strategic customer alliances gains special importance. Account management for key clients in the chemical industry therefore is a necessity. The trend in marketing goes into the direction of joint projects, where at very early stage of development customers and suppliers come together. This is a clear advantage to the bigger companies which have sufficient personnel resources.

3.4 Distribution Channels

The distribution channels for chemical products vary over a wide range. Channels are classified by the number of intermediate steps. No intermediate means direct selling from the manufacturer to the user; with intermediates a retailer lies between manufacturer and user, or a wholesaler between manufacturer and retailer. In the chemical industry all types can be found. Catalysts normally are used only by other chemical producers and therefore, in most cases, are sold directly. Products which are designed for a specific purpose are also sold directly to the client. On the other hand, there are products which will undergo several steps of transformation to a final product: Cosmetics certainly travel a longer path to the final user. The mode of transportation and special regulations have already been mentioned in Section 2.2.4.

Sometimes, however, distribution channels can be troublesome, such as when import taxes are levied on goods or even restrictions are placed on the quantity administered. In these cases a gray market often comes into existence. Global sales require a subtle pricing policy because the purchasing power between individual countries is very different and therefore the price for the same product is geographically sensitive. This is a simple relation of demand (price) and supply. However, when price differences are much higher than their transportation costs, reimports often occur. This means that the products, which are sold in other countries at a much lower price, are imported back into the countries where the company assigned a higher price. Pharmaceutical and cosmetics products often go this way.

The control of the distribution channels is a special case of a monopoly appearing in the market and is closely watched by national authorities. The owner of telecommunication lines, pipelines, or electricity suppliers will sooner or later be forced to grant competitors access to these channels. Large drug wholesalers can gain a considerable market power and influence the final price at the end of the value chain.

Finally, a few very special products are subject of strict regulations and are not freely available to everybody. Drugs, radioactive materials, biologically active substances, and the like are not sold through usual distribution channels. Some chemical substances require export licenses by the national authorities or are on an embargo list.

4 The Economic, Political, and Sociological Environment

4.1 Dependence on Oil and Gas Markets

As already discussed in Section 3.1, the chemical industry depends on oil and gas for two main reasons. First, hydrocarbons are the basis of organic chemistry in general and, second, chemical processes require a source of energy. A lot of effort is spent on research for new reactions which demand less energy for a chemical conversion. In some cases, developments led to new catalysts, such as metallocenes for the polymerization of polyolefins, or to biotechnological agents and procedures. At the beginning of the new millennium, a question often asked is how long the world's oil and gas reserves will last. However, there is no definite answer; even an estimate is difficult. In the following, a few fundamental considerations are given.

Beside the fact that all resources are limited, we can be sure that we have not yet discovered all major oil and gas fields. New sources are discovered practically every few years. However, it is not always possible to exploit these resources because of economic or technical reasons, especially for secondary and tertiary exploration. Furthermore, new technologies have to be developed to allow, for example, exploitation of oil-bearing sands or gas clathrates in the ocean depths.

The three biggest producers of crude oil are Saudi Arabia, USA, and the CIS (former Soviet Union), whereas the three biggest consumers are USA, Japan, and the CIS. In the fourth place in the consumer ranking is China, and we may expect that China, with its rapidly developing economy, will be the world's second largest consumer of oil products in near future. If only 5 % of the Chinese population own a private car within the next half of the century, the world's consumption of crude oil will be pushed significantly upwards. But due to China's huge reserves in coal, perhaps a part of the Chinese chemical industry will be based on that resource, as is the case in South Africa. However, the additional carbon dioxide emission will certainly give some ecologists nightmares.

The world's total annual production in the year 2000 was calculated at 74.5 million barrels (1 barrel = 158.758 L) as an average daily output. Figure 4-1 gives an overview of the most important suppliers of crude oil; it is interesting in this connection to observe the discrepancy between the USA and Japan as the biggest consumers of crude oil. The USA is the biggest consumer of oil in total and in per capita consumption. In Figure 4-2, the European refinery capacities are listed, and clearly a concentration in Italy, Germany, Great Britain, and France exists.

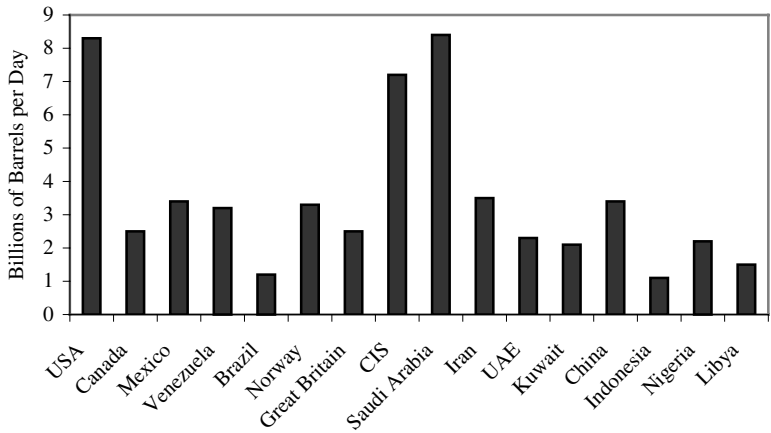


Figure 4-1 Important crude oil extracting countries in 1998

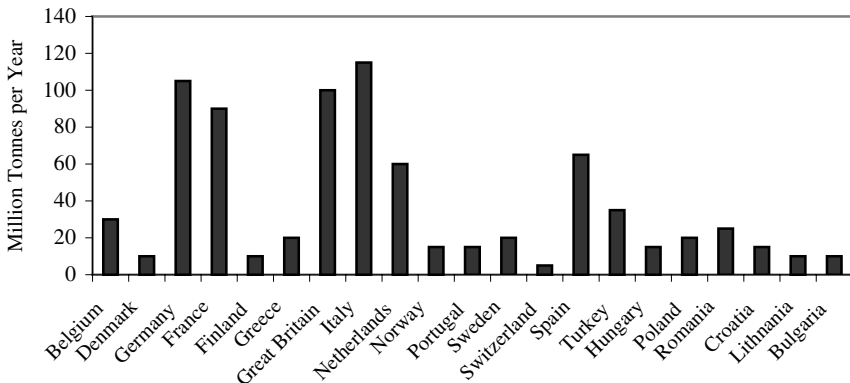


Figure 4-2 Refinery capacities in Europe in 1998

The prices of oil are not only affected by supply and demand but also by politics. The regular OPEC meetings have a significant influence. At the end of 1999, the demand for oil products exceeded production by 2.8 million barrels per day worldwide. In this period prices achieved a ten year maximum. In particular, prices on the spot market show wide fluctuations and, therefore, oil prices impact significantly on the pricing policy of the chemical industry. Figure 4-3 shows the fluctuation in the price of Brent-class oil on the London market.

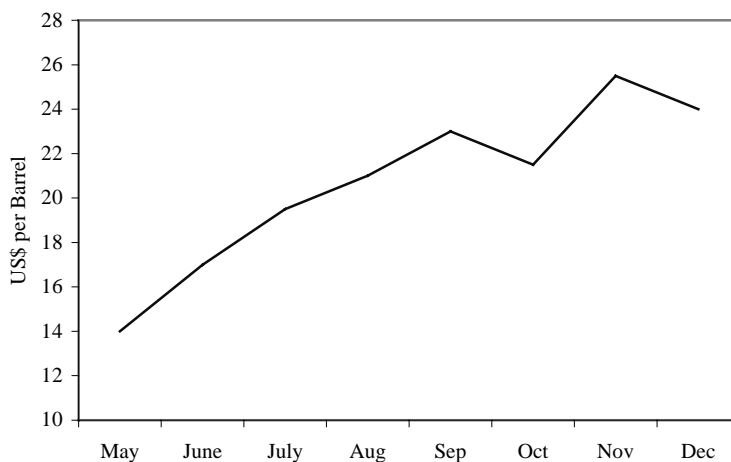


Figure 4-3 Oil prices for a January contract during 1999

The whole of organic chemistry is based on carbon, in turn dependant on hydrocarbons from oil, natural gas, and coal. As resources are limited and perfect recycling of all carbon-based products is still far from reality, it is logical that the use of carbonaceous resources should be dedicated with priority to chemistry. The use of carbon and hydrocarbons for the production of energy has to be reduced in favor of other energy sources like solar, wind, and/or nuclear power. It remains difficult to understand why this simple fact is not understood by many ecological activists. In Figure 4-4, the contribution of nuclear power stations to the production of electricity is given for some European countries. In France, for example, the acceptance of nuclear power is much higher than in other countries, and the question arises if some of the hysterical reactions of the antinuclear movement in Germany are typical.

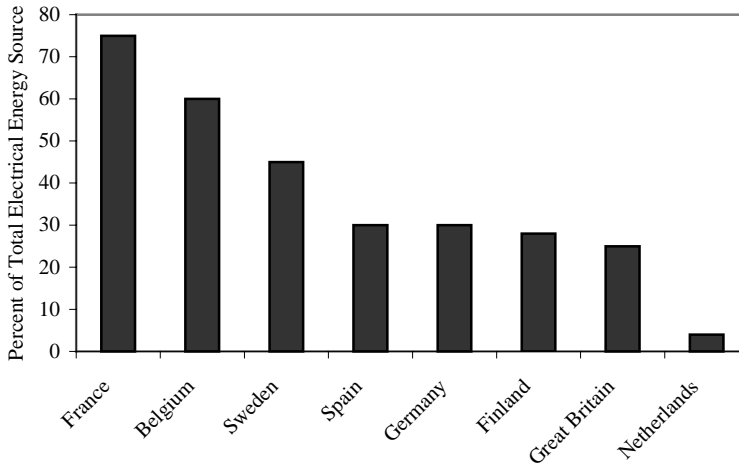


Figure 4-4 The use of nuclear power for the production of electricity in 1998

Another critical point is the availability of oil and gas in Western Europe, in other words, the problem of transporting resources from the sources to the users. There is a dense network of pipelines starting from Southern Europe (Spain and Sicily), from the northern Stavanger (Norway) region, and from the East, especially the Caspian Sea and the Baku region. However, the geographical areas through which the pipelines have to pass are politically not very stable. The Maghreb pipeline passes through Algeria and Morocco, and then goes underwater from Tanger to Cadiz in Spain. The pipelines from Baku passes Grozny in Chechnya and ends in Novorossijsk. Other routes under discussion would pass Georgia or Azerbaijan and Armenia. Oil coming from Iraq passes Syria and Turkey. The gas pipelines from Northwest Siberia (Urengoy, Vyngapur, and others) lead through Belarus. Liquefied natural gas (LNG) is transported by ship and arrives in the harbors of Spain, France, Italy, Belgium, and Great Britain. Beside these networks for oil and gas, other pipelines exist for the industrial gases like nitrogen, oxygen, and hydrogen between the major chemical industry conglomerates.

4.2 Legal Restrictions and Policy Making

In some countries of Western Europe, especially in Germany, it seems that the chemical, pharmaceutical, and biotechnological industries are subject to intensive control from laws and regulations. In spite of all expectations of the free market, these industries are the most regulated ones. Certainly, and without doubt, that for security reasons there must be special supervision of the production, handling, and transportation of hazardous goods. However, a point of criticism is that some research is in essence made impossible or ineffectual with regard to competition. Especially in gene technology, excessive regulations have driven many researchers to other countries. Too late, politicians have recognized that a key competence in future markets has already been lost.

Other restrictions refer to the price policy of the pharmaceutical markets. Here, politicians from all over Europe try to obscure the bankruptcy of their national health policies by administered prices for pharmaceutical products. What Western politicians have criticized for years in countries formerly employing planned economies is now being sold to their own citizens in the West as modern social policy. Here, the interests of insurance companies, insurance takers, and policy makers fight against the laws of the free market—laws that should be valid for all cases with the exception of healthcare. Other obstacles for pharmaceutical products can be detected in international trade. Contrary to the GATT agreements on the elimination of trade barriers and especially the non-tariff, hidden ones, the national drug-admission authorities often do not accept the admission procedures of the other nations. Therefore, costly repeated testing and admission procedures often have to be made in order to gain access to foreign markets.

A carbon dioxide or energy-consumption tax is demanded by the green movement. Without doubt, any reduction in carbon dioxide emissions is welcome. However, it makes little sense to reduce emissions in Western industries to an absolute minimum at extreme cost when, in other parts of the world, antiquated technologies are still used. The atmosphere is a global affair, and so if any tax is imposed then it should be used for to modernize the technologies in developing countries. However, it is more than doubtful whether these taxes ever reached the right addresses.

Numerous laws have been imposed in the field of recycling. Especially for plastic waste, a broad range of regulations have to be observed. In the beginning, the maxim was that the recycling of the material itself had preference—despite the fact that the current technology had no economic methods to separate the different sorts of plastics available. Still today this aspect of profitability is controversial. Meanwhile, recycling the intrinsic energy of the plastic is recognized as an alternative. In many countries, a “green dot” system for the recycling of plastic packaging has nevertheless been established; the system works through the producers paying a supplement on each package, which is later collected by a second company or institution. In Germany, a collaborative organization between a few large companies now control a major part of the plastic waste and collection market. This newly formed collection organization has already been subject of

intervention by the national anti-trust authorities, and now this organization distributes the collected monies by different ways to distinct waste collection and separating companies, who in turn pass a part of it to the recycling companies.

The point of criticism of the anti-trust authorities was that quantities and prices had been determined by the large companies. From the plastic packaging user's point of view, the system looks like this: First, the consumers pay for the green dot, because the merchants, whose goods are packaged, of course pass on the additional costs to the consumer. Second, the consumers pay for the refuse of the local community. Third, they pay for all products made out of plastic waste. The German consumers, as tax payers, have in addition a fourth pleasure by subsidizing this green dot company because it already twice faced bankruptcy. Because the green dot label was misused by a lot of companies, which profited by the ecological image but did not want to pay for the label, a large part of the fees were lost. The weak point in the green dot system is that users are difficult to control. The recyclers have a different point of view. They acquire raw material and, instead of paying for it, receive money. In this way, the law makers have given an outstanding piece of evidence showing that modern economic theory functions well. Another example is the cement industry: At least in a small alpine region, where this industry had formerly formed a cartel, it is reported that they now ask a fee for burning old tires. Obviously the old network of lobbyists still works.

One has a strong sense that there are too few chemical scientists active in policy formation—otherwise things would run a bit differently.

4.3 Lobbying of Interest Groups

The process of law making in Western countries is accompanied by a preliminary exchange of opinions from different interest groups. Under normal circumstances it is a process of fact-finding. The opinions of the industries are transmitted through official speakers representing their industry branches. It is natural that industry branches try to exert their influence during the discussion process, a process commonly described as lobbying. However, this expression already has a slightly negative touch because, in public opinion, it is connected with illegal actions such as bribery and pressure. Nevertheless, lobbying within the legal limitations is a valid democratic tool.

Lobbying by a branch of industry is used proactively in marketing their interests but sometimes also as a defense strategy, when planned actions by government are interpreted as a threat to their business interests. An outstanding example was the announcement of the German government to introduce a take-back obligation for used cars by the automotive manufacturers. Soon after the publication of this planned new regulation, the automobile-manufacturers association intervened on a European level and the proposal was withdrawn.

Interventions by other industry branches were not so successful. The classifications for the toxicity of chemical substances are not guided by scientific argument and proof but on suspicion and the pressure of activists; rumors spread in newspaper articles seem to substitute for knowledge. The violently attacked formaldehyde and chlorine chemical industries serve as an example. In spite of formaldehyde being extensively documented over a longer period than any other substance in scientific history and that there is no proof for its carcinogenic properties, the substance has been classified as “under suspicion”. People believe what they want to be true and not what is scientifically proven. And only the fact that the ban of a specific element in the periodic system is not possible prevented further damage to the chemical industry: There is no powerful and courageous lobby for chlorine.

Marketing without lobbying can be a very costly failure also outside of politics, such as in competition between companies. A very strong competition takes place in packaging. Taking beverages as an example, there are three solutions: glass, polyethylene terephthalate (PET), and aluminum. Behind each of the three, powerful industry branches act. Dozens of ecological balances and calculations have been made to prove that just one material was the best. However, as there is no scientific law in what kind of calculations have to be made, no definite answer could be given. Have the costs of energy production (from coal, oil, gas, or hydroelectricity, among others) an influence on the calculations? Sometimes when a definite answer cannot be given, a decision can be enforced by taxes. A similar case is represented by the fight between the sugar and the chemical industry over artificial sweeteners. The sugar industry lobby created a horror scenario and accused the synthetic substance, cyclamate, of being carcinogenic. When substitutes for cyclamate were at last offered, the resistance against artificial sweeteners broke down. Beside mere marketing arguments, questions of liability are gaining importance. Meanwhile, law makers on an European level have agreed upon the “inversion of finding proof”, in which the accused company has to prove that a process or substance is not responsible for the damage under question. There is a trend that in such cases lawyers demand a one-hundred percent proof that something cannot happen, and so any statement can be a costly affair, especially in the USA.

4.4 Image Problems and Societal Acceptance

At the end of the Second World War, the chemical industry became a symbol of reconstruction and the beginning of public wealth in the 1960s. New products, like nylon stockings (nylon fiber had been originally developed as a silk substitute for parachutes, see Section 8.8), came into the market and demonstrated the progress and utility of applied science. Even the polluting chimneys with their yellow nitrogen dioxide color were acceptable—at least for a while. With increasing wealth

and product saturation, the population began to see the chemical industry with critical eyes. Fortunately this criticism resulted in a significant improvement in environmental affairs. Then the first mega-GEA (greatest expected accident) happened—at Seveso, Italy, a reactor for the production of insecticides went out of control and polluted wide areas with dioxin. Years later, an accident with methylisocyanide occurred in Bophal, India, and thousands of people were killed or injured. The nuclear catastrophe in Chernobyl, in the former USSR, followed soon after. All these events shocked the population and brought the credibility of modern technology in general into question.

Many other smaller—and with increasing technological complexity, inevitable—accidents also happened. Unfortunately, management in the chemical industries in most cases only focused at first on technical explanations and tried to soothe, following the protocol of deny it first, and when it cannot be denied any more, gloss over it. In this way terrible mistakes were made. However, the population was frightened and saw through the obscuring statements. The credibility of science suffered badly. Today most of the chemical companies have learnt their lesson and either voluntarily or forced by law cooperate quickly and thoroughly with the authorities in the case of accidents. They have agreed upon a code of ethics for these events and follow an honest and open policy of communication. Larger companies have not only developed emergency plans to handle accidents but also communication plans for these situations. Nevertheless, the wide acceptance of chemical technology, and especially gene and biotechnology, is in Europe still far away.

These problems, however, are home-made. Perhaps it is in the nature of scientists, that many of them are unable to express themselves in other ways than in technical, scientific terms. This has resulted in a clear deficiency in the information policies of the chemical industries. As long as the population does not understand the benefits, they will be adverse to, mistrust, and fear chemistry and innovations in general. Many scientists do not understand psychology, and even today chemical industry representatives believe in the power of facts and clear arguments. However, this is wishful thinking. At first, frightened people do not believe in facts but rely much more on their emotions and instincts. Second, psychologists have described the filtering effect of cognition, that is, a person is unable to see the reality in total; the filters include previous experiences and disallow absolute objectivity. People want to see and try to gain confirmation about what they believe. This is known to all good marketers, who work with this effect in using the previous positive experiences of consumers. In other words, rational arguments are of only very limited efficiency.

A PR campaign from the nuclear power industry in several journals was advertised with the headline “Nuclear Power is Safe!” Nearly a full page of explanations followed, given by a scientist who explained why this statement was true. From a marketing point of view, this is certainly an example of pitiable naïveté. Similar miscarried efforts were made in the past by the chemical industry. In scientific journals, PVC was discussed as if the broad population would read chemical journals! So, a material produced in a worldwide scale of about 4.5 million tons per year had—at least in Germany again—narrowly avoided being banned. In some German towns, the country government even forbade the use of PVC in public

buildings. When the waiting hall of the Düsseldorf airport burnt down, journalists immediately reported that the victims had been killed by the smoke from PVC—even when it was not present. This incapability to defend one’s fundamental interests brought a whole business branch into danger. Such an image gap, as shown in Figure 4-5, is dangerous to the branch because politicians feel themselves forced to react and demonstrate (unfortunately, mostly unreflected) activity to the public.

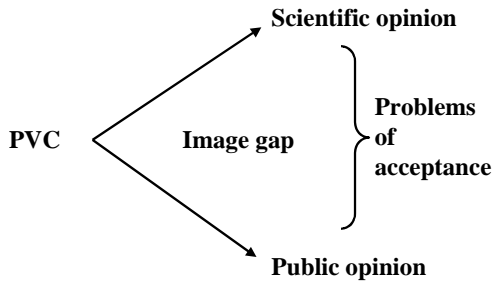


Figure 4.5 Image gap for the case of PVC

For some managers of the chemical industry, it took years of convincing before they finally engaged marketing professionals and enabled communication on the same wavelength as the opponents. Now inserts in weekly newspapers can be seen demonstrating for example the use of chemicals for air bags in cars.

In Switzerland, with its direct parliamentary system, a plebiscite was enforced by activists with the goal of forbidding all animal testing. The protagonists published photos which could have been taken from Frankenstein’s laboratory and shocked the population. The pharmaceutical industry faced losing the vote, but they then switched to a professional PR agency and published photos of Parkinson patients in wheel chairs and asked “Do you want to refuse help to these people?” The pharmaceutical industry won the battle by a narrow vote. That’s the way image marketing is made! This is quite the opposite of what scientists have learnt in school but the only way to communicate is publicity. All other ways miss the target groups and the discussion remains within a closed academic circle in a language non-scientists do not understand.

5 Marketing Chemical Engineering Projects

There are some major differences in marketing engineering projects in comparison to the usual B2B marketing. Engineering projects demand a combined package of physical products, such as the construction and delivery of a manufacturing complex, or complete manufacturing plants and the necessary associated services, such as building, staff training, and commissioning operations, as introduced in Section 3.2.6. This makes it necessary that all operations are concentrated on one single client. It is important that the offering company has a good knowledge of the customer's value chain in order to design this bundle of services and products exactly according to the needs of the customer. Whereas in usual B2B marketing the focus is placed on a target group of possible customers, the activities in the marketing of plants are directed to an individual customer. This does not exclude the possibility that a plant may be constructed from standardized modules, however, through the combination of the complex elements and modifications of modules, the plant achieves a unique and individual character. Furthermore, for the supplying companies it means that many years may pass before a chance to win a big contract for the delivery arises, which makes the business and marketing much more difficult. When the plant is finally handed over, no further business can be expected, with the exception of a subsequent service or maintenance contract. Other forms of agreements, however, can be operation contracts, namely that the supplying company runs the plant after completion for some set period.

5.1 Marketing Chemical Plants

In contrast to other marketing areas, the marketing of chemical plants, whether oil refineries, steam hydrocarbon crackers, fiber-producing plants, power stations, or others, is made before the products exist. There is no oil refinery as a demonstration object in the show room of the supplier. This fact has many consequences. As the products cannot be seen or tested beforehand, it is a matter of trust when a client gives an order worth several hundred million dollars to an engineering firm. So, the engineering company has at first to demonstrate its ability to manage such a complex task, the requirements of which are very high indeed. As the supplying company normally does not have all experts at hand, a consortium must be formed,

wherein the company acts as a general contractor. A consortium comprises several dozen subcontractor firms and they in turn may have their own suppliers. An engineering company can in practice demonstrate their management and technical abilities only through reference projects; without such projects the chance of receiving an offer is near to none. This also means that a new engineering company has practically has no chance for success. It is a vicious circle: No references means no orders, and subsequently no orders means no references. Furthermore, the financial barriers to market entrance in the plant construction business are very high for new competitors. The expenditures for the acquisition of an order are in no relation to those for other businesses. The necessary preliminary efforts in marketing, personal visits, and generating a qualified offer are extraordinarily high.

Several characteristics and phases in the marketing of chemical plants can be distinguished (compare also Figure 5-1).

- the pre-marketing phase
- the contract or acquisition phase
- the project phase
- the post-project phase

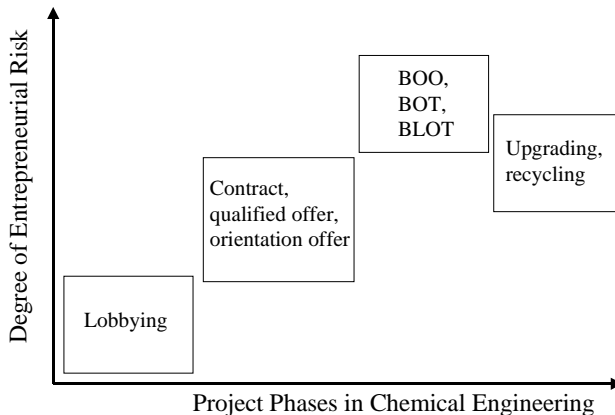


Figure 5-1 Marketing of a chemical engineering project

The market situation is characterized by an unusual transparency because there are only very few customers, either large companies or states and public institutions, who can afford the investment of buying chemical plants. For all market participants in the engineering business, it is obvious who the potential customers are and approximately when new investments can be expected, as the age of existing facilities are known or estimable. According to most national and supranational laws, such large planned investments have to be announced in international newspapers in the form of an invitation for tender.

Now, in the pre-marketing phase, there are two possibilities, either passive, where an engineering company waits for an invitation to bid, or, and preferably, the company is active or even proactive. For the latter, the company tries to gain access to the boardroom of the decision makers in companies and public authorities: a classic lobbying technique. Proactive marketing has different tasks. At first, it is essential to gather information about planned projects as early as possible and, further, to form an in-depth understanding of the client's envisaged working processes. Then, of course it is necessary to demonstrate both technical and management competence. Even more important is to recognize that the key-account managers of the engineering company will try to influence the kind of solution the potential customers desires: When, during the proactive phase, the requirements of the buyer have been already directed towards the strengths of the engineering company, the probability increases that the official offer will fit in a better way than the competitor's one.

The acquisition phase itself can be divided again into several stages. The first stage is an "informative offer", demonstrating interest and competence. The documents outline a principal concept and refer to other reference projects. The first offer is also regarded as a check of one's own chances to win the contract. If the buyer is interested, it will give more detailed information and discusses the project with the engineering company. The second stage is a "qualified offer", requiring much more in detail and, in consequence, demands more effort to precisely formulate the project including all accompanying services and extras. In this situation, it is critical that the general contractor is able to demonstrate solutions which would make the client more successful on the market. The last stage is the definite binding offer. This means that deliveries and prices are fixed and the contract becomes ready to sign. Obviously the entire procedure takes more time than other B2B activities and is costly: The evaluation of a definitive offer for a complex project can amount more than 5 % of the total project cost. From the first contact to the definitive contract, many meetings occur and employees on both sides are involved, spending both time and money.

It is essential that a company establishes an internal evaluation process to improve its chances in gaining the order, otherwise the dozens of elaborate qualified offers, each costing a substantial sum, could eventually ruin the company in the long term. Placing an offer is in itself a considerable financial risk, and it is therefore a question of survival to have an efficient information service in place and an excellent understanding of the market in general and the client's market in particular. The logistics of elaborating offers have to be standardized so far as possible, and of utmost importance is a good reporting system of past projects in order to gain some security for the estimates of time and budget limits.

A special problem during the acquisition phase is establishing the price. This is a very complex and risky process in comparison to other marketing problems. The principal difficulty is that each product is unique and there is little or no possibility for comparison. There is no supply and demand function, as found for commodities or consumer products. Comparison with the competitor's prices is also not possible because they are in the same situation. In other words, there is no set market price already existing for a given gas washing tower with special modifications. A well-

documented collection of case histories is therefore essential, from which at least similar cost structures can be derived. It is also important to know as much as possible about the cost structure of the competitor in addition to their technical capabilities. In this situation, benchmarking (introduced in Section 1.7) may be helpful. The most decisive criteria of the project are listed and then the competencies and potentials of the market participants are compared. The outcome is a profile of one's own company and the competitors showing strengths and weaknesses. Benchmarking can be a very powerful tool; the problem, however, is how to obtain reliable information about competitors.

In the contracting phase, it is essential that, beside all the necessary legal and insurance conditions, an intensive collaboration and exchange of information between the client and the consortium company takes place. Only in this way it is possible that the deliveries will meet the requirements. A joint team of both companies will prepare the essential elements of the contract. Sometimes also outside consultants can be present, who are called in by the client. The presence of consultants is not unusual because the client often does not have sufficient experience in the management of such large projects; it is this outside experience that they need. The time needed in the contracting phase cannot be overestimated, especially in international projects.

Many international projects become still more complex when, beside the technical details, a finance plan is also requested. Developing countries often do not have enough hard currency to finance such projects but their governments wish to accelerate the local technological development. In this case, the offering consortium has to produce a finance plan in conjunction with international banks and financial institutions. A common procedure is that the construction company or the consortium operates the chemical plant for some time to generate a cash flow, which is used as a return on their investment (see Figures 5-2 and 5-3).

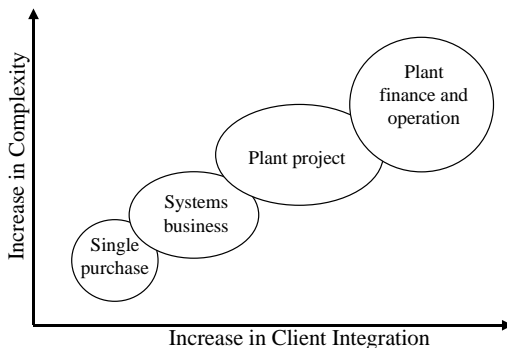


Figure 5-2 Complexity in business-to-business marketing

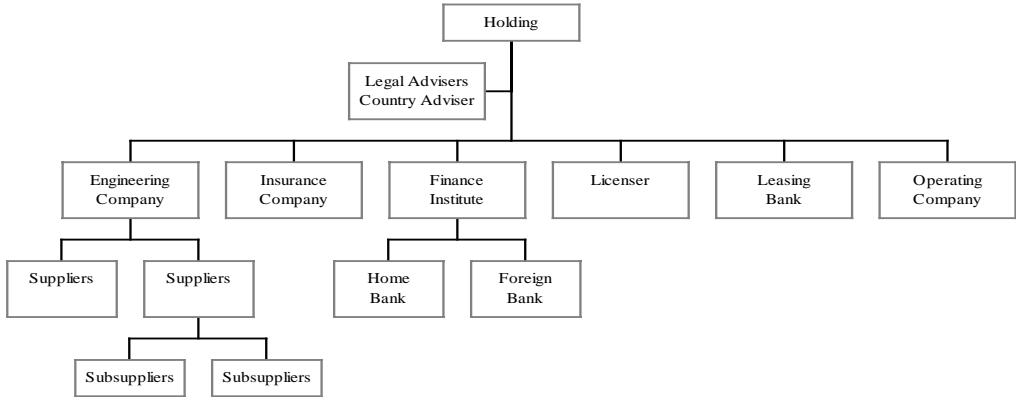


Figure 5-3 Model project consortium

During the project phase, it is essential that the managing company ensures that all the participants in the project work closely together. It is also important to recognize that most of the work has to be performed on site, often in a foreign country under special conditions. Without an effective collaboration with the local managers, engineers, and workers, the project cannot be successful. However, one cannot expect that in developing countries all engineers will have the same standard of qualification as found in Western countries and everyday operating life may be difficult. Nevertheless in all contracts a time limit has been agreed upon, and it is the responsibility of the project management that these limits are observed—in spite of all possible difficulties. Therefore, computer-based project management aids such as CPM (Critical Path Method) or PERT (Program Evaluation and Review Technique) are absolutely necessary in complex projects. Without efficient use of these tools, an engineering company cannot survive. Furthermore, a computer-based management support system is necessary, in which experiences of completed projects are documented appropriately.

After the construction is completed, a post-project phase will follow in most cases. The post-project phase can take several forms. Depending on the contract, an operation phase may follow or, at the end of the chemical plant's lifetime, a phase of deconstruction and recycling occurs, also known as “revamping”, and is form of modular reconstruction and adaptation to more modern technologies. In this connection it is important to refer again to the price-finding process. There is a trend developing that clients ask for the lifecycle cost, the total cost of construction, operation, and recycling. Clearly, for periods of more than 30 years can these costs be only very roughly estimated.

There are three principal models of operation forms:

- BOT Build–Operate–Transfer
- BOO Build–Operate–Own
- BLOT Build–Lease–Operate–Transfer

All three forms represent a certain finance and management style. As already stated, developing countries often do not have the financial potential to buy chemical plants or other larger production facilities, and therefore they ask the supplying company to operate the plant after construction. In such a situation, the project company forms a legal entity, a holding, comprising the general entrepreneur, a bank, an insurance company, and perhaps also a leasing firm, and the government or community. Together they operate the project and accept the entrepreneurial risk. The main advantage is that in this construction the financial security for the bank is given by the operating companies and the cash flow from running operations, independent of what credit standing the country may have at the international scale.

The first possibility, BOT, often is chosen to guarantee the proper function of the plant and to allow a certain period to train the local staff before the transfer takes place. During a relatively long-lasting operation phase under the responsibility of the supplier, cash is generated for the owner and products are made, which may be accepted as a first down-payment from the buyer. For example, the purchaser of an oil refinery pays with the different petrol fractions instead of money. The financial term in economics is a “barter” trade, when no money is involved in a transaction, or “counter trade”, when a payment is made in form of goods which in turn are converted into money. German pipeline producers have accepted the delivery of Russian gas as payment for the delivery of the pipes.

In the second case, BOO, there is no transfer of ownership. In essence, the plant is built on invitation from the host country, where the cheap land and low wages are attractive, and the jobs created and goods manufactures help in the development of the country. The government may hope that, at the end of the amortization time, the owner is willing to negotiate a transfer of the plant to the country at a discount price.

The last model, BLOT, is similar to the first one but it includes a lease period. This is a modification in risk policy: If the supplying company is interested in a quicker return on investment and not willing to maintain a long-lasting financial engagement, it sells the plant to a bank or similar, immediately receives the money, and then leases back the plant from an intermediate leasing institution. The supplying company can then operate the plant as guaranteed in the contract. In this way the company generates a surplus from the beginning. The company is in risk only—beside the usual operating risks—with the payment of the leasing rates (see Figure 5-4).

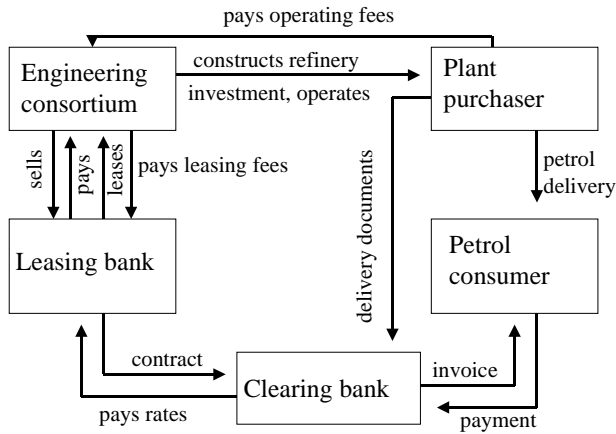


Figure 5-4 Financial construction of a BLOT in the case of a petrol refinery

Another post-project phase is plant recycling. In the past this was often no subject of negotiation. Today however, this part may be a decisive competitive advantage in a contract, when an engineering company is able to demonstrate awareness of ecological aspects.

5.2 Marketing Green Technology

The chemical industries at earlier stages of their development were the source of many environmental problems. Other industry branches and—not to be underestimated—private consumption have also contributed to these problems as well. But since the chemical industries have been the most visible polluters, they therefore became the focus of criticism. However, this industry branch also acquired with time (voluntarily, or by necessity) a deep understanding of the problems and began to develop, together with the machinery industry, highly sophisticated solutions. Today, the market for environmental protection, namely engineering and services, is estimated to a volume of about US\$ 800 billion worldwide. A quarter of this sum stands for Western Europe (see Figures 5-5 and 5-6). The booming business of the last five years, however, has actually slowed because of the Asian economic crisis and the stagnating reconstruction of many Central and Eastern European countries. Nevertheless, green technology has become an important factor in Western economies. This technology comprises in particular:

- waste water treatment
- waste deposition
- air protection
- recycling
- incineration plants
- measuring and regulation technology

Together with the engineering aspects of the business, roughly 60 % of the services are connected. Beside intensive works in connection with engineering, these services are specialty consulting, analytical, and laboratory work.

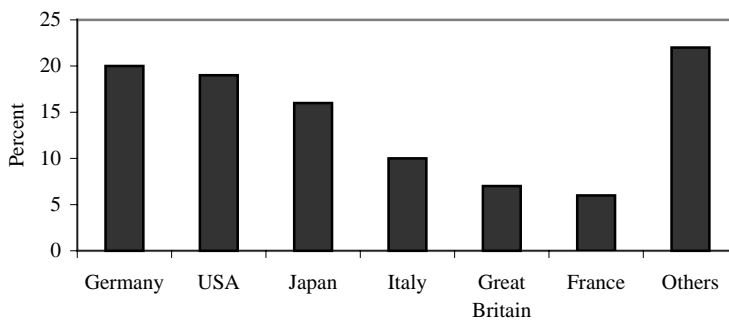


Figure 5-5 Market shares in environmental technology

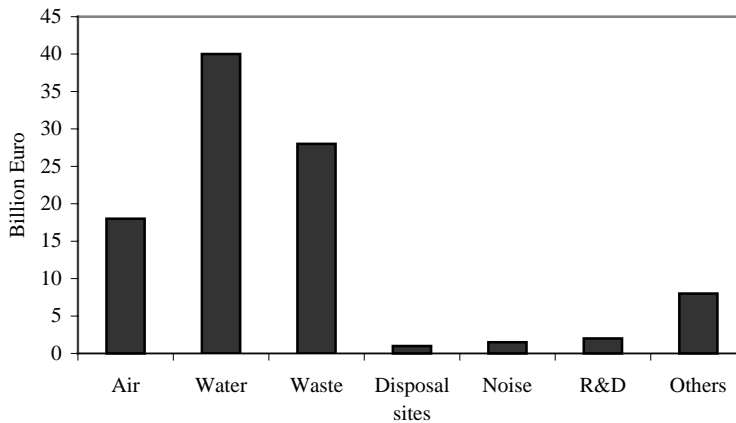


Figure 5-6 European Union expenditures for environment protection

For the European suppliers, the target markets account for about 60 % of all exports to the European market itself, followed by Central and Eastern Europe and the Asian markets in third place. In the world market for suppliers, Germany still holds first place, closely followed by the United States, and Japan in third place. Only a decade, Japan had only a marginal market share in this business branch but within only a few years it has pushed this branch to a leading and strongly competitive supplier to the international markets; Japan is expected to outperform the current market leaders within the next five years. One of the main reasons for this estimate is that the Japanese learn local requirements more deeply and transfer this comprehension into specific solutions.

There are some special elements in the marketing of environmental technologies. The products are very specialized and therefore national markets are rarely sufficient to assure the survival of medium-sized companies. Unfortunately, this category of firm can develop only with great difficulty in the international markets. The financial, personnel, and management efforts required are very high, and technical solutions to environmental problems can hardly be standardized.

A deep understanding of the “local content” of the problem is necessary, as is a good collaboration with all regional stakeholders, the authorities, political parties, and the like. An important part in the acquisition phase therefore depends on a reliable market information system. This in turn requires the formulation of a complete system which fits into the local environment rather than the delivery of single machines or constructions. Again, big companies have a significant advantage.

In addition, many countries which are in urgent need of environmental technologies do not have sufficient financial resources to pay for them. Western suppliers tend to make the mistake in offering a “technological overkill”, in which their engineers place emphasis on the most modern technology, which is not affordable for a developing country and is often so complex that a continuously functioning plant cannot be maintained by the local personnel once the construction engineers have left. A thorough training of the local personnel often does not solve this problem because the necessary maintenance cannot be guaranteed.

A particularly important market for environmental technology within Western Europe is the reconstruction and maintenance of the water pipelines. At the beginning of the twentieth century in most countries, the systematic construction of waste-water pipelines began. Many of the existing pipelines therefore are more than 70 years old and in consequence a number are leaking and near to collapse. In Germany for example, the public net accounts for about 400 000 km and the private net is about four times this length. The estimated market for repair and reconstruction is estimated to about € 50 billion within the next 15 years. The problem is complicated further since in most countries the state or the authorized companies must guarantee a high quality of drinking water and are, in addition, liable for that.

Within the environmental protection business a niche market has developed. This market is the biological soil and water treatment. A few smaller high-technology companies have developed processes to clean contaminated soil or waste water with special bacterial cultures, derived from so-called archaea bacteria, among others.

These strains, *Pyrococcus furiosus* or *Archeoglobus veneficus*, have been, as their names suggest, found in submarine volcanoes and survive high pressures and temperatures up to 110 °C. The latter, *A. veneficus*, digests sulfur dioxide and converts it into elemental sulfur. The abilities of these bacteria are quite extraordinary and it is reported that even dioxins can be digested under normal reaction conditions. It can be expected that this market will boom within the next years. Other bacteria have been discovered that can even resist radiation (*Comococcus radiodurans*), which perhaps may be applicable in the treatment of radioactive waste.

However, one should remember that the application of gene-modified bacteria is not only restricted to waste treatment. Classical chemical processes, such as industrial-scale production of the amino acid lysine or antibiotic precursors have been substituted by such bioreactions. These chemical processes are not only much cheaper but also create less polluting byproducts.

In spite of the positive market prognosis, the recycling industries do not share this optimistic view. Most processes, such as the selection of different types of plastic materials from a mixture, have been optimized meanwhile. Nevertheless, most of the procedures still are uneconomic and are subsidized either directly or indirectly. The cost of recycling cannot be calculated from the chemical and mechanical processes alone; rather the entire value chain has to be considered, from waste collection, mechanical “deconstruction” of the objects, selection and separation of the materials, chemical conversion, and through to the reuse of the material. Virgin plastic material is often much cheaper than recycled material.

In the past and especially in Germany, plants for plastic recycling with huge capacities were constructed at the same time when industry realized that such plants generate monetary subsidies. However, the processes turned out to be more difficult than expected, and today the former official policy of reusing a substance has fortunately been modified on consideration that an energetic reuse (such as incineration to produce energy) is an equivalent solution.

The situation differs somewhat for niche markets, such as the recycling of electronic waste. The recovery of noble or rare earth metals contributes to the profitability of the process. However, the content of these metals in modern components has decreased, and there exist serious problems with the flame-retardant materials bound into the plastic parts, which produce brominated dioxins when burnt. Newer materials do not contain such halogenated flame retardants—provided that they are produced by companies which joined the voluntary convention.

Engineers of incineration plants faced some difficult circumstances over the last years. Due to the physical recycling of plastics and paper, the energy content of municipal waste decreased dramatically in Switzerland and Germany. A paradoxical situation arose, and the city of Zurich raised the municipal waste fees because it had to buy oil to keep the incinerators running. Furthermore, the popular acceptance of new incinerators decreased because activists stimulated a fear of dioxin emissions, totally ignoring the developments in new incineration technologies which reduce the dioxin content in flue gas to practically zero.

A major Swiss producer of incinerators ran into serious financial trouble with its self-built and -operated project in the USA when the permission to run the plant

after construction was not granted, which led to long-lasting legal actions and involvement of expensive experts. This project caused such a loss for the company that financial reconstruction was required. The engineering of incineration plants is a very risky business because such projects are never free from political influence and easily become playthings of political parties.

6 Marketing Chemical Commodities

In this Chapter a few chemical products are described, which can be classified as commodities, although it is a rather subjective decision whether a substance is a commodity or a specialty product. As we will see, in practically all categories of chemicals some niche products can be found, which can be considered specialties. However, a further discussion of these criteria is not of use; a more important question is how these markets will develop in future and if they will remain in Europe or slowly shift to other countries.

6.1 Gases

One of the most important basic products is natural gas, transported through pipelines or as liquefied natural gas (LNG). The supply of natural gas to Western Europe is expected to increase from about 420 to 550 billion cubic meters from today to 2010. The importance of natural gas as an energy source in general, and in particular for the chemical industries, will increase because forecasts predict its use in power stations will rise from 20 % currently to 30 % over the next ten years. The poor acceptance of nuclear power may be—among others—a reason for this speculated increase. It is estimated that on a global scale of primary energy supply natural gas accounts for 25 %. The biggest producer is the Russian supplier Gazprom with about 35 % of the world's total known resources, of which 20 % go to Western Europe. Shares in Gazprom can be negotiated in all major European stock markets.

Huge investments, however, are necessary for the transportation of the gas, and therefore the distribution systems are a very important instrument of market power. Most of the gas is transported through pipelines, which in some cases passes unstable regions. Gazprom is planning a new pipeline to Finland, thereby circumventing the Ukraine; investments made already are reported to about US\$ 5 billion in 1998 and 1999.

The second important market are the industrial gases, a blanket term for nitrogen, oxygen, hydrogen, argon, carbon dioxide, and acetylene. The most important customers are, beside the chemical industries, steel producers and their subsequent clients. The world market volume for technical gases is about US\$ 28 billion with

considerable growth rates, especially in South America. The business of liquefied gases is expanding at 10 % per year and even more in the process industries where the gases are produced “on-site”, at the customer’s own site. This is an added value for the client in the case that the gas producer also runs the gas-producing plant near the source of consumption. These on-site plants are mostly air-separation devices. Other additional components are facilities for welding and cooling. Figure 6-1 shows the major players in the gas markets. In late 1999 Linde announced the takeover of AGA and also officially showed interest for a takeover of Messer-Griesheim, while in March 2000 the takeover of British Oxygen by Air Liquide was reported.

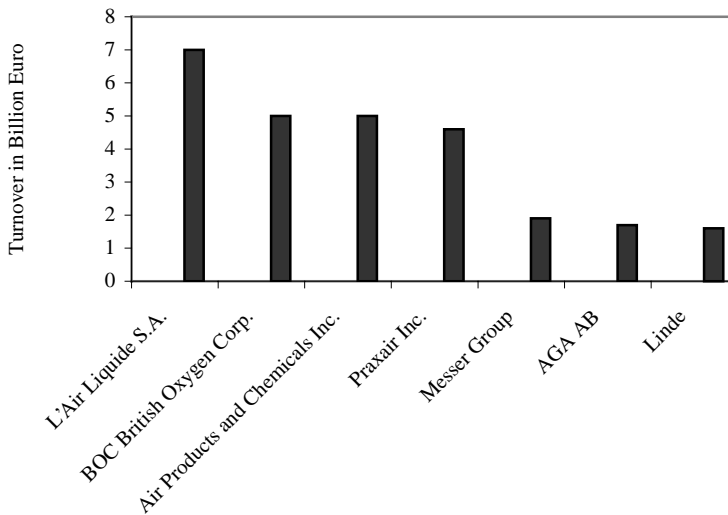


Figure 6-1 Turnover of major gas producers in 1999

A special and highly profitable niche market are all kinds of ultrapure gases, used in the electronics industries or in medicine. Minimal invasive surgery uses ultrapure carbon dioxide, and noble gases are utilized for eye surgery. However, these gases are subject of very strict registration procedures, the same as for pharmaceuticals. As most gas-producing companies are not familiar with these procedures, it is probable that they will look for partners and form strategic alliances.

Other special gases, such as silanes or fluorocarbons, are not produced by the classical suppliers of technical gases but by chemical companies. In some cases such substances are bought to support the business line. An important application is surface-modification technologies, for example fluorine gas diluted with nitrogen is used as a fluorinating agent for rubber seals and valves to reduce friction and wear.

Another important family of surface-modification methods are the plasma techniques, employing radicals of organic and inorganic gases.

6.2 Oil

Oil and gas certainly are, together with salt and phosphate, the most basic natural products for the chemical industries. Especially in the oil business, a large restructuring on a global scale has recently taken place. A wave of mergers and cooperations completely changed the market picture (compare Figures 6-2 and 6-3). It is a curiosity of economic history that the actual trend of mergers goes back to the very origins of the large oil companies. Mobil Oil started in 1866 under the name Vacuum Oil, which in 1879 was taken over by the Rockefeller–Imperium Standard Oil. However, this “empire” was forced by the American antitrust authorities to split into the famous “Seven Sisters”. One of the sisters was Mobil Oil, another was the Standard Oil Co. of New Jersey, today known as Exxon. In 1998, these former sisters merged again. Analysts estimate that by the merger of Exxon and Mobil cost reductions of about US\$ 2 billion would be possible. Also in 1998 three further fusions occurred among the oil giants, as well as the takeover of Amoco by British Petroleum and the acquisition of Petrofina by Total. Certainly other companies will follow.

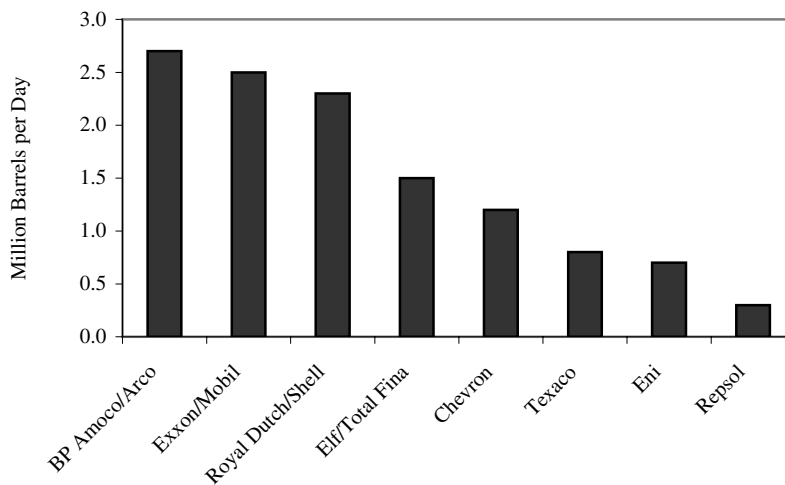


Figure 6-2 The largest oil companies in 1998

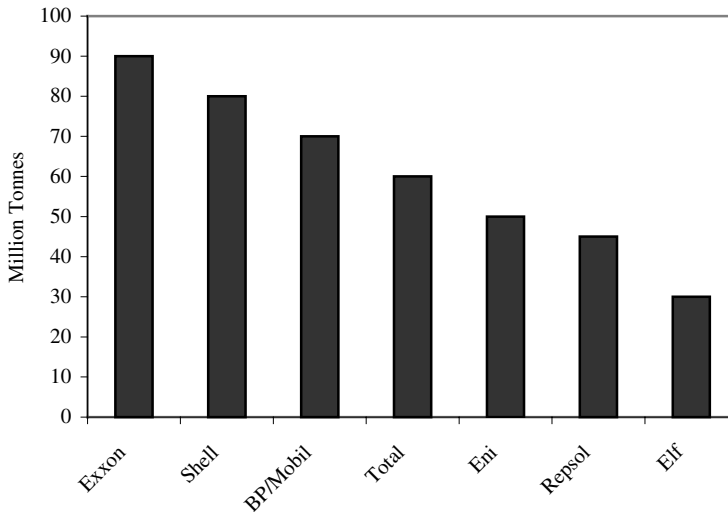


Figure 6-3 Refinery capacities in Europe in 1998 by company

The driving force behind the merger wave is the extremely tough competition. None of the large oil companies are big or strong enough to achieve a significant competitive advantage as there are too many companies of a similar size. Therefore it seems logical that some of them try to grow into still-larger proportions and gain cost leadership. A cost leadership, however, can only be achieved in the case of mergers or acquisitions, if there are sufficient synergies available. This buzzword “synergy” is cited by management in all cases of mergers. However, more than 50 % of all mergers and acquisitions become problematic or even disastrous. Just this magic formula of synergy often does not work because of cultural differences. Perhaps responsible managers will someday realize that mere size is not the decisive point and that the strategy of a downstream integration could be more successful.

In the past, oil companies have concentrated too much on the exploitation of oil and gas fields, which becomes ever more difficult and cost intensive. The network of petrol stations in Western countries has already achieved an economic limit and further expansion is only possible in Asia, Eastern Europe, and South America. With the traditional businesses alone, the local service stations cannot exist any more as the margins are far too low, and for this reason the franchise owners “diversify” into convenience products. Between the drilling holes and the consumers are situated the refineries in the supply chain, which indeed could gain more economies of scale through fusions (compare Figure 6.3). Whether the logistics of oil and gas transportation can contribute enough to the value chain remains questionable, and therefore it seems clear that the oil companies must enter more into the business of

oil-derived basic chemical products and their first steps of their conversion, for example lubrication products and polyolefins.

A special situation arises in Eastern Europe. In spite of all difficulties and rumors in connection with privatization, Russian oil companies will be in the near future among the world's leading oil players (see Figure 6-4). Cooperation with its former allied states in Central Europe as well as with emerging countries, especially India and China, will push Russia into a privileged position. Considerable investments have already been made in the modernization and expansion of its tanker fleet, new pipelines are planned, and last not least thorough cost-reduction programs begin to work.

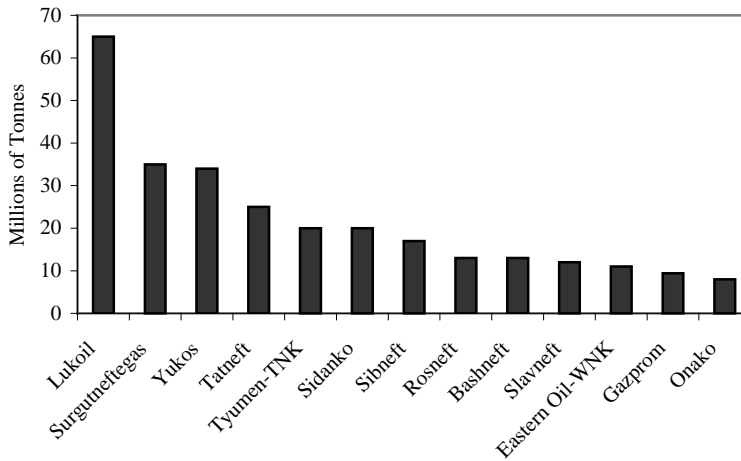


Figure 6-4 Russian oil production in 1998 (estimated total 330 million tonnes)

6.3 Pulp and Paper

The world's paper markets are characterized by overcapacities and fragmented industry structures (Figure 6-5). A lot of companies are producing below a critical size, which means that smaller companies have extreme difficulties in achieving economies of scale, while large producers are insufficiently big to enforce a cost leadership in the market (Figure 6-6).

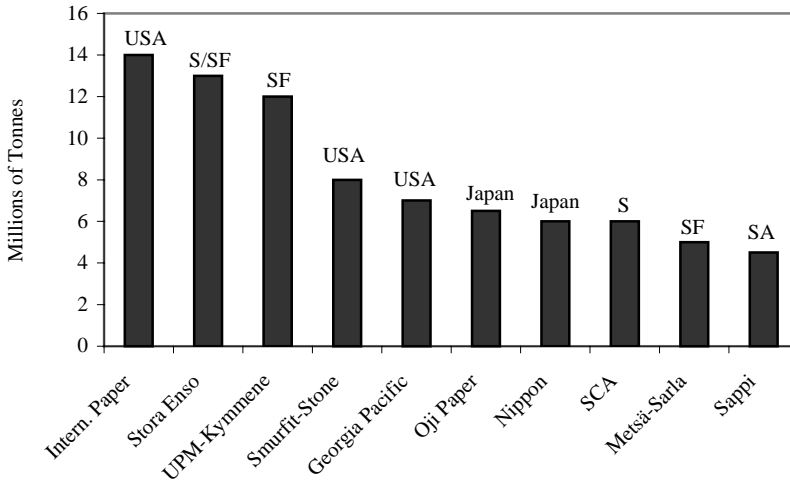


Figure 6-5 World's biggest paper producers in 1998 by capacity

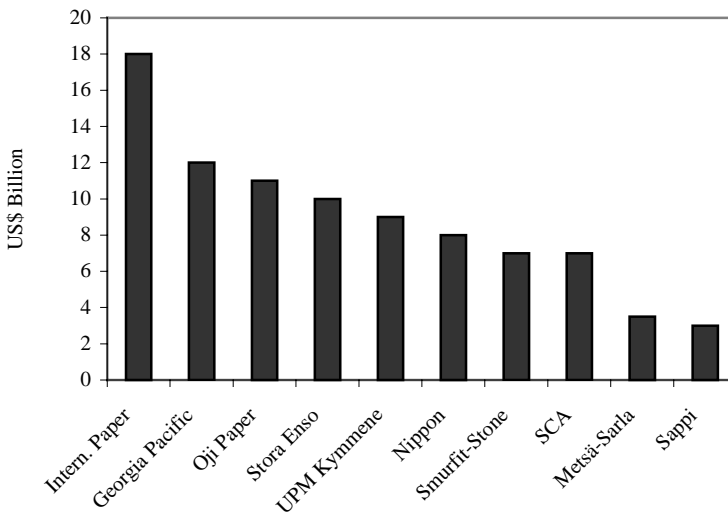


Figure 6-6 World's biggest paper producers in 1998 by turnover

In Europe, Japan, and the US, the markets show only a very slow increase in consumption (see Figure 6-7), the costs are continually increasing, and the profit margins are very volatile. The paper-producing industry is very dependent on the economic cycles of consumption products. The old-world producers are under heavy market pressure from dynamic competitors in Asia and Latin America. In these regions demand is rapidly increasing and is expanding about four times as rapidly. China meanwhile is the third most important market for cellulose, paper, and corrugated cardboard. In the last years it has rapidly expanded capacities for pulp (compare Figure 6-8). Two-thirds of all paper mills on a global scale are reported to be located in China; detailed figures however are not yet available. The average consumption of paper per capita in the world is about 50 kg (this value for the USA alone is 350 kg). In Northern Europe and Canada, the main sources for cellulose are slow-growing trees like pines, spruce, and birch. At the end of 1998 the price for cellulose was about US\$ 500 per metric tonne; costs break even with prices greater than US\$ 600 per tonne. Since 1997 in London a special exchange, the Pulpex, has existed for cellulose. Still, the number of daily contracts is rather low but such developments take time.

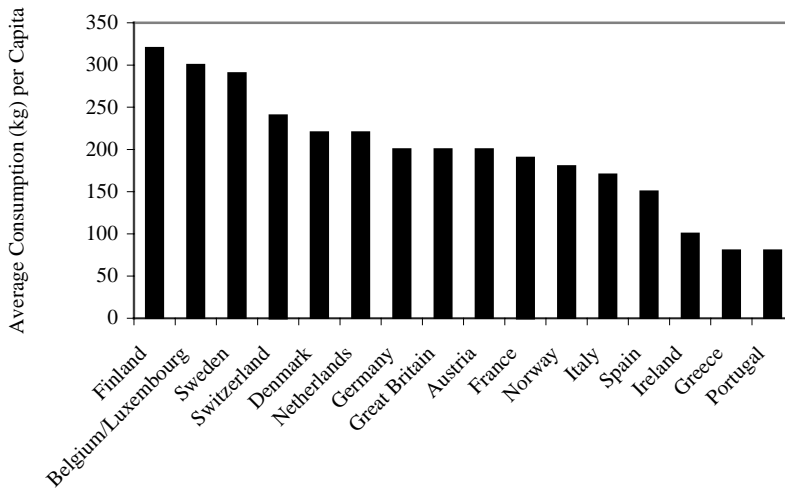


Figure 6-7 Consumption of paper and corrugated cardboard in Europe

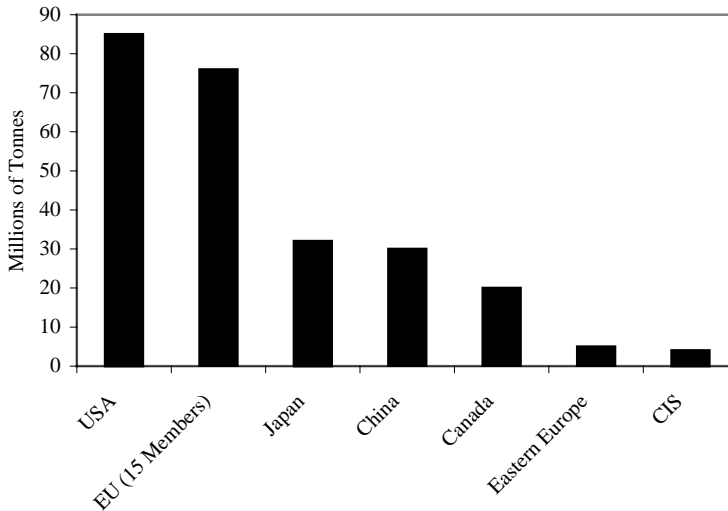


Figure 6-8 Production of paper and corrugated cardboard in 1998 (estimated world production 320 million tonnes)

For all these reasons, a consolidation process in Western countries is now taking place in the form of reorganizations and mergers. Reductions in capacities and even temporary production shutdowns were also used in the West to stabilize the situation. Increases in market shares can only be achieved through acquisition: Major transactions were the merger of Stora–Enso (Sweden/Finland), thereby forming Europe’s biggest paper industry, and Jefferson Smurfit and Stone Container (USA).

The main products requiring cellulose are:

- writing and graphic papers
- packaging
- newspapers
- hygienic papers
- special papers

The ten biggest paper producers showed a turnover in 1998 of about US\$ 100 billion. Figure 6-6 gave an overview. In spite of all claims about the paperless office, the trend in consumption of paper clearly points in the opposite direction. If there were a significant decrease in the consumption of paper for offices, then at least there must be an extreme overcompensation from other sources, and this cannot be seen. A part of the increase in consumption is due to the growing demand for packaging. To a certain extent the consumption of paper can be correlated with

increasing wealth in developing countries. However, one has to be careful because the same has been interpreted in connection with the consumption of steel and plastics.

A considerable part of the above-mentioned paper products, at least in European countries, is meanwhile produced with a high degree of recycled paper. An exception are most of the papers for graphic applications and some special types, such as for packaging in which a high tensile strength is demanded. In Germany and Switzerland, high collection rates of used paper caused an oversupply. Of course an indefinite number of (re-)cycles is not possible: After about six cycles, the cellulose fibers are too short to provide the necessary mechanical strength and must be eliminated. Therefore about 15 % of the material has to be replaced with new or high-quality types to maintain the necessary quality. The collection of used paper and corrugated board is costly, and these costs are not covered. Consequently, one can expect that some countries will introduce a fee for the collection of paper in a similar manner to that for plastic bottles (see Section 4.2). Figure 6-9 and 6-10 give examples of recycling rates in Switzerland. Concerning ecological arguments, there are two different trends. In the developed regions it is relatively expensive to cultivate the forests and the achievable prices for cut wood are rather low, while for less-developed lands a motive exists to clear forests in order to gain land for agriculture or for building and construction, which brings more profit. Cheap exports of wood to Western countries are the consequence.

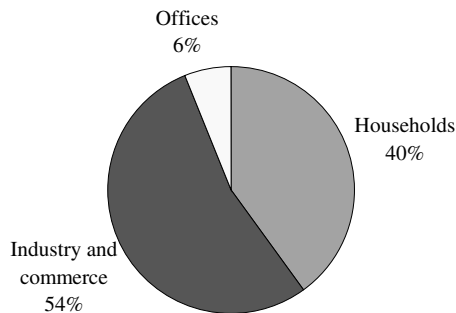


Figure 6-9 Sources of recycling paper in Switzerland

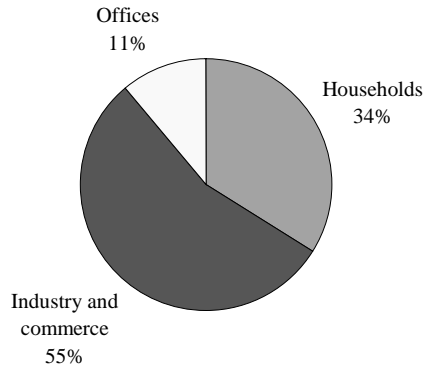


Figure 6-10 Recycling quotas of paper in Switzerland

Innovative and profitable applications for paper are in food packaging for example, where compound materials which act as a strong barrier are demanded. Aluminum-metalized liners can substitute for traditional oriented polypropylene (OPP) for external packaging. The market for animal-food packaging is also steadily increasing. Adhesive stickers for public relations are also a very interesting market. For these materials, very thin paper films are necessary which can be cut by a laser and compounded or impregnated with other materials.

6.4 Fibers

Industrial and textile are the two main categories in the synthetic fiber business. The production of textile fibers is stagnating in Western Europe, especially for nylon, polyester, viscose, and polyacrylate fibers. In contrast, development of the world market in total shows positive growth rates of about 2–3%. Whereas the production is stagnating also in Japan and the USA, in Asia huge capacities for polyester fibers have been built up in recent years. Taiwanese plants produce more than twice as much fiber as German ones. These overcapacities place pressure on world prices and competition is a struggle for market share with low prices. Between 1998 and 1999 prices for polyester fibers dropped by 30%. It is understandable that large Western companies therefore try to consolidate their portfolios and that some announce their fiber businesses are for sale. A fundamental restructuring of the fiber market is necessary, either by joint ventures or by mergers. The strategies most probably will follow the usual pattern of strategic alliances and fusions in order to gain cost leadership through economies of scale. Akzo–Nobel sold its fiber business

Acordis to a consortium of investors, from which CVC Capital Partners took 64 % of the shares. However, in which way the fiber business will become more profitable in the future through this deal remains a question. Hoechst, in the course of its total restructuring mentioned in Section 3.2.4, also lost interest in the fiber business and integrated its fiber-based activities into the new Celanese holding.

The picture is different for industrial fibers, which mostly cannot be regarded as commodities. These fibers are high-performance types like aramide or carbon fibers or other based on benzimides or phenolic resins. The usually show good margins and a slow, but continually growing, market.

6.5 Fertilizers

One of the most important chemical products are and will be fertilizers. These products are based on:

- phosphates
- nitrogen (urea and ammonium nitrates)
- potassium salt
- other minerals

Some fundamental considerations indicate certain trends in the fertilizer markets. The world population is still growing exponentially, and area usable for agriculture is decreasing. In the past, the consumption of fertilizers grew much faster than the production of food, now there is a significant and increasing gap between these two factors. What makes things worse is the fact that in addition to this gap, the efficiency in food production has had to increase at a rate greater than the world's population growth rate. Furthermore, agriculture in Western Europe and in Japan is connected with an excessive consumption of energy.

However, in spite of the urgent need of fertilizers, especially in the highly populated less-developed countries, the demand in the West is sluggish and prices are under pressure from cheap imports. Russia produces in its old plants and can offer fertilizers, such as ammonium nitrate, at much cheaper prices (even when including the transportation costs) than Western companies will ever be able to do. European states tried to levy "anti-dumping taxes" on Russian ammonium nitrate, who simply circumvented these barriers by rerouting deliveries to the US. The market situation in Russia and especially in the Ukraine remains nebulous as former Soviet "apparatchiks" took control over the export of fertilizers. The portmaster of Yuzhny in the Ukraine, from where the biggest quantities were shipped, was said to be called the fertilizer czar and controlled the market. Western companies helped themselves by engaging Russian insiders in order to guarantee a continuous delivery.

For a while in late 1977, China completely stopped the import of urea with the effect that prices per tonne on the world market dropped from US\$ 180 to US\$ 60. China and India remain the most important consumer for phosphates and potassium, together these countries buy 70 % of the phosphates and 25 % of potassium produced globally.

Strong competition induces innovations also in the field of commodities. A major disadvantage of common fertilizers is that their efficiency depends on the weather. After application of the fertilizers onto the field, the quantity of rain determines how much is absorbed by the plants or how much and at what rate the fertilizer is washed out. The optimum would be that in the right periods of growth just the right quantity of the right mineral needed were delivered to the plants. BASF researchers have produced fertilizer particles coated with an ultrathin film of polyethylene, which restricts fertilizer release according to its diffusion rate through the coating material, independent of the quantity of rain. Perhaps the idea can be optimized further by the application of degradable polymers.

6.6 Chlorine

The “green element”, hated so much by the “Greens”, is estimated to be involved in about 50 % of all chemical processes, where it plays a significant role in some reaction step. More than 85 % of all pharmaceuticals are produced by reactions where chlorine is necessary, and 95 % of our drinking water is treated with chlorine. In our stomach digestion takes place with excellent chlorine chemistry.

More than 95 % of chlorine is produced by chlorine-alkali electrolysis of a solution of sodium chloride in water. Until about 1980, the old amalgam and diaphragm processes dominated, while today membrane technology is employed. These membranes are composed of perfluorinated fibers. The advantage of the membrane process is that no mercury or asbestos is needed and less energy is required. The world total production capacity of chlorine is estimated to about 50 million tons per year and the demand is currently approximately constant. However, it is possible that the consumption in reality is increasing because the recycling quotas are not calculated in the total consumption. Figure 6-11 shows the production capacities. The major demand for chlorine comes from polyvinyl chloride (PVC), cellulose bleaching, and in the manufacture of ultrapure silicon for electronics, of titanium dioxide for white pigments, and of chlorine-containing solvents. As an important intermediate—but not in the end-products—chlorine serves in the production of polycarbonates, polyurethanes, and epoxides.

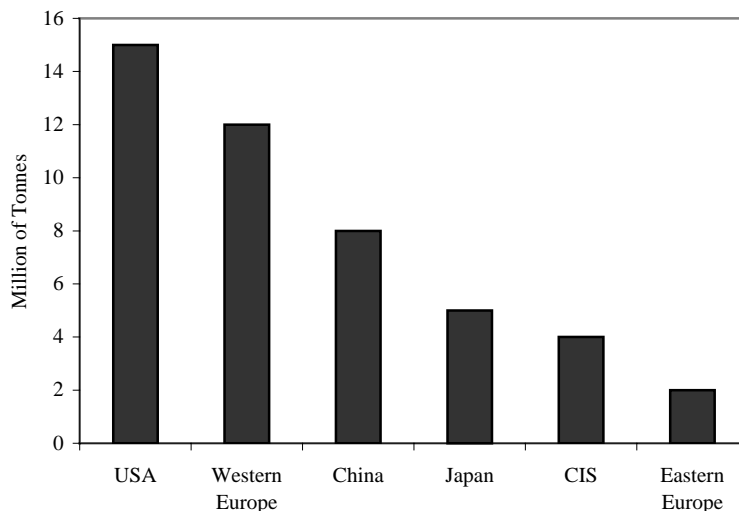


Figure 6-11 Capacities in chlorine production in 1998

The main points of criticism against the use of chlorine were the release of the heavy metal mercury, arising from the production in older plants, and more recently the subsequent products, specifically emissions of chlorinated solvents and the formation of dioxins when chlorinated substances are burnt. However, in modern (post-1980) plants, which use diaphragm technology, mercury is no longer needed and the use of chlorinated solvents is on the wane. Many plants using chlorinated solvents have been equipped with modern recycling systems, while incineration plants are able to reduce the dioxin emission to an absolute minimum. None of all of these efforts have helped increase the public's understanding of the necessity of chlorine chemistry; green activists have vigorously fought for years.

Finally a comprehensive study by the Stanford Research Institute (SRI) proved that PVC fits excellently into the concept of "sustainable development", in which industrial processes should be run in a way that natural resources can be maintained over the long term. For the production of PVC, salt is used, available in unlimited quantities, in conjunction with oil or natural gas, derived from more limited resources. PVC is composed of 57 % chlorine, which can be recycled when the polymer is pyrolyzed. The energy consumption for this process can be fully covered by the oxidation of the hydrocarbon components of PVC. In comparison to other plastics, PVC was more environmental friendly according to this study. Nevertheless, the Swiss government forbade the circulation of PVC bottles and some regional governments in Germany prohibited the use of PVC windows in official buildings. The problems associated with PVC are still not overcome, as one can see when an accident happens: In each spectacular fire, PVC is made responsible for the origin of measured dioxins—even when none was present.

The mere fact that these discussions could rise to such an extreme level made it evident to the chemical industry that they had completely missed a fundamental element of marketing—communication. In their clumsy way, scientists tried to educate the population in their incomprehensible language (see also Section 4.4). They argued on a rational basis, as other forms seemed undignified. Only later did they learn that the problems of misunderstanding were emotional ones. Public relations campaigns started, showing a lifeboat made of PVC—that is what people understand!

A second severe mistake was made in that political lobbying was totally insufficient. Nowadays a similar problem arises in the biotechnology industries. Marketing is not restricted to the product, rather it has also to be extended to external interest groups. The chemical industry has to demonstrate for what purposes their products serve and what they are good for.

7 **Plastics and Rubbers**

The age of plastics was predicted in the 1970s and, ten years later, high-performance polymers were regarded already as successors of most metals in the automotive industry. The euphoric mood has meanwhile passed and a more realistic view is dominant. Only the commodities are still successful and show remarkable growth rates over the decades, although sometimes interrupted by recession periods. The problems with the new materials, which should substitute for steel, had been underestimated. Whereas the production and the handling of steel products can profit from the experience of nearly two centuries, the processing and transforming of plastic materials needed some decades of trial and error. Filled and fiber-reinforced materials showed strong anisotropic behavior, which required a thorough understanding of their rheology during molding and extrusion. Completely new technologies had to be invented for, by way of example, the transformation of bulk-molding and sheet-molding compounds (BMC, SMC). The treatment of plastic waste also needed new technologies.

High-performance polymers showed astonishing physical properties, such as heat resistance or mechanical strength. However, in most cases their higher cost could not meet the added value in comparison to traditional metals. Only niche markets now exist for them, but fortunately profitable ones. Furthermore, the development of new polymers requires an extreme investment not only in research but also especially in production plants, process development, and marketing. Therefore, only the largest companies can accept such risks and investments, and even then they are very reluctant to enter into such a risk, preferring rather to expand their traditional product lines through modifications. The entrance barriers to this market are very high for newcomers, with the exception of very innovative applications or materials, such as in the medical sector. On the application side, companies needed completely new equipment to process these materials. The usual extrusion and injection machines were unable to work under the high temperatures needed for processing polyetherketones or polyimides. In addition, the new class of liquid crystalline polymers showed a completely different melt and rheological behaviors. The producers of these high-performance polymers sometimes had insufficient experience with the applications of these new materials and could not give precise processing parameters to their customers. This may be another reason why these polymers have not yet been so successful in the market as initially forecasted. Nevertheless the overall market for plastic is increasing, especially in Asia. The consumption worldwide was estimated for the year 2000 at about 165 million tons with a growth rate of 4 % per year on average. This data contains the engineering plastics, accounting for about 11 million tonnes.

Meanwhile, many plastic producers concentrated their efforts less on the development of new materials and more on the modification and combination of existing materials. Together with the increasing demand for tailored polymers, materials in which their physical properties are exactly designed for their application, this sets the trend for the polymer business. In former decades, only a limited range of standard types of certain polymers were available, and therefore the products had physical properties that were often “overdesigned” for reasons of safety. Although a waste of money, it was often unavoidable. As an example, the moving parts in magnetic information-recording disks may be mentioned, formerly produced from polyoxymethylene. After a calculation of the average lifetime of such a disk, producers discovered that a specific type of polyethylene (PE) was just as appropriate. With a better understanding of how to run the polymerization processes, especially how to influence the molecular weight, the producers could offer more customer-oriented solutions. A bimodal PE was one such solution. This polyethylene shows two peaks in its molecular weight distribution, one in the low and another in the higher weight range, where the former population serves as an internal lubricant during extrusion. As well as designing for properties, designing for cost is demanded. Polymer blends offer a broad range of cost-saving materials for engineering purposes. This part of polymer science has created a better understanding of compatibility problems and new blending auxiliaries have led to construction materials with many interesting properties.

In the past decades, most of the larger chemical companies followed the strategy of possessing an overall presence in plastics, perhaps to limit the fear of missing an important market. Very soon, however, they learnt that this extreme diversification was unprofitable and began to concentrate on only a few types of polymers. Because all of them were producing basic chemicals and had ethylene and propylene available, polyolefins and in addition some types of high-performance polymers such as polysulfones, polyetherketones, or fluoropolymers were made. However, beside the already-mentioned troubles with the high-value polymers, no manufacturer could achieve major economies of scale with these commodities. As a consequence, a total regrouping in the market structure began in the late 1990s and is ongoing. The new strategies in the plastic branch are characterized by alliances and cost leadership with world-scale plants. If new products are launched, global grades are introduced. The second issue is horizontal integration featuring the same motif of cost leadership. An actual example is the acquisition of companies for the production of components necessary for polyurethanes.

7.1 Polyolefins

Polyolefin is a blanket term summarizing the five principal polyethylene types, low density (LDPE), linear low density (LLDPE), very low density (VLDPE), high density (HDPE), and ultra high molecular weight polyethylene (UHMWPE), as well as polypropylene (PP) and its copolymers. The applications of LDPE covers the areas of film and sheet fabrication, injection molding, extrusion coating, wire and cable insulation, pipes, and profile and blow molding. HDPE is used for the same purposes, with the addition of fibers. UHMWPE is a special grade and used as low-friction material and as a corrosion-resistant polymer. VLDPE initially had been designed as a modifier for other polymers like LLDPE and PP, however, in some cases it can replace the barrier copolymer ethylene–vinylacetate (EVA) in multilayer films. Figure 7-1 shows the world capacities of polyolefins and Figure 7-2 the application areas in Western Europe.

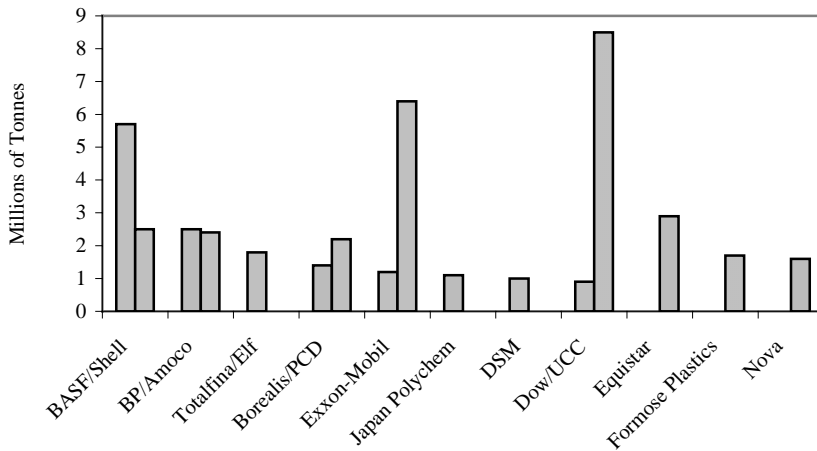


Figure 7-1 Capacities of the leading producers of polyolefins in 1999; left column PP, right column PE

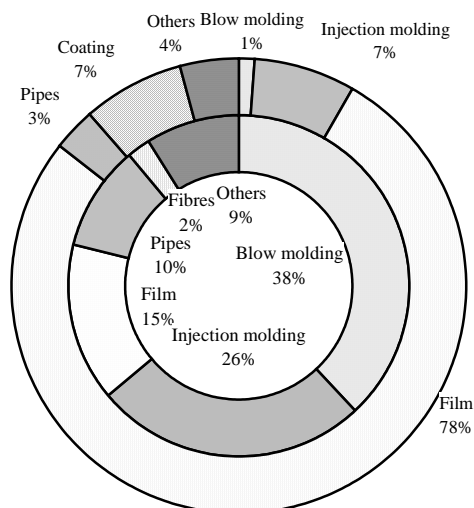


Figure 7-2 Polyolefin consumption in Western Europe; inner circle HDPE, outer LDPE

BASF and Shell combined their polypropylene businesses in 1998 to begin a 50:50 joint venture under the name “Elenac”. This was thus far the biggest coup in the industry, forming the world’s biggest polyolefin producer holding first place in polypropylene and fourth in polyethylene. For both partners it seems to be an ideal combination, allowing BASF to strengthen its leading position and Shell to integrate more downstream components into the chemical business. Market growth rates are estimated at 3 % for polyethylene and 6 % for polypropylene. BASF obviously follows the strategy of joint ventures and has other engagements with Shell for polystyrene, DSM for ABS copolymers, and with Solvay for PVC. Figure 7-1 shows important joint ventures in the polyolefin market.

In recent years the polyolefin market has offered some new and interesting materials. Due to a new generation of catalysts, the metallocenes, polyolefins with a very high stereoselectivities have been developed and produced in large quantities. These materials show high mechanical strength and good barrier properties, which makes them especially attractive for the food-packaging industry.

Packaging is the most important outlet for polyethylene. LLDPE shows high growth rates, together with PP and PET for bottles. Figure 7-3 shows the European turnover of plastic packaging. More than the half of the material in packaging is used for the production of films. The trend in the market is to increasingly thinner films and multilayer films. Coextruded films of LDPE and LLDPE of thicknesses less than 150 μm are state-of-the-art. Even films composed of five 20- μm thick layers can be produced. They are applied for food packaging, containing polyvinyl alcohol (PVA) as a barrier material. These ultrathin films require polymers with a special distribution in the molecular weight and of course a sophisticated production technology. Another trend in the production of films include tailored multilayer

materials applications ranging from stretch-wrap films to bullet-proof windows constructed from a glass-polymer sandwich. The stretch wrapping of palletized loads is becoming the norm in Western Europe and represents a rapidly growing market, in which coextruded films with high tensile strengths are used. Mono- and biaxially oriented films are also produced, resulting in films with enhanced mechanical strengths and better barrier properties. LLDPEs have captured most of the market for rotational molding (rotomolding) in Western Europe, as applied principally to large tanks, containers, and drums.

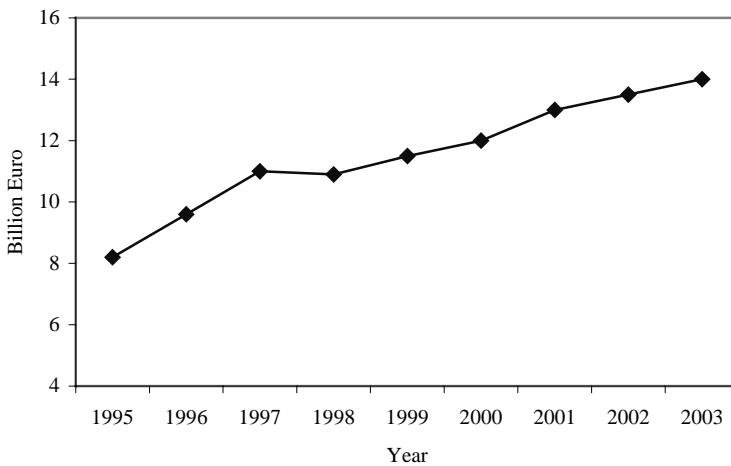


Figure 7-3 Reported and projected plastic packaging turnover in Europe

Special modifications and new developments in the field of polyolefins have to be mentioned. First, the cycloolefin copolymers (COC) and ultrahigh molecular weight polyethylene (UHMWPE) are good examples. COC, produced by the copolymerization of norbornene and ethylene, has excellent optical and insulating properties and heat resistance. Both polymers exhibit good biocompatibility. The outstanding wear properties UHMWPE leads to its application in artificial hip joints, and wherever else it can substitute for expensive polytetrafluoroethylene (PTFE). Second, many new coextruded products for stretch-cling layers, shrink films, barrier films, and metallized or coated films have found their markets. Lastly, the food industry tried to introduce a special silicon monoxide (SiO)_x-coated PE for the preservation of aromas.

Polypropylene has found its market as an engineering plastic, especially in the automotive sector, where its use for the molding of bumpers/fenders is remarkable. Together with blends, PP covers a broad range of applications and faces, as a low-

cost material, higher growth rates than most of the other polymers. Its higher temperature resistance makes PP more suitable for household equipment, and its newer applications include the production of GMT (glass-mat reinforced thermoplastics).

7.2 Polystyrenes

About 17 million tonnes of monomeric styrene are annually produced globally and find their way into three main applications (the numbers in parentheses indicate the consumption in millions of tonnes):

- polystyrene (PS, 11)
- expanded polystyrene foam (EPS, 3)
- copolymers (3)

The European market counts for about two billion euro, a fifth of the world market. Similar to other chemical markets, a concentration effect can be observed in this sector, which is expected to continue. Table 7-1 shows the biggest PS producers in Europe as of July 1999.

Table 7-1 Market share (%) of major European producers of PS and EPS

| PS | | EPS | |
|---------|----|--------------------------|----|
| BASF | 20 | BASF | 20 |
| Elf-Ato | 17 | Shell | 17 |
| BP | 16 | Eni | 10 |
| Dow | 16 | Huntsmann ^[a] | 10 |
| Eni | 15 | BP | 9 |
| Others | 16 | Others | 34 |

[a] after its sale to the Canadian Nova Corp., Nova became the world leading producer of styrene and polystyrene

Polystyrene, as a thermoplastic resin, is a low-cost material and can be easily processed by extrusion, injection molding, or thermoforming. There are many applications, such as packaging, household goods, electronics, and in construction. Different grades are delivered to the market, such as crystalline types, with a high molecular weight and a transparent glassy appearance, an oriented form, designated OPS, or as HIPS, a form modified with polybutadiene in order to raise the impact strength and overcome the characteristic brittleness of PS. Expanded polystyrene,

most commonly fabricated as beads through a suspension polymerization of styrene in water where at a late stage *n*-pentane is added, finds its uses for packaging and insulation purposes. As a packaging material EPS has problems with disposal because of its large volume. For building insulation, additional treatment of the EPS with a flame retardant is necessary.

7.3 Polyvinyl Chloride

In spite of all rumors, polyvinyl chloride (PVC) production is expanding by 1–2 % per year in Europe. About 40 % of the world's chlorine demand (estimated to about 40 million tonnes) is for PVC. Figure 7-4 gives an overview of the leading European PVC producers and the corresponding joint ventures. PVC has some unique properties and in many of its applications cannot be substituted by other polymers—at least not by materials in the same price range. The most outstanding properties of PVC are its resistance to degradation and aging, and its barrier properties against oxygen. It is an ideal material for tubes, pipes, cables, window frames, flooring, and roofing, especially when, in building and construction, guarantees of ten years and more are demanded for tubes, pipes, and frames. In packaging, however, it has lost some significance, especially for films and bottles. Nevertheless for medical purposes PVC is a favored material and has maintained the market position. In this area, it is vitally important that blood, for example, undergoes no reactions with the surface of a bag or an infusion tube or during dialysis. In addition, the material is resistant to oxygen and, above all, PVC can easily be sterilized by radiation, vapor, or with ethylene oxide. In Germany, about 10 000 tonnes of PVC are used annually for medical purposes.

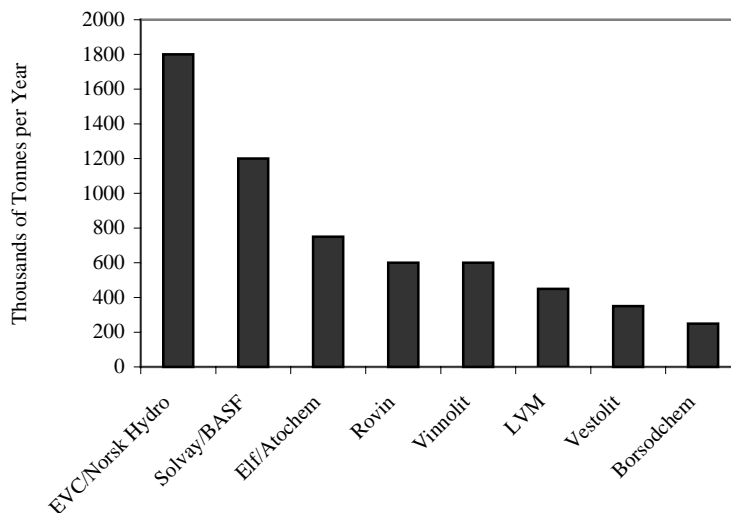


Figure 7-4 Capacities of major European PVC producers in 1998

PVC is one of the most criticized chemical substances and has a bad public image. Lack of understanding, as well as pure ignorance, has led PVC to become a major suspect as a source of dioxins in the environment. However, modern filter systems in incineration plants are able to eliminate these dangerous decomposition products. Other problems include elimination of hydrogen chloride upon ultraviolet irradiation or the combustion of “old fashioned” PVC types, which may release their cadmium-, tin-, or lead-based stabilizers. There are different procedures available to recycle or to pyrolyse PVC. A melt of sand and calcium oxide (the Solvay process) at 1440 °C under oxygen cracks PVC into carbon monoxide and hydrogen chloride; the gases can be directly used to synthesize new PVC. Recycling used PVC by mechanical grinding and mixing together with fresh material, however, makes sense only when the old material contains no heavy metals as stabilizers, otherwise the undesirable cadmium, tin, and lead is only “diluted” into new PVC. A good PVC marketing strategy therefore has to integrate a convincing recycling concept. Finally, training the users in how to use PVC in a correct and durable way for roofing, sheet welding, or tube bonding applications is a service for the customers that creates a competitive advantage.

7.4 Unsaturated Polyesters

Unsaturated polyesters are obtained by a condensation reaction between glycols and dicarboxylic acids, for the latter a certain molar fraction is based on an unsaturated precursor. The polyesters are dissolved in a reactive vinyl-based monomer, usually styrene. In combination with a mineral filler, such as chalk, fibers, and some additives, mixtures are obtained which can be extruded or molded when heated, resulting in shaped finished products with high thermal and mechanical stability. These transformation processes are called sheet or bulk molding. Today, many applications in the automotive industry, where unsaturated polyesters substitute for steel in panel sections or complete truck cabins, may be found. Other applications, encountered especially in Japan and in the USA, are complete bathroom units or in electrical components, such as switchboards. Molded parts in general form a major outlet for these compounds because of their high filler and fiber content which results in relatively low prices for these mechanically stable materials. For automotive parts, however, the molded surfaces are not good enough to compete with steel without further treatment. In order to produce perfect, pinhole-free surfaces, a gel coat is necessary. The gel coat, injected shortly after a first pre-molding of the part, ensures a perfect color and gloss when painted, similar to enameled steel parts.

A further application for unsaturated polyesters and vinyl esters are pipes and large tanks, produced by filament winding. Long fibers are drawn through a resin bath and wound at a predetermined speed and angle to form a pipe or a tank. By this technique, tanks of several meters in diameter can be produced, which find application as grain silos or in houses as fuel tanks for central heating. For the latter purpose, numerous tests were required to prove mechanical resistance and fire safety. Vinyl esters are especially resistant to corrosion.

Unsaturated polyesters are a good example of a product that is not marketed alone but wrapped together with a bundle of other services. Without a complete system of “adds-on” (molding technology, painting, calculations of the stamping form, and so forth) the material itself would be useless for the client. In addition, a long training for “thinking in plastic” instead of “thinking in steel” is a prerequisite for a successful substitution of metal by plastic. A completely new technology had to be developed for the molding and subsequent procedures. Testing the final parts to make sure that they meet the same standards as steel and show adequate mechanical strength is another important point, and as such new test methods had to be established.

Finally when all the services were available, a new way of recycling had to be developed. Engineers, who had overcome most difficulties in construction, nearly failed to offer a proper solution for the waste management. Again, because of the extreme difficulties with the new class of material, a lifetime concept was required to ensure a definite acceptance in the market.

7.5 Polyurethane Foams

Flexible foams are mainly used as cushioning material in furniture, bedding, and transportation. They are normally produced by a mixture of toluene diisocyanide (TDI) and polyether polyols. Rigid foams find application as insulation material in refrigeration and construction. They are formed by reaction of mostly methylene diphenyl diisocyanate (MDI) with an aromatic polyester polyol. The fluorocarbons, the heavily criticized foam-blowing agents, have been substituted in industrialized nations by less harmful substances in accordance with the 1989 Montreal Protocol of the United Nations Environmental Program.

Foams are produced during the reaction of the liquid components and shaped by extrusion or injection under heat or at room temperature. The exact formulation is adjusted according to the processes. Polyurethane (PUR) components are delivered in a standardized premixed form, a machine-ready system. However, systems have to be designed for specific applications and the machinery used by the customers. In most cases the best way of production has to be established in an experimental phase on the customer's production site. The assistance of the supplier's technical staff is often necessary because the specific production situation—retention times of the liquids in the machines, tubes, and mixing equipment—cannot be easily simulated in the laboratory. As the polyurethanes are quite reactive, the process kinetics depend on the given chemical and physical parameters, and the industrial process needs to be designed according to situation. A profound knowledge of the process technology is absolutely necessary for the sales team. Successful marketing of polyurethanes needs a technically oriented team with a high degree of practical experience; a compilation of case studies is an important marketing asset.

Companies which integrate all PUR components (diisocyanates, polyols, and propylene oxides) have an advantage not only in price but also in the increased possibility of modifying the components according to the customer's needs. A strongly integrated company in the PUR business is Bayer, supplying about a quarter of the world demand in MDI and TDI. Figure 7-5 gives an overview over the different markets for polyurethane foams.

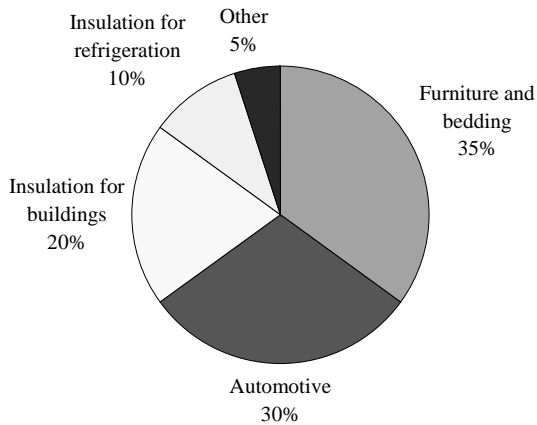


Figure 7-5 European consumption of PUR foams in 1998

7.6 Polyethylene Terephthalate Resins

Beside PVC, it is certainly PET, widely used for bottles, which has been vigorously discussed and exposed to political discussions and lobbying. For this reason, it represents a good example for marketing lessons. In summary, one can say that technical reasons were sometimes much less important than the political ones. The case of PET is very interesting because two powerful organizations, the plastic and the glass industries, were fighting against each other and sometimes even against a third one, the aluminum industry. The point of dissent was which of the three packaging forms for beverages was more environmentally friendly: glass bottles, PET bottles, or aluminum cans. The main argument in favor of PET was that the transport of lightweight packaging consumed less energy; the argument for glass was that it was the best material to reuse over many cycles in one form and at the end could be easily recycled; while the aluminum industry argued that the aluminum production consumed less energy (and in addition clean electrical energy) than glass and could be recycled as well. Millions were spent to produce ecological balance sheets, and most ecobalances proved that the material produced by the group who ordered the balance was the best. In one case, when the desired result was not

delivered, the industry actually complained! The study had not considered that the “clean” hydroelectricity produced in their region was much less damaging to the environment than the glass-melting furnaces supplied by “dirty” energy from oil- and coal-powered stations. In the end, when research institutes were requested to create an ecobalance that even included the creation of coal in the Carboniferous period, technology had progressed so far that reusable and recyclable PET bottles finished the discussion. It was a similar case to that of the sugar industry against the producers of artificial sweeteners (Section 4.3).

The marketing aspect of this case is that a technological leap or a break of traditional patterns has to be prepared very carefully. Seldom are the arguments only of scientific nature—on the contrary, they are on an emotional level that states artificial sweeteners would cause cancer, PET bottles would emit toxic substances, and so forth. Severe mistakes are often made in marketing of new materials. Far too late the consumers (the main people in this scenario) were asked about their points of view and their acceptance or refusal of lightweight bottles. Too late were the producers of beverages confronted with possible pros and cons of the different solutions. Before significant innovations are launched, a pre-marketing step in very early stages has to be made and possible rejections to be evaluated in advance. Only later can traditional marketing step in.

7.6.1 Polyethylene Terephthalate Films

The polyester is produced from the same basic polymer that is used for PET bottles, fibers, and engineering resins. A profound understanding of the production process is necessary to fabricate films with well-defined properties. Molten PET resins are quenched to form an amorphous film. However, in this stage the film is of little use because it needs to be stretched, and the stretching steps give the film a controlled degree of crystallinity.

The applications for PET films are numerous, such as in diverse photographic films, magnetic media, electrical insulation, or packaging, and it is important that the physical properties required for each specific application are achieved with very narrow tolerances. This in turn means that marketing of PET film can only be successful if the scientific basis behind the products can be demonstrated. And of course there is no need to emphasize that the producer has a sophisticated quality-assurance program. It is the difficult task of the sales staff to manifest this intangible asset and transfer it to the client. A thorough understanding of the client’s technology is necessary, as is open communication between producer and user. A further competitive advantage is that the producer of films has captive PET resins available.

7.6.2 Polyethylene Terephthalate Fibers

The flourishing times of the late 1960s for the European polyester fiber business have disappeared. For all fiber producers in Western Europe—with the exception of technical fibers—it is extremely difficult to compete with current production in Asia. There is a strong shift of the whole textile technology, including spinning, weaving, and dyeing, towards developing countries with emerging industries. In the last years most of the fiber-processing branches were a permanent loss-maker. In the course of restructuring, Western companies found it difficult to sell their fiber plants because there are so few buyers. The question arises whether, or when, some of the fiber plants will be shut down.

7.7 Rubbers

Beside natural rubber (NR), the most important groups of elastomers are:

- butyl rubber
- ethylene–propylene rubber
- nitrile rubber
- polybutadiene rubber
- polychloroprene rubber
- polyisoprene rubber
- styrene–butadiene rubber

These categories normally are included in the commercial statistics. Not included mostly are specialty rubbers, like epichlorohydrin, fluoro, silicone, polynorbornene, or polysulfide rubbers. In contrast to the general purpose elastomers, these materials show at least one outstanding physical property like heat, oil, or corrosion resistance. Also not included in the list above are the thermoplastic elastomers (TPE), which represent a special class of multiphase polymers and contain hard thermoplastic and soft rubberlike units in their polymer chain. The market for TPEs are expanding rapidly to the cost of rubbers which need vulcanization by sulfur or peroxides.

7.7.1 Natural Rubber

Asia produces about 90 % of the world's supply (estimated at about 6 million tonnes in 2000) of natural rubber; Indonesia, Malaysia, and Thailand compete among each other for the first position. The importance of natural rubber as a blend component for tires has slightly decreased. Nevertheless, about 70 % of the world's production goes into tires. Other synthetic types gain market shares steadily. New stereoselective polymerization catalysts open possibilities for new materials, which are expected to substitute for NR even more. Running against this trend, the consumption of latex has increased sharply in recent years. Marketers had already forecasted a decrease of the NR market when the demand for latex increased significantly for the production of prophylactics. Again, an unexpected effect like the increase in demand for indigo (Section 1.6) made secure-seeming forecasts obsolete.

The International Natural Rubber Organization (INRO) formed a cartel which has existed for twenty years, similar to OPEC for oil. In this cartel six producer countries (Indonesia, Thailand, Malaysia, Ivory Coast, Sri Lanka, and Nigeria) and eighteen selling organizations are present. Their task is to stabilize the world price for natural rubber. When prices are low on the world market, material is placed into stock, in essence the supply is artificially diminished, and vice versa. However Thailand, the biggest producer, left the cartel in March 2000. The price for natural rubber then is expected to go down because the stocks will be sold, predominantly on the Tokyo exchange, the most important forum for rubber futures. The tire industries most probably will profit from this price decline.

In spite of decreasing prices for the raw material, the tire industries seem to have been in a permanent crisis for years. The main complaint is that the margins for passenger car tires are far too low. In addition, there is obviously a marketing problem, as consumers may not distinguish the different tire types. That means the efforts of a differentiation policy are insufficient. Furthermore, three companies (see Figure 7-6) are of similar size and cannot gain a decisive advantage. Goodyear now has developed a new marketing concept: They offer a stronger collaboration with the tire shops, assisting with a whole range of additional services, for an agreement that the shops sell a certain percentage of their brand. Pirelli announced at the end of 1999 that it had revolutionized the production process of tires to a totally mechanized procedure requiring no more manual work.

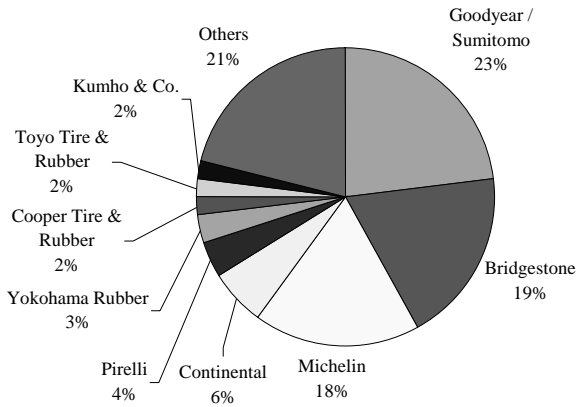


Figure 7-6 Major producers of tires in 1999

7.7.2 Synthetic Rubber

The world demand of synthetic rubber is estimated to about 11 million tonnes for 2000. The largest quantity is styrene-butadiene rubber (SBR) followed by SBR latex (see Figure 7-7). The market leader for synthetic rubber actually is Bayer, with about 10 % market share. The major part of SBR goes into the tire industries, where it is still the workhorse. This immediately indicates the strong dependence of the SBR market on the development of the automotive industries and the investment policies for trucks and construction machines. The dependence is affected somewhat by the geographical separation of the triad USA, Japan, and Europe, which in turn implies that the business must be global and companies must be of a minimum size.

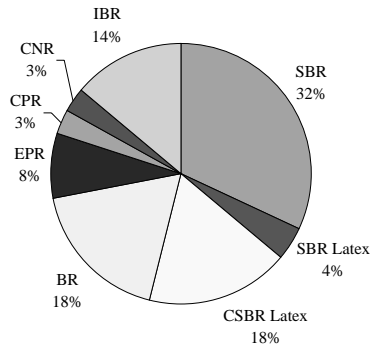


Figure 7-7 Consumption of rubber in 1999

7.7.3 Styrene-Based Thermoplastic Elastomers

The styrene-based block copolymers (SBCs) are increasing in importance for their use as adhesives and sealants. The strongest market for these polymers are the hot-melt pressure-sensitive adhesives for tapes and labels. They are especially popular because they are more environmental friendly, in contrast to solvent-containing adhesives. They are also used as modifiers in polymer blends to increase the impact strength or stress-crack resistance of other polymers. An important application is the blend with polystyrene to produce the high-impact polystyrene (HIPS, Section 7.2). Other applications are as asphalt modifiers and in footwear.

8 Specialty Chemicals

Specialty chemicals are characterized by low volumes in production but high margins in profit. Sometimes they are also called “effect chemicals”, meaning that small amounts of substance cause a large effect, such as the superabsorbers which can bind some hundred-fold their own mass in water. Table 8-1 shows the most important categories of specialties and Figure 8-1 gives an overview on the volume of different types of specialties.

Table 8-1 Uses of specialty chemicals

| | |
|------------------------|------------------------|
| Additives for food | Diagnostics |
| Additives for polymers | Electronics |
| Biocides | Flavors and fragrances |
| Catalysts | Lubricants |
| Cellulose derivatives | Pigments and varnishes |
| Cleaners | Specialty polymers |
| Corrosions inhibitors | Surfactants |
| Cosmetics | Textile dyes |

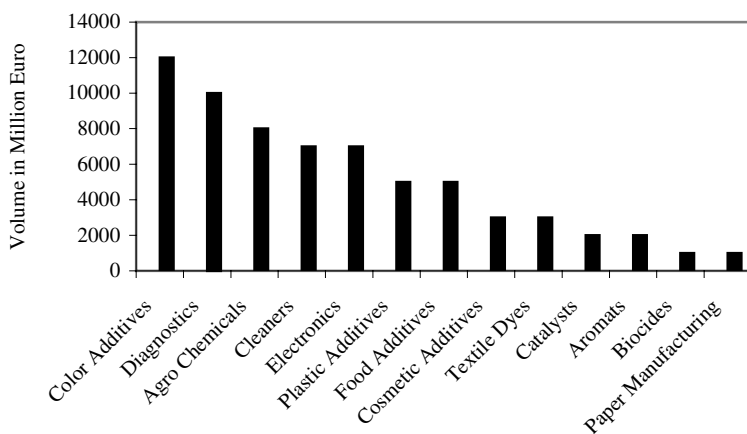


Figure 8-1 Chemical specialties by volume, as estimated for 1999

For a long time, business with specialty chemicals has been regarded as some kind of local corner shop, which meant the margins are good but quantities are small, inapplicable to the logistics of the bulk chemistry, while economies of scale were far from realized. This picture meanwhile has thoroughly changed. A number of specialties have proven to be the most profitable aspects within a company's portfolio, although still lacking the necessary volume of sales. Therefore the same effect of divesting and, on the other side, accumulating market shares through acquisition took place. Table 8-2 gives an impression of some major changes in ownership and Table 8-3 lists some major suppliers. The market volume for chemical specialties in 2000 is estimated to about US\$ 100 billion worldwide. Major companies try to focus on "core businesses" in specialties, which means here "core competencies". In this market sector, the transfer of information to the customers is even more important than the usual services. For a lot of applications, the specialties are particularly designed for the customers, through formulation or chemical structure, such as pharmaceuticals. Consequently, there are only a few suppliers for most specialties and, for a very limited number of substances, there is even a quasi-monopolistic situation. The problem for the specialty chemical market is that for the small quantities ordered by customers a worldwide sales network still has to be maintained. Furthermore, in spite of the attractive margins, a market leadership only can be conserved when it is simultaneously connected with an intellectual leadership; this in turn demands the most modern, and therefore costly, research facilities. In order to justify these costs, corresponding volumes in sale are necessary but these can only be achieved, however, when the company is present in all important world markets. The outcome of this cycle is that only big companies can afford to operate, but a few exceptions exists as niche markets within specialties.

Table 8-2 Mergers and acquisitions

| Buyer | Target |
|------------------------------|-----------------------------------|
| ICI | Unilever SC (Specialty Chemicals) |
| Ciba Spezialitäten Chemie AG | Allied Colloids Pcl |
| Hercules Inc. | Betz Dearborn Inc. |
| Akzo–Nobel N.V. | Coutaulds Plc |
| Clariant | Hoechst SC |
| | BTP |
| BASF | Chemdal International Inc. |
| SKW Trostberg | Sanofi–Dio Industries |
| | MTB |
| | Harris |
| DuPont | Herberts |

Table 8-3 Major suppliers of specialty chemicals

| | | |
|--------------------|------------------------|----------------------|
| Akzo Nobel | Ferro | Morton International |
| Alled Signal | Fuller | Nacol |
| BASF | Great Lakes | Rhodia |
| Bayer | Hanna M.A. | Röhm & Haas |
| Ciba SC | Henkel | Solutia |
| Clariant | Hercules/Betz Dearborn | W. R. Grace |
| Crompton & Knowles | ICI | Witco |
| Dai Nippon | International Flavors | AstraZeneca |
| DSM | Laporte | |
| Ecolab | Lubrizol | |

The customers are often chemical industries themselves, in turn using these specialties for their own formulations or for the synthesis of pharmaceuticals. The suppliers (direct or indirect) of these specific chemicals depend on the economic cycles of their customers' industries. There are industries which react very sensitively to changes in the general environment, named the cyclic markets, which include the automotive, building and construction, metal, and paper industries. Good times for these branches result in good profits for the producers of specialties and vice versa. Noncyclic markets, which are not so deeply affected by such fluctuations, are food, hygiene, telecommunication, life sciences, and fertilizer industries.

8.1 Coatings and Varnishes

The world market for colors, coatings, and varnishes in a broad range of applications is estimated to about US\$ 70 billion in volume. About half of this volume is divided among the ten biggest producers. After the takeover of Courtaulds by Akzo–Nobel, this new company takes the first position with a turnover of about US\$ 6 billion, followed by Sherwin Williams Co. with about US\$ 5 billion and ICI with US\$ 3.5 billion. PPG Industries and BASF follow in fourth and fifth place. Of course these data do not refer only to specialties. The main applications are in the building and construction, automotive, naval, aircraft, print colors, or wire coatings industries. The growth rates in volume are relatively low at 3 %. This branch belongs to the mature markets and further consolidation is expected. After the Asian crisis, markets in this area are now recovering.

Within this range of applications, some companies have developed core competencies in, for example, automotive varnishes as did BASF with its daughter BASF Farben+Lacke and as Hoechst with its daughter Herberts (now owned by

DuPont). The main turnover in this business sector (50 % in the case of BASF) is attributable to automotive varnishes and the corresponding repair formulations. The market strategy in such a case is consequently directed to the car manufacturers and is therefore a global business. Joint developments comprise not only the material itself but also the application processes and therefore exist in a state of mutual dependence.

Innovation and research in this field is essential. The development of many more environmentally friendly products within the last decade have created a new generation of varnishes, emitting little or no solvent during application. In addition, new materials, such as powder and water-soluble coatings, have made the processes more economic. Even more, a few real technological leaps have created entirely new markets. An outstanding example is the collaboration of DuPont with Ormecon Chemie, which invented a polymeric coating based on polyaniline. This polymer is electrically conductive and has been announced as the ultimate corrosion inhibitor. This is a good example to show that smaller companies also have a chance with innovative products in niche markets. The collaboration with a larger company opens the necessary distribution network and can be regarded as a good marketing strategy.

For the color and pigment industry, researchers investigate the correlation between crystal structure, morphology, molecular structure, and color. Whereas the interrelation between color and the structure of chromophores can be calculated with quantum mechanical models, its correlation with the crystal structure is very complex, and the particle size influences the color to a significant extent. Through computer simulation, researchers try to find new ways for a crystal design as a key for the development of high-tech coloring agents.

Coatings are polymers or oligomers which are cured by radiation, either high intensity, often ultraviolet, light sources or electron beams. The components of these formulations differ from conventional coatings. The pigments are dispersed in reactive monomers, which in turn act as a solvent for the reactive polymer or oligomer. In the case of ultraviolet curing, a photoinitiator is required to initiate the polymerization. The application for radiation curable (radcure) coatings are as protective layers for plastic substrates, overprint varnishes for paper and cardboard, wires, or other special purposes.

8.2 Textile Dyes

Dyes for textiles are chemical products which represent the inception of some of the largest German chemical companies in the 1870s. In the 1920s, IG-Farben started work with the industrial production of aniline colors and indigo, synthesized first about a century ago. After the Second World War, IG-Farben was divided according to the direction of the Allied Powers. With the beginning of this new

century, a reunion at least in the dyestuff business took place when the three companies BASF, Bayer, and Hoechst decided to collaborate in the new Dystar group. The group achieved a joint turnover in 2000 of approx. € 1.3 billion, accounting for about a quarter of the world market.

This is the consequence of a consolidation process in an extremely difficult economic environment. For BASF, this represents part of a comprehensive strategy to focus, in contrast to other companies, more on joint ventures and collaborations than on mergers and acquisitions; in the course of this market policy, BASF has undergone a series of other collaborations, especially in the field of polymers, with DSM, Shell, and Solvay.

Today most of the former dyes have lost their importance and have been substituted, with the exception of indigo (Section 1.6). In recent years the dyestuff business has suffered much through a ruinous price competition and the shift of the textile industries away from the West. This is not surprising because the supplying industries always are connected with the fate of the main consuming industries. As the textile industries shifts to Asia because of the cheaper wages and less strict environmental production restrictions, among other reasons, all the corresponding commodity products will follow as well. Only high-technology chemicals will have a chance—provided the markets appreciate the efforts.

8.3 Corrosion Inhibitors

Corrosion can be defined as any damage to metals caused by chemical and electrochemical activity from the environment. The most significant problem results from the oxidation of iron and its alloys. Rough estimations calculate the annual costs of corrosion in the scale of billions of US dollars. Metal corrosion can be prevented by coatings and paints, which however must be often renewed. Corrosion inhibitors are substances which retard the chemical and electrochemical processes that lead to deterioration of metals and are active at very low concentrations. Often the inhibitors are added to formulations which are in contact with metals, such as water in heating systems. There are mainly three areas of applications:

- water treatment
- metal-treatment fluids
- oilfield chemicals

The substances are produced for other formulations from the same manufacturer (“captive use”) or sold either to other intermediate formulators or to end-user industries like the petroleum, chemical, or steel industries. In contrast to other additives, most of the very time-consuming corrosion research is not done by the companies themselves but instead outsourced to universities and research institutes. Some substances are produced mainly for other purposes and corrosion inhibition is

a side effect. Therefore, they sometimes are handled as commodities and the sales staff often remain unaware of this additional marketing potential: The inhibitor properties are, so to say, in the shadow of the product's main application. Furthermore, marketing may find it difficult to gain additional resources to allocate to such small quantities. For special formulations and problems, a closer collaboration with the applicant is necessary. However, producing companies often are reluctant to dedicate more research on these chemicals. A solution is that the end-user or the intermediate company shares the development cost and in return demands exclusive marketing rights. Some basic chemical producers may intend to upgrade and give an added value to their products by the addition of corrosion inhibitors. In this situation, they may enter in competition with their own customers, who use these products in their own formulations. It is also nearly impossible to establish patent rights on the intrinsic properties of a substance, such as hydrazine, as corrosion inhibitor. Only in special formulations it may be accepted. Critical factors for success in this diffuse market are environmentally friendly products or products developed for big markets or for major partners such as the automotive industry. Table 8-4 gives an overview over the commonly used classes of inhibitors.

Table 8-4 Corrosion inhibitors

| Organic inhibitors | | |
|---------------------------------|--------------------------------|---------------------|
| Phosphatonates | Acids, their salts, and esters | Others |
| Nitrogen-based compounds | carboxylic acids | acetylenic alcohols |
| Neutralizing amines | sulfonic acids | organic azoles |
| Filming amines | | oxygen scavengers |
| Inorganic inhibitors | | |
| Chromates/molybdates | Phosphates | Zinc salts |
| For water treatment | | |
| Sodium hexametaphosphate (SHMP) | Monoammonium phosphate (MAP) | |
| Sodium tripolyphosphate (STPP) | Trisodium polyphosphate (TSPP) | |
| Monosodium phosphate (MSP) | Heavy metal salts | |
| Disodium phosphate (DSP) | Sodium sulfite | |
| Trisodium phosphate (TSP) | Hydrazine | |

8.4 Chemicals for Electronics

Within the specialty chemicals business, chemicals for electronic applications have become very attractive. The extraordinary growth of the computer sector certainly has contributed to this effect. This fact has motivated many firms to step into this business with a consequent sharp increase in competition. The simultaneous demand for higher purity and added services, however, has dampened the enthusiasm of some firms, which cannot maintain the pace. Especially so, prices for commodities like silicon have dropped significantly. The selection of chemicals for electronics is very broad, ranging from ultrapure solvents, rare-earth metals, and gases to precious metals, plastics, and ceramics (compare Table 8-5). Gases in this connection are specialties like arsine, boron trifluoride, diborane, silanes, diethyl telluride, germane, hydrogen selenide, and so forth, used in the production of semiconductors. The corresponding technologies comprise photochemistry, electrochemistry, plasma physics, and laser-induced reactions. Originally the markets had been concentrated in the US, Japan, and Western Europe, but in the meantime emerging countries like Taiwan, Korea, and India have gained importance. The most well-known substances in this field are certainly liquid crystals for flat screens and digital displays. For these markets, a few suppliers have developed core competencies and created or found niche markets in which they hold a quasi-monopoly. The production of most electronics chemicals need a high grade of purity, which cannot be achieved in usual reactors, and therefore demands special equipment and processes. The distribution channels are about 75 % directly to end users and the rest to formulators or resellers. Often the sales staff are not familiar with the highly sophisticated applications and they need scientific assistance from their R&D staff more than ever.

Table 8-5 Chemicals for electronic applications

| For semiconductors | For printed circuitboards | Other materials |
|--------------------------|---------------------------|--------------------------|
| Polycrystalline silicon | Resist chemicals | Rare-earth compounds |
| Photoresists | Etchants | Capacitor body materials |
| Wet-processing chemicals | Planting chemicals | Liquid crystals |
| Etchants | Raw materials | |
| Specialty gases | | |
| Thin-film metals | | |

8.5 Catalysts

Historically, new catalysts have often opened completely new business fields or at least revolutionized technologies. The most important ones in the past certainly have been catalysts for ammonoxidation, which enabled the production of synthetic fertilizers, or the Ziegler–Natta catalysts for polymerization. The modern generation of catalysts are the metallocenes for stereoselective polymerization and a broad range of catalysts in the environment business for the conversion of toxic emissions into more harmless products, for example. There are mainly three categories of catalysts, directed to chemical processing, petroleum refining, and emission control catalysts. Table 8-6 gives a list of catalyst application fields. Not included are enzymes for biotechnical processes (see Section 3.2.3). Producers do not cover the full range of catalysts; they are mostly specialists.

Table 8-6 Applications for catalysts

| Chemical processing | Petroleum refining | Emission control |
|---------------------|------------------------|------------------|
| Polymerization | Alkylation | Automotive |
| Ammonoxidation | Hydrocarbon cracking | Industrial |
| Oxychlorination | Hydrothermal treatment | Incinerators |
| Ammonia production | Desulfuration | |
| Hydrogenation | | |
| Dehydrogenation | | |
| Methanol synthesis | | |

Catalysts have a limited lifetime and, when they lose their efficiency, must be periodically recovered and recycled. Others are substantially lost during the production and remain at least partially in the products. Their consumption is directly related to the branch of application, and this shows, as the chemical industry does, a typical cyclic behavior. However these cycles are more or less counterbalanced by the geographical diversification. The catalysts business is a global one, as otherwise producers could not achieve economic sales volumes. Smaller producers, which do not have the necessary distribution channels, give licenses. A significant fraction of the catalysts produced is also for captive use. Normally producers concentrate on a certain family of catalysts or on specific end-use industries. The catalysts market is characterized by high entrance barriers because the development of marketable products consumes time and money and requires very specialized skills.

Significant growth rates show catalysts in the environment protection. The anti-NO_x (nitrogen oxides) catalysts are of course more related to the automotive industry. Whereas in most Western countries these catalysts are obligatory and state of the art, other countries are still far from this standard. The legal harmonization in Western Europe has given substantial support to the consumption of emission-control catalysts, and with proceeding regulations this trend will continue.

8.6 Plastic Additives

Most, if not all, commercial polymers and their compounds need additives for better processing or later protection during use. Additives for processing, also called processing auxiliaries, are lubricants for polymer extrusion, release agents during thermoforming, antistatic agents against pigment aggregation, coupling agents for better adhesion in fiber-reinforced plastics, and so forth. A second class of additives is used for the protection against chemical and physical damage during application. In this category fall heat stabilizers, antioxidants, corrosion inhibitors, ultraviolet absorbers, and flame retardants. A third class contains chemicals which cause certain effects like blowing agents for foams, impact modifiers, plasticizers, or peroxides for scavenging free radicals. There are numerous other applications for additives, even in the food industries, such as thickening agents, emulsion stabilizers, conservation chemicals—perhaps it is better to ignore the details for the sake of the appetite of some sensitive consumers. However, some additives may be mentioned in detail because of the importance of their markets and because of the turmoil they have caused in the past. Table 8-7 gives a short overview on plastic additives.

Table 8-7 Plastic additives

| | | |
|--------------------|------------------|-------------------------|
| Antioxidants | Coupling agents | Peroxide catalysts |
| Antistatic agent | Flame retardants | Plasticizers |
| Blowing agents | Heat stabilizers | Polyurethane catalysts |
| Color pigments | Impact modifiers | Processing aids |
| Conductive fillers | Lubricants | Ultraviolet stabilizers |

Plastic additives are sold to base-resin producers, plastic fabricators, or custom compounders. The latter group are specialists which prepare certain formulations for customers according to their requirements. This is done in all cases in which there is insufficient volume for the customer to be directly supplied by the other two sources. The formulations with the additives depend on the manner of processing the polymer by the end user and the physicochemical requirements of the articles to be made from the compound. The decisive marketing issue is that the compounder must have extensive experience of numerous and various cases. There is still little systematic understanding about the interrelating effects of what can be more than a dozen substances; the art of the compounder makes a firm successful. Pigmented compounds especially need special care and the highest technology for absolutely constant production conditions, because the slightest changes in formulation are clearly visible.

Again it is PVC which attracted much criticism. There are many additives in this material, as pure PVC is very difficult to process and needs significant quantities of added lubricants. However, this is not the point. The subject of concern had been the use of cadmium and lead stearates as stabilizers against degradation (see Section 7.3). Window frames, tubes, and cables need stabilizers against the

influence of weather, sunlight, and physical degradation. Ultraviolet radiation cracks the polymer chain with consequent elimination of hydrogen chloride and formation of double bonds, which in turn may be oxidized and make the material brittle. Cables and wires under soil also degrade when not protected. The concerns about heavy metals are commonly known. However, in the case of PVC, problems arise in two other ways. The first problem is connected with the heavy metal chlorides and oxides when PVC is burnt together with other municipal waste in incinerators, the second problem arises when the material is recycled. Meanwhile most of these critical stabilizers have been substituted with calcium and/or barium stearates; however, mixing old and modern types of PVC for recycling purposes is undesirable but difficult to avoid. Marketers have to be familiar with these problems and should be well prepared for a vigorous discussion.

We shall remain with PVC in connection with additives. The material seems to attract all possible kinds of problems—this time it is the plasticizers, which make the original material smooth and flexible. Up to more than 50 % of plasticizer can be added, commonly dioctyl phthalate (DOP). Soft PVC is used among others for the fabrication of children toys and although DOP is suspected to affect human fertility, scientific proof is so far missing. As always, if all suspicions uttered against materials lead to governmental interventions, nothing would be left to construct anything; carcinogens are found in the sawdust of oak and benzene, used as an antiknocking additive instead of tetraethyl lead, is also carcinogenic but these facts do not fit into the picture of the green parties. Marketers have to live with these obvious contradictions and should acquire some knowledge of psychology. The latter can be rewarding when targeting ecologically oriented consumer groups. The above-described contradiction in psychology is known as “selective perception”—in other words, everybody has some kind of mental filter, formed through previous experiences. In a very simplified form: One believes what one wants to believe.

A new class of very effective ultraviolet stabilizers are named HALS (hindered-amine light stabilizers). They act as radical scavengers and efforts are underway to chemically link these substances to the polymer so that they are not washed out. These compounds carry names like bis(2,2',6,6'-tetramethyl-4-piperidyl)sebacate and have corresponding prices. Other light stabilizers act as quenchers. These are metal chelates that convert the excess energy from ultraviolet radiation absorbed by the chromophores to heat; an example is nickel bis(3,5-di-*tert*-butyl-4-hydroxybenzyl) phosphonic acid monoethylester. As one can see, these are really specialty fine chemicals.

An important group of additives are flame retardants. These substances are used in wallpaper, textiles, carpets, upholstered goods, or plastic material in general. Flame retardants are extremely important in fire protection, especially in all public and institutional locations. The substances used are mainly based on brominated aromatic and aliphatic compounds, sometimes together with antimony oxide. The effect is that bromine radicals interrupt the chain-reaction kinetics of flame propagation. However, and at high temperatures in particular, brominated aromatic compounds may form toxic dioxins. As we know from the Seveso accident described in Section 4.4, the formation of such substances should to be avoided at all costs. However, there has been no equivalent substitute so far and, on the other

hand, fire protection in most countries is required by law. Materials without impregnation are not allowed to be used in public spaces. Other possible additives are aluminum trihydrate (ATH) and compounds based on organic phosphorous esters or red phosphorous, among others. However, these compounds are significantly less efficient and show up as a discoloration. Marketers acting internationally must remain informed about the different national regulations of fire protection and liabilities, which can be a very costly affair for a material supplier if a case of negligence is proven. Normally legal matters have little to do with marketing and often even the customers and applicants do not know their own national regulations. Nevertheless, the sales department must know about such details if it wants to remain on the “safe side”.

8.7 Biocides

Biocides represent many different types of chemicals. Their sole common property is that they kill or inhibit a broad range of microorganisms, including bacteria, fungi, or algae. However, they are not so complex in structure as pharmaceuticals and relatively nontoxic to higher forms of life. Table 8-8 gives an overview on types and market segments. The producers of these chemicals often regard the biocides as a business in addition to others. Out of the diversified range of possible substances they mostly offer only a few product types. The reason is that biocides are subject to governmental regulations and need registration. The producers must demonstrate that the substances are effective and can be handled safely, and therefore lengthy and expensive toxicological tests are required. As these tests require special expertise and laboratory equipment, the producers of biocides very often produce pharmaceuticals or pesticides also so costs can be spread among the different product types. The general trend leads towards tighter regulations and still more tests and documentation, and for this reasons producers are relatively reluctant to change formulations because the product may become subject to a new registration procedure. As the costs for these procedures are significantly rising, a consolidation in this industry is the consequence. At the same time these costs represent also an entrance barrier for competitors. Most biocide producers concentrate on one or a few product families, such as for water treatment or industrial cleaners, and the marketing is often handed over to the formulators. Nevertheless, the producer is fully responsible for all of the necessary registration. In this business, knowledge of governmental regulations is of utmost importance and, due to legal liabilities, most producers therefore engage their own legal experts.

Table 8-8 Biocides

| Product type | Market segments |
|---------------------------------------|------------------------------|
| Active halogen compounds | Water treatment |
| Inorganic salts | Disinfectants and sanitizers |
| Organic acids and salts | Cosmetics |
| Metallorganic compounds and complexes | Food preservatives |
| Phenolic compounds | Personal care products |
| Others | Paints and coatings |
| | Wood preservatives |
| | Plastics |
| | Pulp and paper production |
| | Oil and lubricants |

A few products, formerly used in large quantities, meanwhile have had to be withdrawn from ecological concerns, such as pentachlorophenol for wood impregnation or tributyl tin (TBT) as an antialgal agent for nautical paints.

8.8 Specialty Polymers

Specialty polymers are mainly temperature- or corrosion-resistant materials with outstanding properties. Often they are processed in a special way and require machinery other than that for the normal engineering plastics. Specialty polymers are delivered as powders, granulates, fibers, and films, and a great number on the market include fillers or fibers for reinforcement. These fibers include glass, carbon, graphite, and aromatic amide-based materials and their use results in a material with very high mechanical strengths. Sometimes also special fillers are applied, such as molybdenum sulfide, copper bronze, or polytetrafluoroethylene (PTFE) powder to grant excellent antifriction properties. Fluorine-containing polymers represent in themselves an important class of specialty polymers on account of their extreme corrosion resistance. However, PTFE is especially difficult to process, as it does not flow even when melted at 342 °C but forms a solid gelatinous mass and instead has to be sintered. Other fluorocarbon polymers can be processed by the usual techniques. Spinning procedures for ultrahigh tensile strength fibers are often also quite specific. Unusual solvents, such as concentrated sulfuric acid, are needed. The production of the raw materials and the processing techniques require special procedures, which companies protect with numerous patents. Each of the materials have found very lucrative niche markets and therefore their owner-companies concentrate on a very few specialty polymers, where, in these niches, they are world market leaders or compete with only a few other firms. As such, it is not surprising that the law suit that broke out between Akzo and DuPont over their aromatic amide

fibers was fought with an unusual intensity, and went down in history as one of the most expensive patent-law suits.

These polymers are seldom sold in the pure form but as compounds. The raw-material producers offer in addition some standard compounds, which are produced in higher quantities, while other mixtures are fabricated by specialist compounders to cover the market for smaller quantities and tailor-made compounds. The preparation of special compounds often results in a long-term relationship with the client and leads to further joint developments. Clearly then, there are two distribution channels, a direct and an indirect one, the latter represented by the compounders. Successful compounders must maintain both good technical service capabilities and corresponding testing facilities. Furthermore, a sophisticated quality control is necessary to guarantee material of constant composition and physical properties: Not only the proportion of the components have to be constant but also, for example, the fiber-length distribution or the particle sizes of the fillers need be maintained, and statistical process control is a prerequisite. The number of compounders for the specialty polymer market is therefore limited.

High-performance polymers are a good example for a special marketing strategy. Innovations and products with no or few competitive producers normally are sold according the “skimming strategy”, in which the company asks for the highest possible price to maximize its profit. The highest price is that just below what competitor would ask for a substitute or an other comparable material. The customers still must hold an advantage to prefer the polymer instead of metal or another material. When other materials or new competitors enter the market, then and only then is the price lowered in order not to lose market share. Sometimes also, without new competitors, the high prices drop if new application fields are found with larger volumes; the history of nylon follows this pattern. Nylon fibers had been developed in the laboratories of DuPont as an urgently needed substitute for Japanese silk fibers, since silk was used for parachutes and the supply had been interrupted by the Second World War. At first, these innovative fibers were only used for military purposes, but then a civilian product with greater volumes followed: nylon shirts. The name nylon meanwhile had become a generic name for all long-chain polyamides. This initial success was relatively short but then the ideal application was discovered—nylon stockings. They were quickly promoted and became a symbol for modern, well-situated women all over the world, and in response the international textile industries rapidly built huge production capacities. The latest application, and perhaps the final stage in the long-lasting lifecycle of nylon, was in the production of carpets. Of course there are many other applications of nylon as an engineering plastic, but in this segment such an outstanding cycle cannot be found.

Niche markets for high-performance polymers can also be found in the aerospace industries. In this small but very prestigious sector the application of light-weight materials is essential. One kilogram less mass may save a space mission several thousand dollars. It is an ideal field for specialty plastics. In technical marketing applications, the aerospace industries are a promoter for business as efficient as a Hollywood star for consumer goods. A lot of advertising can be observed showing plastic parts in connection with aerospace pictures; however, this image must be

carefully examined, otherwise the effect might be counterproductive by producing the impression of prohibitive prices.

8.9 Cosmetics

One of the most fascinating sectors is the marketing of fragrances and cosmetics. In a certain sense the perfume industries are the uncrowned kings in marketing because they know best how to sell illusions. The largest portion of a product's price refers to the intangible, imaginary part. Packaging for perfumes is also developed to a high level in design.

Among the specialty chemicals, these products, together with diagnostics and biocides, have the largest growth rates. Especially in Asia, and particularly China, the consumption of these productions will increase significantly in importance. In this connection, L'Oreal, the world market leader of perfumes, announced its entry into the Chinese market. This announcement came just at the moment when L'Oreal's competitors in the Chinese market, firms such as Wella, Unilever, Procter & Gamble, Beiersdorf, and Henkel, reported a reduction in losses as their only success. However, perfumes are only a part of the cosmetics market. The different classes of cosmetic chemicals are listed in Table 8-9, and Figure 8-2 gives an overview over the turnover of major cosmetic companies. About half the consumption is derived from emollients, moisturizers, and fragrances. In Western countries a clear trend indicates a continuous growth in the consumption of antiwrinkle and -ageing formulations. In China, where the population is much younger than the Western average, the trend is based on a backlog consumption, as is the case in Eastern and Central Europe.

Table 8-9 Cosmetic chemicals

| Multipurpose chemicals | Single-use additives |
|------------------------|--------------------------------|
| Colors and pigments | Antidandruff agents |
| Emollients | Antiperspirants and deodorants |
| Fragrances | Dental polishing agents |
| Moisturizers | Hair-conditioning polymers |
| Preservatives | Hair-setting resins |
| Propellants | Sunscreen chemicals |
| Solvents and carriers | |
| Surfactants | |
| Thickening agents | |

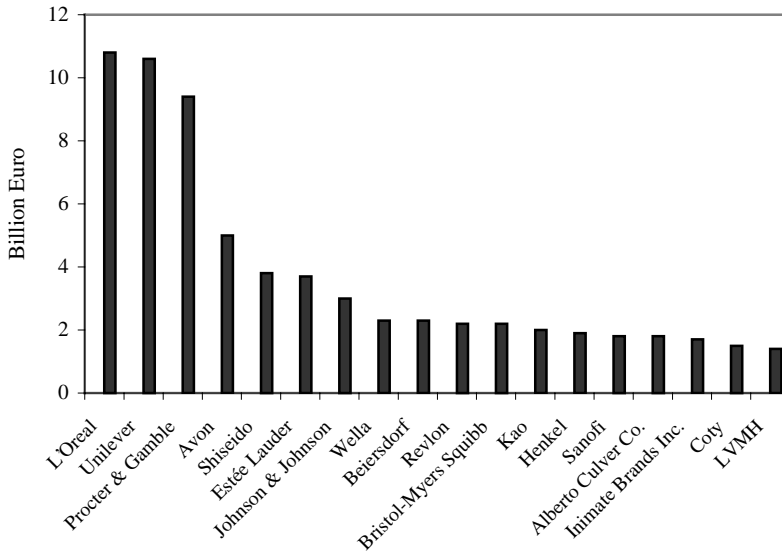


Figure 8-2 Major cosmetic companies, estimated turnover for 1999

On the supply side, the market is very fragmented. It is estimated that there are about 2000 suppliers of cosmetic chemicals worldwide, not including the producers of soap. The process of concentration is also visible in the cosmetic industries. Major chemical companies have sold their cosmetic businesses because they do not belong to the core activities; Hoechst sold Marbert, Roche announced the separation of its daughter Givaudan, and Sanofi is reported to negotiate with Louis Vuitton–Moët Hennessy. Several factors indicate that further major changes in the market structure are to be expected. From the legal side, tighter restrictions are made on a European level concerning the safety and purity of substances. Good manufacturing practice (GMP) is required, and an increasing amount of documentation is necessary before companies gain the approval for the use of certain chemicals. All this requires additional personnel and laboratory equipment and smaller firms therefore face difficulties. The distribution channels are increasingly the key to success, and major distributors shift their orientation towards lifestyle firms, collaborating with fashion and jewelry industries. The Douglas chain is already diversified in this way and has now announced its expansion into international markets. In a certain way the double expansion strategy makes sense because the margins in the sales of perfumes were under pressure because of numerous discount shops. The local drugstore/chemist's shops will face still harder competition in future. On the other hand, cosmetic producers will try to integrate vertically and gain direct access to the market through the control of distributors; in the course of this strategy Marbert bought the Italian perfume chain Limoni.

However, especially for the perfume creators, risk increases. In Germany, about 900 perfumes are currently on the market, competing with each other. Five producers of aromas and fragrances have about two-thirds of the world's market (see Table 8-10). With the exception of some evergreens like Chanel No. 5 and 4711 Eau de Cologne, lifecycles are extremely brief. It is reported that the marketing costs for the launch of a new perfume total about €25 million. Even successful brand names seldom achieve more than a two to three percent market share. In addition, the failure rate of new creations is very high. Nevertheless, the major companies report two-digit profits. A compensation strategy for the market risk, as successfully applied by L'Oreal, is to bundle several brand names of perfumes under a family brand name. Perhaps for this reason L'Oreal was accoladed by the American journal "Business Week" as the "United Nations of Beauty". This marketing strategy is extraordinary because it needs a very subtle management: As there are more than twenty different brands assembled under the family name, there is a great risk that the brands compete and thereby cannibalize themselves. In practice that cannot be avoided, but the task of each brand manager is to create market loyalty for his product. However, the strategy enables managers to spread risk through a broader portfolio of perfume brands. Attention must be paid to ensure that exclusive and expensive perfumes are not marketed with cheaper products of the same family. Such exclusive types have their own separate distribution channels and are never marketed in discount shops, otherwise the prestige value would suffer.

Table 8-10 Major producers of aromas and fragrances

| Company | Turnover in 1998 (million euro) | Market share (%) |
|-------------------|------------------------------------|---------------------|
| Givaudan | 1600 | 16.5 |
| IFF | 1600 | 16.5 |
| Quest | 1300 | 13 |
| Firmenich | 1100 | 11 |
| Haarmann & Reimer | 1000 | 10 |
| Bush Boak & Allen | 550 | 6 |

9 The Agricultural Business

A fundamental task of the chemical industries since their beginning has been the support of agriculture. Today supplying the six billion inhabitants on Earth with food is more a problem of distribution of than of production. The main problem is, run the arguments of some agricultural scientists, that not enough food is produced in places where it is urgently needed. However, it is questionable if the increase in food supply can match the increase in population. Furthermore, with slowly increasing wealth the population of developing states will change their nutritional behavior. Forecasts claim that a 40 % increase in the supply of cereals and rice would be necessary until 2020. Without biotechnology, specifically genetically modified plants, this increase in output and efficiency in agriculture seems unachievable. Therefore, in spite of all criticism in Western countries from their well-nourished population, scientists are optimistic for the future of biotechnology.

9.1 General Trends

The agricultural business (“agrobusiness”), understood classically, comprised basic chemicals like fertilizers and all substances for plant protection in a broad sense, especially pesticides, herbicides, and fungicides. When plant protection became more sophisticated, this branch was designated as a part of the life sciences. Together with pharmaceuticals, these substances should have formed the core business of the companies which formulated their new strategy in this way. However, the expected synergies, coming from the technology of fine chemicals, could not be made manifest. Furthermore the agrobusiness divisions suffered from the cyclic nature of the business and the lack of public acceptance. These developments were very rapid in these branches and they have therefore diverged from a common origin: Pharmaceuticals and plant protection are too different in development, application, and marketing. It comes therefore as no surprise that only a few years after the declaration of the “lifescience concept” some companies tried to divest their agricultural divisions. The Swiss Novartis and the British–Swedish AstraZeneca announced in December 1999 the repositioning of their branches into a new, separate joint entity for agrochemicals and seeds with the new name “Syngenta”. This constellation should have a turnover of an estimated € 8 billion

and economizing effects are expected above all in distribution and administration. Monsanto and Pharmacia & Upjohn revealed a similar strategy, which also announced a separation of their agrobusinesses in the course of the planned fusion and to go public with this new entity. In March 2000, BASF announced the acquisition of the plant-protection activities of American Home Products (AHP), accelerating the global trend in concentration. The seven leading companies in agrobusiness meanwhile have about 80 % of the world market and earn about 50 % of their turnover through herbicides. Figure 9-1 shows the major producers of agrochemicals.

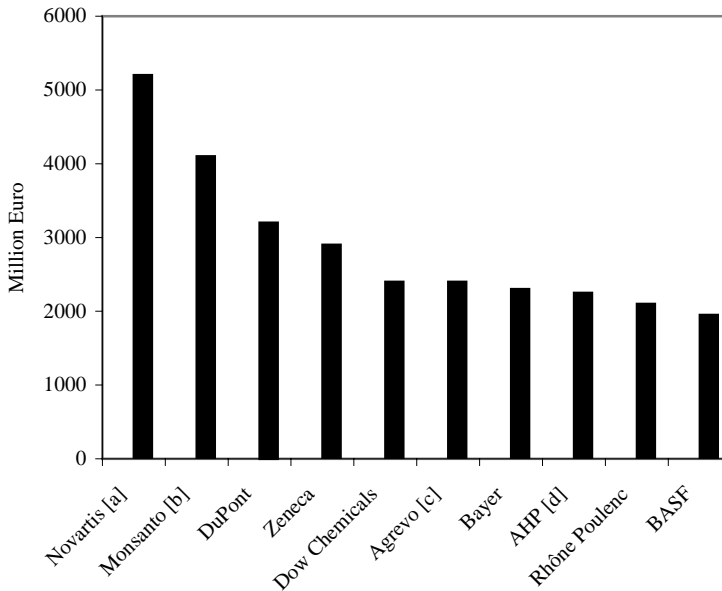


Figure 9-1 Major producers of agrochemicals, as measured by their estimated 1998 turnover. [a] Fused with AstraZenca in 1999. [b] Fusion with Pharmacia-Upjohn. [c] Hoechst/Schering. [d] Now together with Monsanto.

In connection with a complete restructuring of the agrobusinesses, the biotechnology and genetically modified seeds areas have already been developed into a special business branch. Furthermore, another newly arisen business branch, functional food and nutraceuticals, has arisen to take a position between food and pharmaceuticals.

9.2 Pesticides, Herbicides, and Fungicides

The world market for these three categories of chemicals is estimated for the year 2000 at about € 30 billion, distributed into 55 % herbicides, 25 % fungicides, 10 % pesticides, and other substances for the remainder. Within this remainder category fall modern biological plant-protection methodologies, such as the use of a specific fungus to control plant parasites. This elegant plant-protection method continually gains in market share due to its stricter control of residues in food. A special issue in marketing of chemicals for plant protection is the demonstration of nontoxicity for other animals and, thereby, having a clean bill of health granted. Therefore natural toxins or derivatives of natural substances are favored. As an example, the class of strobilurines for the protection of cereals have gained a broad acceptance in agricultural applications. An overview of the leading players in crop sciences is given in Figure 9-2, and Figure 9-3 shows the major producers of plant protection agents.

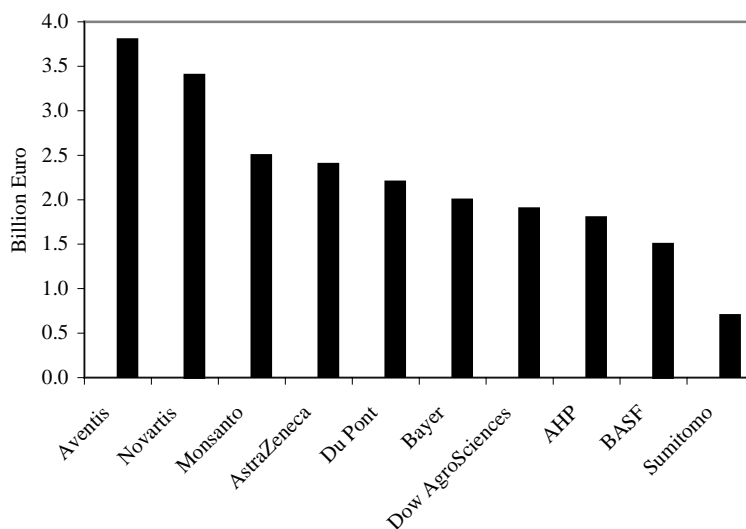


Figure 9-2 Major players in the crop science market according to estimated 1998 sales

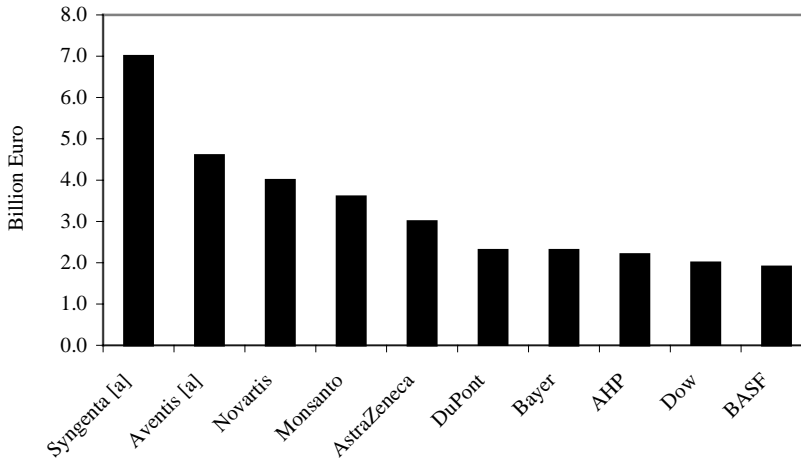


Figure 9-3 Major producers of plant protective agents according to estimated 1998 turnover. [a] Based on invoices sent

Other well-known substances like the insecticide DDT have practically disappeared from the Western markets after the accident at Seveso (Section 4.4). DDT and other substances developed in this time gave agrobusiness the image of “overkill chemistry”. With increased popular awareness the demand for “smarter and softer” chemistry arose, especially in the agricultural and food industry. However, as a consequence of the withdrawal of DDT in equatorial and African countries, malaria returned, which had been significantly reduced through the broad application of DDT. The World Health Organization (WHO), a suborganization of the United Nation, reports the worldwide return of malaria; cases have been reported even in Southern Italy.

With the assistance of the FAO (Food and Agriculture Organization), another suborganization of the United Nations, 95 nations have agreed on an international convention for the trade of dangerous chemicals and pesticides. The creation of an information system enables especially countries in transformation to be notified about substances banned in industrial nations. Exporting countries are obliged to place information prior to any delivery.

Today the trends of agricultural pest-control chemicals favor those with high efficiencies, narrow application ranges, species specific, and shorter shelf lifetimes. This has turned the marketing strategy into one of application advice, thereby adding service value. This service comprises not only a standard information but refers to the specific environment of the farmers. Dosage, time, and application methodology are tailored. In the USA, with its large farming areas, even air or satellite surveillance of plant diseases and fertilizer application is offered. In this way, even a

commodity like fertilizer is upgraded with a high-technology service. This again is a good example that a product at the end of its lifecycle or a commodity can be relaunched with added value through service.

9.3 Genetically Modified Seeds

Agriculture is a growing industry. It will have to meet the challenge to provide food for an increasing population, estimated at 8.5 billion people by 2025. Besides increasing quantity, the demands from consumers as well as from farmers change. Agrobusinesses can be regarded from their input and output sides. Increasing the output by the application of fertilizers and chemicals to prevent or reduce the loss of harvests by parasites is one possibility, while the other is to produce under a given environment greater quantities of food, namely an increase in efficiency. The last approach is followed by biotechnology. An increase in efficiency is the only approach which is in accordance with the concept of sustainable development because traditional ways of farming consume more resources than they create. Contrary to the sentimental glorification of traditional farming, also called “biological agriculture”, it has to be made quite clear that this policy would decrease, instead of increase, efficiency and allow the gap to broaden between food supply and demand in the world.

Meanwhile about 40 million hectares (99 million acres) of genetically modified plants are already cultivated worldwide (compare Tables 9-1 and 9-2), which represents an area the size of Germany and the Netherlands combined. Half of the area is used for soy beans, about 30 % for corn, as well as for cotton and rape plants. However, only a few countries allow the agriculture of modified plants, among them the USA which represents three quarters of the area. According to the protests in Western Europe against the use of soybean oil from modified plants, a temporary decrease in the USA is also expected. A significant increase in transgenic crops, however, can be observed in countries in transition. China, as a progressive developing country, has meanwhile maintained the second position in transgenetic plant cultivation with an estimated area of plantation of 4.5 million hectares (11 million acres), followed by Argentina and Canada (Figure 9-4).

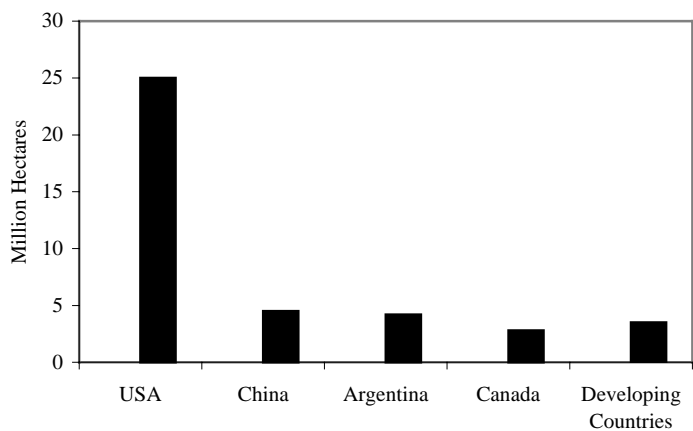


Figure 9-4 Areas with transgenic plants (world total 40 million hectares)

Table 9-1 Producers of seeds

| Company | Country | Million Euro |
|----------------|-----------------|--------------|
| Pioneer | USA | 1800 |
| Novartis | Switzerland | 1150 |
| Limagrain | France | 780 |
| Monsanto | USA | 750 |
| Advanta | The Netherlands | 550 |
| Takii | Japan | 500 |
| Dekalb | USA | 430 |
| Seminis | Mexico | 430 |
| Sakata | Japan | 410 |
| KWS | Germany | 400 |
| Cargill | USA | 300 |
| Cebeco | The Netherlands | 210 |
| Pau Euralis | France | 200 |
| Svalöl Weibull | Sweden | 200 |
| RAGT | France | 180 |
| Mycogen | USA | 180 |
| Saaten-Union | Germany | 160 |
| Sigma Semences | France | 150 |
| DLF Trifolium | Denmark | 150 |
| Barenberg | The Netherlands | 140 |

Table 9-2 Examples of transgenic plants

| Plant | Trade name | Producer |
|--------------|-----------------|----------------------|
| Cotton | BXN Cotton | Calgene |
| Cotton | Bollgard | Monsanto |
| Cotton | Roundup Ready | Monsanto |
| Potato | New Leaf Potato | Monsanto |
| Maize (Corn) | Maximizer | Novartis |
| Maize (Corn) | Nature Gard | Novartis |
| Maize (Corn) | Event 176 | Novartis |
| Maize (Corn) | Liberty Link | AgrEvo |
| Maize (Corn) | Yield Guard | Monsanto |
| Maize (Corn) | Seed Link | Plant Genetic System |
| Maize (Corn) | B16 | DeKalb |
| Rape | Laurical | Calgene |
| Rape | Roundup Ready | Monsanto |
| Rape | Innovator | AgrEvo |
| Soybean | Roundup Ready | Monsanto |
| Tomato | FlavrSavr | Calgene |
| Tomato | Endless Summer | DANN Plant Tech |

Currently, however, the acceptance of genetically modified foods in several European countries is quite low. Once again, management in the corresponding companies and researchers have failed to inform the population at an early stage about the benefits of a new technology, almost as if the disaster of the anti-PVC campaign had not shown the industry clearly enough what can occur when sleepy management neglects an appropriate marketing strategy. Again, the incredibly dilettante public relations of this industry has left the initiative to the so-called environmentalists. The saturated consumer does not recognize the benefit of a “FlavrSavr” tomato, and while this product is not of overwhelming importance it is a necessary step in acquiring experience for more important modified plants, such as new vitamin-producing plants.

However, there are also the arguments of critics that lead us in an important direction, namely promises by companies to increase the harvests by using certain herbicide- or parasite-resistant transgenic plants like Bt-176 maize (that contains a gene from *Bacillus thuringiensis*). Here, the “terminator technology” prevents poor farmers from reusing seeds and are therefore forced buy new seedlings each year. This kind of marketing is perspicuous but clearly shows that some companies tried to gain a monopolistic market position. This is not at all in accordance with a marketing strategy trying to win acceptance of a new product. Such are the inconsistencies in the companies’ strategies, which undermine their own goodwill campaigns.

A much smarter approach with better chances of popular acceptance is the cultivation of plants like the “golden rice”, genetically engineered to contain beta-carotene, which gives the rice a golden color. Of course it is not the color but the

precursor of vitamin A which makes this plant very valuable, especially as it could help to fight against childhood blindness arising from vitamin-deficiency diseases.

9.4 Plants as Chemical Reactors

The cultivation of plants such as rape, linseed, or sunflower to produce oils is long established. The production of rape oil in Germany amounted to about 100 000 tonnes in 1999 with an expected dramatic increase to 300 000 by 2001, principally for fuel. The production of biofuel, however, will not substitute for more than 5 % of the total demand of diesel oil. Currently in the European Union, there seems to be an oversupply of such oils. The reason may be one of these unusual EU agricultural regulations that state farmers will receive a premium of € 300 for each hectare not cultivated but, for whatever reason, this subsidy will not be invalid when rape is planted. The estimated area of cultivation for industrial substances rather than food in Germany was reported to be half a million hectares in 1999. Furthermore, the methyl ester of castor oil, the substitute for diesel, is exempted from tax. Prices for castor oil fluctuate on the world market between € 600 and € 1200 per tonne. Other plant oils are used as lubricants, plasticizers, release agents, or for the cosmetic industry.

New possibilities, however, arise with genetically modified plants used as biological reactors for the production of yet more sophisticated products. Experiments are underway to produce “silk” from a bacterium with a spider gene. Other high-technology bacteria could produce organic hydroxyacids for direct condensation to polyesters. It is possible that in near future a new market segment will be created, in which complex chemicals are “cultivated” on a farm.

9.5 Functional Food

A long-held dream is that medicine or vaccines can be delivered through ingestion of simple food. This kind of food is called functional food and represents a link between pharmaceuticals and genetically modified plants. As a matter of fact, one of the most interesting new business areas arises here. Already commercially available is “prebiotic food”, such as the lactobacillus-containing yogurts, which are said to stimulate flora in the stomach. The worldwide turnover with these prebiotic foods is estimated to about € 11 billion with annual increase rates of more than 40 %. The

new word for this kind of products is nutraceuticals. Other more challenging experiments includes the genetic modification of potatoes with a cholera toxin: Especially in poor countries with an insufficient water supply, cholera is a severe and dangerous problem, and the possibilities of vaccination are limited. Other foodstuff could be modified with cholesterol-repressing genes or with properties that protect against different kinds of cancer.

The positioning in the market will cause difficulties because of the separation of functional food from the legislation for pharmaceuticals. Nutraceuticals are positioned in an area between food and pharmaceuticals. Only in Japan do laws for this new class already exist, in the USA the Food and Drug Administration is responsible for the admission of health-related public relation, while in Europe “health claims” are mostly forbidden.

A new focus may also be put on food containing natural substances—albeit in tiny quantities—which have shown biological activity against certain diseases. The most known ones are omega-3 fatty acids. Less known are the phytochemicals, like isothiocyanates, isoflavones, and phytoestrogens, and antioxidants like catechines which are said to activate the immune system.

9.6 Legal Aspects

The enormous investments of companies in the development of transgenic plants must be compensated by a reasonable return of cash flow. Therefore patent laws guarantee firms protection of marketing rights for a specified time. This is a usual procedure, recognized by most nations, otherwise there would be no incentive to spend money for research. Concerning the cultivation of plants, a similar “protection of sorts” exists based on the International Agreements on the Protection of Sorts of 1961. However, normally it is rather difficult to get a protection of sorts and therefore producers apply for ordinary patents for their transgenic plants. About 1500 demands are waiting in the European Patent Office in Munich. According to the European Guidelines on Bio-Patents of 1997, plants had been excluded from patent protection, whereas patents on single genes are allowed. Patents on transgenic plants or human or animal genes are problematic. The creation by farmers of their own seedlings—a practice since the beginning of systematic agriculture—would be a violation of patent rights under the new situation. In other words, farmers were obliged to buy new seeds from the producing company each year, which is unaffordable especially for farmers in developing countries. The argument from marketing, that these transgenic plants were especially designed for farmers in third-world countries, immediately becomes ridiculous and destroys what remains of their credibility. A group of critics in the USA has announced their intention to bring an anti-trust suit against firms who follow this terminator strategy. The highest European patent court in Munich, acting on a complaint of Novartis

against a sentence of 1995, decided on December 20th, 1999, to grant protection also for genetically modified plants and animals. Details, however, are not yet clear, especially if the agreement does not impact the free-trade treaties of the World Trade Organization. Table 9-1 lists the leading seed producers, including both unmodified and transgenic seeds.

According to the Montreal protocol on biological safety of January 29th, 2000, the European Community has now overcome concerns from the American government against the obligatory labeling of transgenic products. The protocol says that genetically modified plants and animals are only allowed for export if the importing nation has agreed beforehand. The agreement shall be enacted in 2003.

Other new regulations—partly also in connection with plant protection—are concerned with the use of chemicals such as DDT. The so-called persistent organic pollutants (POP) convention of the United Nation's Environmental Program (UNEP), a successor of the Montreal convention, addresses the reduction and banning of dangerous substances. However, the poorest nations still use DDT to protect their population from malaria as they cannot afford modern pharmaceuticals, and the development of a vaccine seems unprofitable to the pharmaceutical industries.

10 Marketing Pharmaceuticals

Marketing pharmaceuticals is one of the most challenging, most expensive, and most interesting subjects in the different disciplines of marketing. It is challenging in so far that the marketing is enclosed within a framework of regulations and economic restrictions—just the opposite to our free-trade philosophies. Of course, a part of these regulations refer to strict admission regulations, on safety grounds, for newly developed drugs by the Food and Drug Administration of the USA or the corresponding national authorities of other countries. However, numerous other regulations refer to state intervention for reasons of price or trade restrictions.

Furthermore, pharmaceutical marketing is rapidly changing in nature because, in recent years, it had been focused too much on the prescribing doctors. It is the most expensive kind of marketing, since it must contribute to the recovery of the enormous cost of drug development, which requires numerous scientific and clinical studies to guarantee the highest grade of safety. Figure 10-1 gives a simplified overview of the different stages of development. Consequently, pharmaceutical marketing has to promote innovations on a global scale, as the extremely high costs of research and marketing can never be covered by national markets (compare Figure 10-2). All this together makes this part of marketing to a very interesting subject, a marketing requiring a strong ethical background and astute perception.

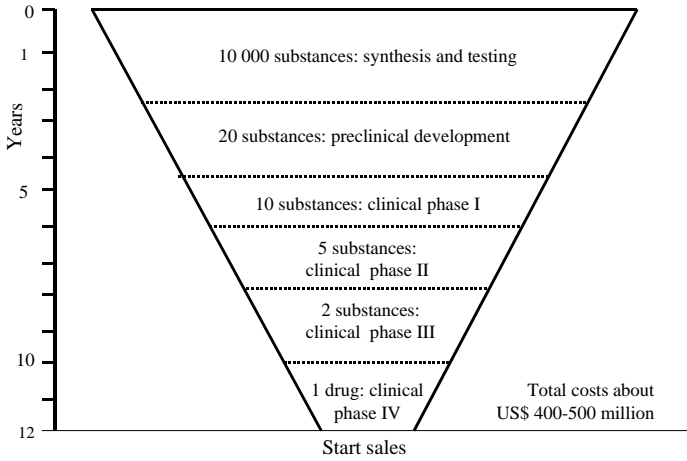


Figure 10-1 Drug development procedural funnel

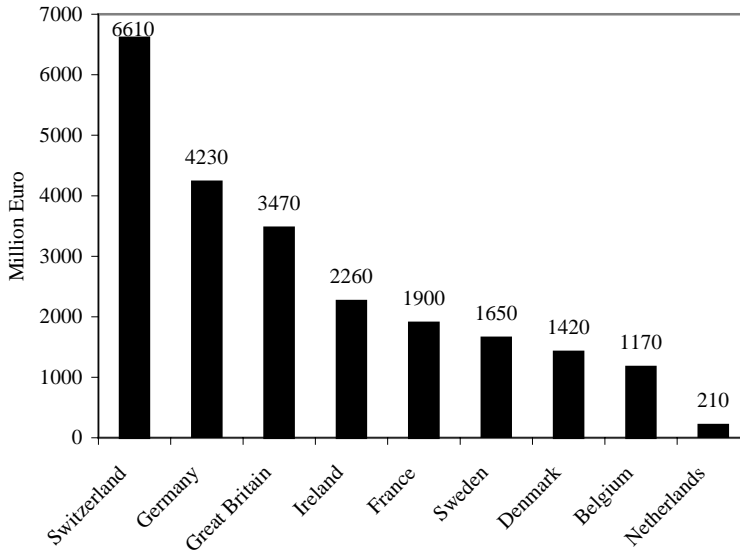


Figure 10-2 European pharmaceutical export surplus in 1997

10.1 Demographic and Social Factors

One of the most important factors is the age distribution of the world's population. In Western regions in the near future there will be an extremely large number of older people; in Asia the number of younger people is still dominant. The average life expectancy increases due to better medical treatment, which shifts the demographic statistics in favor of older people. In the developing countries, the demand, both in quality and quantity, for better healthcare is increasing. Logically then, the overall demand for healthcare will increase worldwide—the current situation is shown in Figures 10-3 and 10-4—and inevitably this demand causes severe economic problems that the public and private insurance companies cannot overcome. The exploding costs of our healthcare systems will most probably make medical treatment subject to a quota. In addition, the socioeconomic environment of healthcare is rapidly changing, as wellness means in the public opinion more than just the absence of illness. Therefore three targets in marketing have to be covered: diagnosis, cure, and prevention. Higher demands for medical treatment in the sense of quality and quantity makes healthcare a costly public benefit. Within the discussions about the dramatic increase of costs for healthcare in all industrialized countries, pharmaceutical marketing has to be positioned between the forces of the patients, the doctors, the insurance companies, and policy.

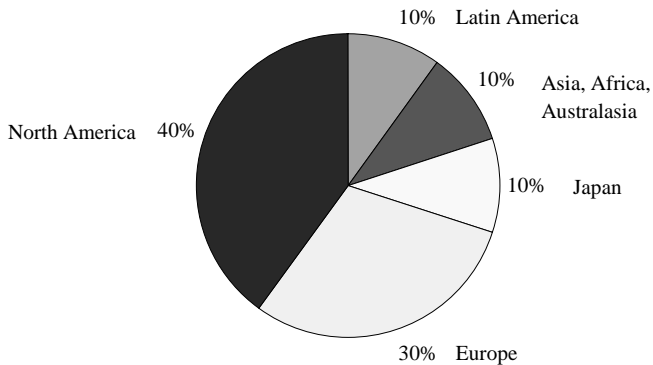


Figure 10-3 World pharmaceutical market distribution for 1999 (estimated total € 320 billion)

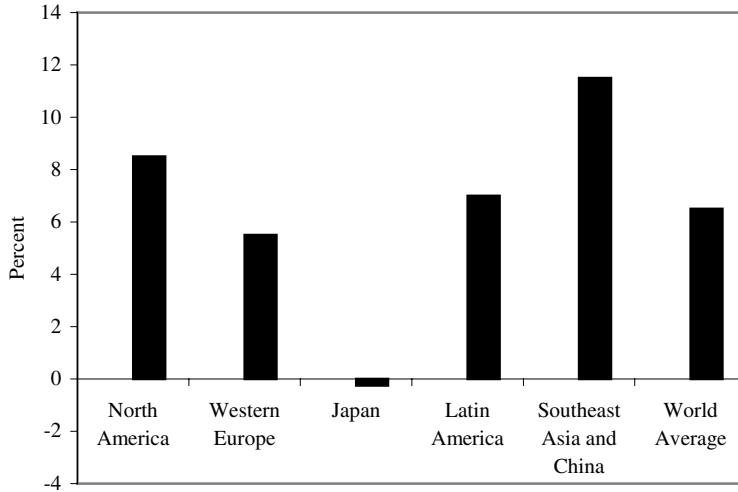


Figure 10-4 Average annual growth rates of pharmaceutical markets, projected for 2000–2005

The economic forces to reduce costs and share the risks in the development of new drugs are also a driving force for the globalization of the pharmaceutical market. The visible outcome is the wave of mergers in recent years (see Figure 10-5). Sharing the extremely high development costs and the joint use of distribution networks are a necessity for the industry, while more companies concentrate on special fields in development because they cannot cover several fields of research simultaneously. That may be also a reason why no company—despite all the mergers—has gained a market share greater than 10 % (see Table 10-1). Beside the large companies, some other pharmaceutical producers operate quite successfully in niche markets.

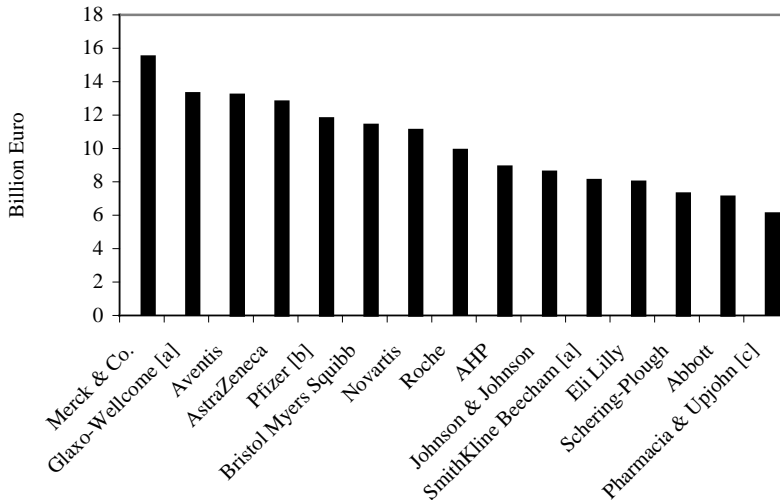


Figure 10-5 Turnover of the largest pharmaceutical producers, according to estimated 1998 values. [a] Now merged to form GlaxoSmithKline. [b] Merger with Warner-Lambert announced. [c] Merger with Monsanto planned but failed.

Table 10-1 Market shares of biggest pharmaceutical producers

| Company | Market share (%) |
|----------------------------------------|------------------|
| GlaxoSmithKline ^[a] | 7.4 |
| Pfizer / Warner-Lambert ^[a] | 6.7 |
| AstraZeneca | 4.6 |
| Aventis | 4.5 |
| Merck & Co. | 4.4 |
| Novartis | 4.1 |
| Bristol Myers Squibb | 4.0 |
| Johnson & Johnson | 3.6 |
| Roche | 3.2 |
| Eli Lilly | 3.0 |

[a] Estimated from merger

For reasons of cost, it is expected that the market share of generic pharmaceuticals will increase at the cost of new products. Generics are pharmaceuticals whose patent protection has expired and now can be produced also by other companies. The development of new drugs will therefore be concentrated on the blockbusters, the

drugs with a turnover of more than one billion dollars (see also Section 3.2.2). Research for less-important “disease markets” will for this reason diminish or even vanish—in contrast to that for lifestyle drugs like Viagra.

10.2 Changing the Marketing Paradigm

In the last decades, pharmaceutical marketing had focused mainly on two target groups, the prescribing doctors and dispensing druggists/chemists. The patients played only secondary roles; they were passive and not a target group in the classical meaning of marketing. On the other side, product marketing was focused on the cure of diseases or the alleviation of injuries instead of integrating healthcare into a concept of prevention. This situation has completely changed and will change further. Several factors require a new way of pharmaceutical marketing. First, the patients take more responsibility for their health, have better access to medical information, and demand more rights and participation in the diagnosis. Internet chatrooms provide valuable medical information to users and allow some kind of “second opinion”. The range of self-medication is expanding, which impacts also on the distribution channels (compare Figure 10-6). Second, the doctors have lost a significant part of their professional sovereignty, as the insurance companies influence both which drugs may be prescribed, through their network of financial restrictions, and which surgical treatments may be given, through their catalogues in which fixed prices for “cases” are set. In this connection consultants have made studies on operation times; the extraction of a “standard appendix” shall not exceed a stated time limit in order to stimulate the efficiency of the surgeons and limit their costs. One can only hope that the patients’ heirs will appreciate these savings. Third, the interests of the insured, which is in practice all members of a country, must accept that the exploding cost in healthcare has set limits on the financial capacity of their insurance. Marketing therefore has as an additional target group, the public and the their political representatives. Marketing must demonstrate and justify what the development of a new drug contributes, not only for the patient but also for the society. The cost–benefit relation gains more in importance and will substitute for the philosophy of a cure that “costs what it may”.

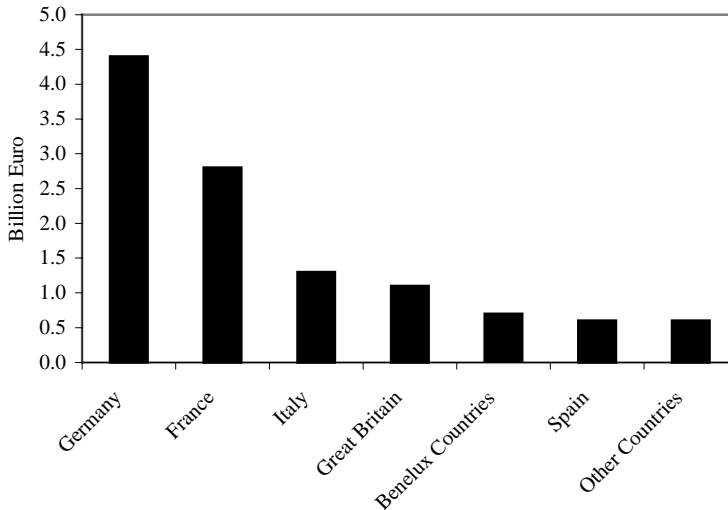


Figure 10-6 Self-medication in Europe according to estimated 1997 volume

The increasingly demanding behavior of the insured, that the community shall pay not only for the cure of diseases but also for their own health, imperils social solidarity. The so-called lifestyle drugs are especially subject to intense discussion. In future, it may be possible that insurance will cover only a core risk, and all other private risks will be covered by separate policies. A broken leg from a skiing accident would then be subject to private financial regulations. Very obviously, a dual system of patients, some with private insurance and some with mandatory public insurance, will split society into two classes and probably cause a further segmentation in pharmaceutical marketing.

10.3 New Market Segments

As already mentioned, environmental changes have created new and modified target groups. Therefore the segmentation process in pharmaceutical marketing has to be revised. Currently, a partial restructuring of the healthcare system can be observed. Due to cost reasons, new organizational forms of medical treatments are practiced, such as “managed care” and “health maintenance organizations” (HMOs). These activities try to reduce the costs of medical treatment by establishing cooperatives formed by regional doctors. The patients resign their free choice in

doctor and instead bind themselves to pass through the joint surgery of the HMO before visiting a specialist. How this system will lead to significant savings in medical treatment has still to be proved. Critics argue that these new forms serve only to smokescreen the bankruptcy of the public healthcare system. Some major HMOs in the US have established their organization in the legal form of a stock corporation, but it remains to be seen if these corporations start to create more shareholder value by introducing cost-saving programs. The first cases of litigation have been already reported. In any case, a new trend in healthcare has arisen and marketing has to address also these consumer groups.

Another increasing segment is self-medication. More drugs are freely available on the market and not bound to prescriptive regulations. Especially vitamins, such as ascorbic acid (vitamin A precursor), general minerals, or aspirin represent an increasing segment. In addition Internet-based pharmacies may stimulate the marketing of freely available drugs. However, it is reported that also generic drugs can be delivered by on-line shops if a prescription is presented, which may have an important impact on price policy as well as on control. Price differences between countries will in this way become more transparent. Furthermore, the repetitive prescription of the same drug, often used by doctors in order to keep control on a patient's medical treatment or to gain reimbursement through an additional "consulting fee", will be substituted by alternative Internet orders.

Self-dispensing managed-care surgeries on one side and Internet distribution on the other side indicate that a major change in the distribution channels can be expected in future. The marketers have to find new ways to address these outlets. Generic products will gain market share at the cost of new drugs for the already-mentioned cost reasons. The strategic position of this product group will have to be revised as well through management. In future, the acceptance of new drugs will be evaluated even more if there is an intrinsic advantage against established drugs. This will impact severely on innovation strategies for research.

10.4 New Competitors

Of relevance for marketers are not only existing competitors but also potential competitors which may enter the market. Among these potential competitors are companies which have overlapping business areas or where new technologies create competitive situations. In connection with transgenetic foods, nutraceuticals were mentioned in Chapter 9. If these technologies are to succeed further—and there is little doubt about that—then as a logical consequence large food companies like Nestlé will most probably enter this market segment. Procter & Gamble has produced headlines in newspapers by its announcement to acquire a company in the pharmaceutical sector. The stock markets rejected this public speculation with a drastic drop of share prices, a reaction that may be explained only by a lack of

knowledge and imagination. It will not prevent management developing new strategies of this kind.

There remains also the question which position in future the large and powerful distribution companies will take. Similar to other industrial branches a concentrating process has taken place. The manufacturers complain about low margins and claim that nevertheless they have to provide for a sophisticated distribution network. It is possible that they will try—at least in the prescription-free segment and perhaps also for generic drugs—to enter their own brands into the market. This has been the classical approach of many distributors in the consumer markets.

10.5 Developing a New Drug

The path from the first idea to the introduction of a new drug is long (see Figure 10-1) and may take up to twelve years in total. The first step is the screening of some hundreds of thousand of different chemical substances, their synthesis, and testing for possible pharmacological properties. Of course research is not done by pure chance: There are typical chemical structures of biologically active substances, which may be modified, and although the derivatives can lose these properties, other unknown substances may surprisingly show desirable effects. In principal, there are two research streams, either the systematic synthesis of derivatives of known structures or the analysis of natural products and identification of specific active substances from the complex mixtures.

For the former, a huge number of derivatives must first be synthesized. This can be done by synthesis robots, which work with miniscule quantities; a solid-phase synthesizer (Sophas) may create 864 syntheses within two days. The following step is high-throughput screening, also by a fully robotic system, which can screen 40 000 substances per day (newly developed instruments achieve several hundred thousand screening tests per day). Substances are tested in palettes dotted with wells containing a few microliters of the substances. At the beginning of the 1990s the simultaneous testing of 96 substances was state of the art, but now the most modern equipment tests 1536 wells simultaneously, and 2080-well technology is expected soon; such a progression is similar to that for microchip development. Bayer recently announced a capacity of 300 000 samples per day, about 200 samples per minute. Reducing the time-to-market for drugs from twelve to six years is the goal of pharmaceutical companies looking to gain a marketing advantage. This, however, can only be achieved with a completely diverse discipline, not chemistry or biotechnology but rather bio-information science.

After the identification of a promising substance the first stage of a battery of tests begins, the proof of pharmaceutical effectiveness in cellular systems or on animals. Pharmokinetic studies are performed in great detail. The second stage of the preclinical phase is the tolerance test with animals and teratological effects on the

animal fetus. Simultaneously the development of Galenic forms—infusions and decoctions—of the new drug is performed. After these preliminary studies, four clinical phases follow: pharmacology and pharmokinetic tests on healthy volunteers (phase I); the efficiency is tested on a limited number of patients and on animals for a period of about 12 months (phase II); a greater number of patients under normal medical practice conditions, accompanied by further compatibility tests on animals for longer periods (phase III); and finally the introduction on a broader scale in clinical practice and the surveillance of possible secondary effects (phase IV).

10.6 Pre-Marketing

The term pre-marketing describes efforts preceding the physical availability of products. In the case of pharmaceutical marketing, it means the pre-launch of a drug already in one of the last admission stages. Contrary to other branches, which tend to keep an innovation top secret until the last moment and then present it as a surprising new development, a pre-marketing stage in the pharmaceutical industries seems to be even necessary. As the prescription behavior of doctors tends to be conservative, an intensive information policy is useful and preliminary results of clinical studies can be discussed in a forum.

There are three main reasons for pre-marketing. First, possible market restrictions can be identified beforehand and possible objections can be answered. Second, the patent claim for an innovative introduction can be assured before a competitor steps in. Third, after successful pre-marketing the break-even point for an innovation can be achieved earlier. In other words, pre-marketing is a new form of competition in time and may furthermore compensate for the foreshortening of a product's life cycle, such as longer development times and relatively short patent protection in the case of drug development. Pre-marketing is not an invention of the pharmaceutical industry; software industries especially have successfully introduced this form of marketing. However, one has to be careful. Pre-marketing must be followed with conventional marketing, that is, with the available product itself. Otherwise such "vaporware", announced with much ado, will severely damage a company's reputation.

Beside the above-mentioned goals of pre-marketing, there are additional aspects in favor of this approach. Unknown patients' needs may be recognized at an early stage and possible new applications could be discovered. Modifications of Galenic application forms could be detected and open new market possibilities. Last not least the "enticing campaign" of pre-marketing attracts attention, which is essential in this stage because, from the usual array of marketing instruments, only promotion can be used.

The pre-marketing stage is often focused on launching blockbusters (see Tables 10-2 and 3-3). On these drugs efforts in marketing are concentrated. It is

expected that in future a greater number of blockbusters will be represented in the category of lifestyle drugs.

Table 10-2 Examples of blockbusters

| Drug | Condition | Launched | Company | Estimated annual sales (million euro) |
|---------|---------------------|----------|-------------------------|---------------------------------------|
| Viagra | Impotence | 1998 | Pfizer | 10 000 |
| Lipitor | Cholesterol reducer | 1997 | Warner-Lambert / Pfizer | 6 000 |
| Zyprexa | Schizophrenia | 1996 | Eli Lilly | 3 500 |
| Celebra | Arthritis | 1999 | Monsanto / Pfizer | 3 300 |
| Vioxx | Arthritis | 1999 | Merck | 2 400 |
| Rezulin | Diabetes | 1997 | Warner-Lambert / Pfizer | 2 200 |
| Evista | Osteoporosis | 1998 | Eli Lilly | 2 000 |

10.7 Relaunch of Pharmaceuticals

In consumer marketing a relaunch means that at the end of a product's lifecycle a modification or the change of environmental factors can prolong the marketing. In the pharmaceutical business, this is the exception but is nevertheless worthwhile to mention. There are two outstanding examples, aspirin and contergan. The analgesic aspirin (acetylsalicylic acid ester) has been indicated as a protection against heart attacks. Contergan, a drug which lead catastrophically to thousands of disabled children in Europe when their mothers took it during pregnancy, has found a new application in defeating certain secondary effects of AIDS and leprosy. Meanwhile, the American FDA has approved the drug, albeit under extreme safety restrictions.

10.8 Distribution Channels

Similar to the globalization trend on the side of the producers, the wholesalers also join together, as shown by Figure 10-7 where the market shares of major wholesalers in Germany are given and demonstrates the concentration process in a single country. This distribution segment alone meanwhile has grown to a market worth € 16 billion in Germany (see Figure 10-8). At least on the European scale, the trend of acquisitions continues with a special focus on Central Europe. Simultaneously the entrance of Japanese companies in the European market can be observed, such as with the Chugai Pharmaceutical Co. which has already a joint venture with Rhone-Poulenc. Decreasing margins together with increasing competition by reimporters, large food chains, and mail-order shops are the driving forces for the globalization. These changes occur with cost to the classical local druggists'/chemists' shops. Furthermore, according with the harmonization of European laws, doctors have and hospitals will gain the right for dispensation.

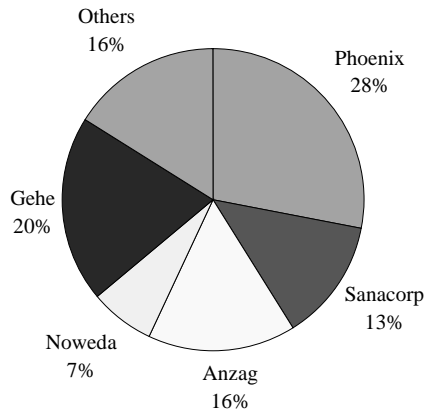


Figure 10-7 Pharmaceutical wholesalers in Germany according to 1998 turnover (total € 30 billion)

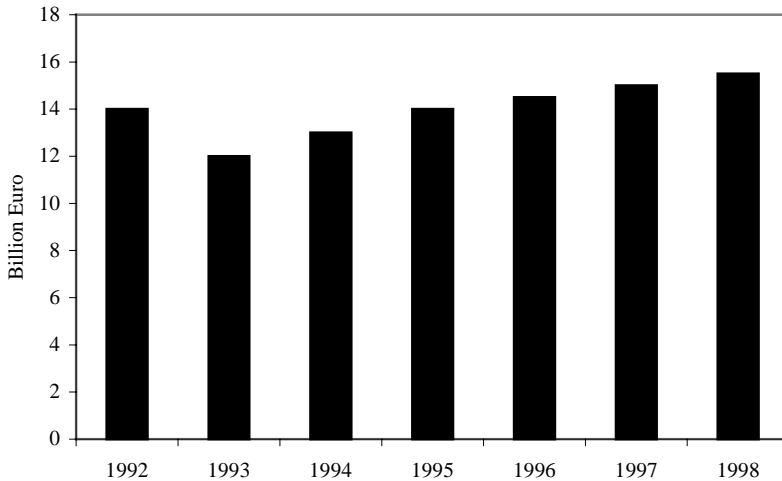


Figure 10-8 Development in pharmaceutical wholesales in Germany to 1998

Self-medication in Western Europe is estimated to account for about 20 % of the total pharmaceutical volume, with growth rates of about 5 %. The trend towards self-medication is enforced by the mail-order and discount shops. The low margins of the food industries encourage them to enter this market segment and expand their assortment. The local representatives of the druggists/chemists argue heavily against selling over-the-counter (OTC) drugs in the supermarkets and mail-order shops. However, the representatives need to realize that the advice of the druggists/chemists is obviously not appreciated sufficiently by the customers and, although they are regarded as highly educated experts, in the end they are seen more as sellers than scientists.

This profession must quickly find a new marketing concept, changing from pure supply to a service-oriented function and integrating still more of the OTC market. The future image could be that of a “wellness” market, following the trend of self-medication. In contrast to former market behavior, they have to focus more on competencies and added service value. Furthermore they should expand the nonprescription assortment, which actually contributes 5–10 % of their total turnover. The overall margins in the upper price range of ethical pharmaceuticals have decreased to about 5 %. In addition, purchasing associations will put further pressure on prices and margins.

11 Electronic Commerce in the Chemical Industry

11.1 The Significance of E-Commerce in Marketing

The rapidly developing possibilities in information technologies will lead to major changes in marketing. From the classical marketing mix of product, price, place, and promotion (see Chapter 1) the latter two elements will shift significantly and increase their relative importance. Virtual market places and the direct promotion to a (theoretically) infinite number of potential customers opens a much broader outlet for products and services. E-commerce also increases significantly the efficiency of promotion efforts in comparison to traditional ones, like mailing actions, which have a limited range in space and time. Furthermore, the medium enforces the process of standardization of products and therefore initiates a trend that pushes more products into the category of commodities. This in turn, beside increased transparency of markets, places additional pressure on prices. At a first sight the virtual markets seem to be a particular place where low-cost goods are traded and it is not—at least not yet—a market for luxury goods. For this reason, producers of luxury goods avoid this medium whenever possible. However, initial attempts to sell high-priced products through the Internet have already been detected, which in some cases led the producer to cancel the sales license. However, restrictions of e-commerce to low-cost goods and commodities certainly would be short sighted. Already now patents or complex technical machinery are offered in this way.

It is more likely that e-commerce in general will develop into a completely new marketing instrument for distribution. There is little doubt that e-commerce will cause a dramatic reorganization of the intermediate trade. The Internet enables the online trader to communicate directly, and at lowest cost, with potential customers. No other medium has this potential. The traditional sales force could visit perhaps two or three customers per day in the local region, whereas communication by Internet multiplies the number of contacts. However, this requires software designed for interaction; a simple homepage is insufficient. An additional severe problem is the lack of security in financial transactions by the Internet as well as that of legal

regulations. It starts with the question of which country's laws are binding for a purchasing contract. Other interesting problems arise in connection with the local value-added taxes (VAT, MWSt, and similar).

In spite of the enthusiastic forecasts about the growth rates, one has to be more realistic in expectations. E-commerce fills an information gap and multiplies the possibilities for business contacts. However, an order given over the Internet does not at all mean that products will arrive more quickly; the logistics of transportation are still and most probably will remain a bottleneck. In addition the question arises of what happens when most of the products will be available on virtual markets. Certainly the marketing law of differentiation (Section 1.4) will step in again.

11.2 Virtual Chemical Marketplaces

For a number of years it has been possible to order products through Electronic Data Interchange (EDI). Standardized products, especially low-value products with regular consumption, were traded. In connection with just-in-time delivery, the supplying companies had direct access on the customers' stock-keeping and production data and the supplier automatically delivered the required parts on an as-needed basis. This procedure, however, is directed only to a few special clients and based on a bilateral agreement. Some chemical companies also had already established an electronic catalog, in which customers could order directly and chose among some thousand substances. However, this has been so far an exception. Several raw materials, like metals or oil, have already been traded on the commodity exchange for a long time. Air Products can be regarded as a pioneer in e-commerce and is said to be the first company in the chemical branch which provided customers with a complete order-to-cash process online.

A revolutionary technological breakthrough, however, is now the Internet trade with chemical and pharmaceutical products. About a dozen providers have already established or announced a platform for online trading of chemicals. Table 11-1 gives some examples of services available currently or in the near future. The German Stock Exchange announced at the World Economic Forum 2000 in Davos, Switzerland, the introduction of a regular trade in chemicals, electricity, and telephone time during the year.

Table 11-1 Electronic market places for chemicals

| Internet address | Participants |
|---------------------|-----------------------------------------------------------------------------------------------------------------------|
| www.chemdex.com | Independent online broker |
| www.verticalnet.com | Independent online broker |
| www.chemconnect.com | BASF, ICI, DSM, Celanese, Dow Chemicals, Eastman Chemical, Andersen Consulting, Goldman Sachs, Chemical Week magazine |
| www.yet2.com | BASF, Boeing, Dow Chemical, DuPont |
| www.chematch.com | Bayer |
| www.mysap.com | SAP, BASF, Degussa-Hüls |
| www.tpn.com | General Electric |
| www.poymerland.com | DE Distributor |
| www.echemicals.com | Independent online broker |
| www.euroboard.com | German stock exchange (Deutsche Börse; chemicals, electricity, telephone) |

Most of the large chemical companies are actually forming joint ventures with service providers or other large software houses to create their own trading forum. The market for such platforms is booming, and forecasts about the future market share of e-commerce in the chemical industry are more than optimistic. Estimates report about € 50 billion of total sales worldwide already for 2001, with an increase to € 300 billion in the succeeding two years. The total volume for chemical trade worldwide is estimated to about € 2000 billion per year. Growth rates of a chemical online trader have been reported to more than 1600 % per year. DSM, the Dutch chemicals group, expects to generate € 4 billion in sales by the Internet within the next three years.

As the chemical industries are relatively fragmented, they are regarded as difficult to market. Therefore e-commerce seems to be just the right instrument. The branch is especially suited for e-commerce because most of the products are standardized. Even specialty chemicals can be regarded as standardized products because they are characterized and described by their formula and their physical properties. In this way, a new platform is established for trading thousands of chemicals, formerly found only in catalogs or on special request. Of course the competitor is only a mouse-click away, with all corresponding consequences.

E-commerce will have special impact on pharmaceuticals trade. As already mentioned in Chapter 10, the current markets show significant differences in prices. A leveling of the market therefore will be inevitable. In the case of pharmaceutical marketing, the connected explanatory services, as an added value, will at least partly become substituted by information available in the Internet. Especially for doctors, who sometimes regard the visits of pharmaceutical representatives as a bother, may prefer the timely, more flexible information source of the Internet.

The advantages of online trading are obviously seen mainly in the saved transaction costs on one hand and additional savings by a worldwide auction process

in which a purchaser will achieve lowest possible prices. However, one has to keep in mind that the chemical industries mostly produce hazardous goods which have to be handled with care. Therefore packaging, shipping declarations, customs clearance, and the like still have to be performed in the traditional way. Physical transport cannot be made by electrons, and therefore an increasing gap between ordering and the logistics of delivery will develop.

12 Emerging Markets

A few remarks shall be made on two emerging markets, which certainly will gain major importance in the near future: The oil region of Baku, and China. There are a lot of other most interesting markets but reliable data is very difficult to gather. Therefore the following remarks shall more be regarded as an indication about additional difficulties arising for marketers in these new markets.

12.1 The Baku *Oil Dorado*

In the last years of the Russian Empire, before the First World War and the Russian Revolution, half of the world's oil extraction came from the Baku region near the Caspian Sea. In 1910, more than 2500 drilling towers were installed. Experts estimate that the equivalent of about 200 billion barrels of oil could be found in this region. No wonder that today nearly all important oil companies are still present near the Caspian Sea, such as the Russian Lukoil, British Petroleum, Amoco, Mobil, the Norwegian Statoil, and Tengischevroil (in a 45 % joint venture with Chevron). However, a look at the map and a glance into the newspapers show that the region is politically very unstable. The states around the Caspian Sea are Russia, Kazakhstan, Turkmenistan, Iran, and Azerbaijan. In 1998, an agreement between Russia and Kazakhstan was signed concerning the different points of view on the legal status of whether the Caspian Sea was to be regarded as a sea or an inland lake. The status of an inland lake had given the five states the rights of common exploitation of resources; now it tends more to be defined as a sea. Most of the resources are expected to be found in the territories of Kazakhstan, Turkmenistan, and Azerbaijan.

A major problem is the distribution of the recovered oil and gas. So far, most of the oil had been transported by pipelines through Russia by the state-owned monopolies Transneft gas and Gazprom. In order to circumvent this bottleneck, Tengischevroil transported the oil by train to the Baltic states and even to China. There are few alternative routes for additional pipelines which avoid regions of political and social unrest. In principal seven routes are under discussion, each of them favored by a different group of investors.

- 1) Kazakhstan–Russia by the Caspian Pipeline Consortium (CPC)
Tengis–Atyrau–Novorossiysk
Tengis–Atyrau–Samara
- 2) Azerbaijan–Black Sea by the Azerbaijan International Operation Company (AIOC)
Baku–Novorossiysk
Baku–Supsa
Baku–Ceyhan
- 3) Circumvention of the Bosphorus
Burgas–Alexandropolis
Odessa–Brody
Samsun–Ceyhan
- 4) Transcaspian Pipelines
Aktau–Baku
Turkmenbaschi–Baku
- 5) Kazakhstan–Turkmenistan–Iran Pipeline (KTI)
- 6) Turkmenistan–Afghanistan–Pakistan Pipeline
- 7) Kazakhstan–China Pipeline

The capacities vary from 5 to 67 million tonnes of oil per year and planned investments from US\$ 750 to 2500 million.

Besides the crude oil business, the joint venture between the BASF daughter-company Wintershall and Gazprom (65:35) has to be mentioned. Gazprom is, with a production of about 570 billion cubic meters, the biggest gas producer in the world. Gazprom controls a pipeline net of 148 000 km, and shares in the company are 40.9 % to the Russian state, 30.3 % to private and institutional investors, and 26.9 % to other legal entities. The rest is traded on the New York stock exchange, however not as usual stock but as American Depositary Receipts (ADRs).

As in the past, the oil companies will function as a pathfinder for the following industries of the production chain, namely refineries, raw material producers, and subsequent transformation industries. Some of the newly independent states in the Transcaucasus region show astonishing growth rates and an increasing gross domestic product (GDP); Table 12-1 gives a rough overview.

Table 12-1 Growth in real GDP in Central and Eastern Europe

| Country | GDP growth (%) | Wealth per capita for 1999 (US\$) |
|-----------------|----------------|-----------------------------------|
| Albania | 8 | 1098 |
| Bulgaria | 0 | 1315 |
| Croatia | -0.5 | 4334 |
| Czech Republic | 0 | 5176 |
| Estonia | 0 | 3593 |
| Hungary | 3 | 4562 |
| Latvia | 1.5 | 2789 |
| Lithuania | 0 | 2935 |
| Poland | 3.5 | 3887 |
| Romania | -4.0 | 1409 |
| Slovak Republic | 1.8 | 1617 |
| Slovenia | 3.5 | 10708 |
| Armenia | 4 | 503 |
| Azerbaijan | 3.7 | 521 |
| Belarus | 1.5 | 958 |
| Georgia | 3 | 727 |
| Kazakhstan | -1.7 | 1067 |
| Kyrgyzstan | 0 | 355 |
| Moldova | -5 | 283 |
| Russia | 0 | 1377 |
| Tajikistan | 5 | 191 |
| Turkmenistan | 17 | 353 |
| Ukraine | -2.5 | 840 |
| Uzbekistan | 3 | 547 |

12.2 Business in China

At the beginning of the new millennium, China shows all signs of an emerging economic superpower. In future, any business strategy with an international issue will have to consider China. In spite of major cultural differences in behavior and business style, practically all big chemical companies invest heavily in the new markets: No crisis could prevent them from further investments, as a market with 1200 million inhabitants is too attractive. Investments in China are facilitated in different ways, such as tax exemptions for the first year, a reduced tax rate for the

initial business period, and accelerated building permission. However, without the assistance of local managers a project may turn out to be wearying and local authorities very imaginative in supplemental fees. Furthermore, a contract has a complete different meaning in the Chinese culture: A document is a piece of paper that means the beginning of a fruitful business process in which changes are inevitable, and may represent the first link in a chain of endless misunderstandings. The way it goes depends—as always—on the people involved.

Today the infrastructure for the China's future chemical industries are laid, including petrochemical, fertilizer, and fiber plants, hydrocarbon crackers for ethylene and propylene, and plants for the production of basic materials for plastics, while most modern production facilities for pharmaceuticals and plant protection are in construction. BASF and the state-owned Sinopec want to construct one of the world's biggest integrated chemical regions near Nanjing; Bayer and Shanghai Chloralkali Company agreed on the construction of a similar Chemical Industry Park near Shanghai. Each of the investments is worth several billion euro. The importance of the investments become obvious when companies forecasts a regional turnover in Asia of 25 % and more of the consolidated balance. The volume of the total Asian chemical market is estimated to about US\$ 500 billion, where Japan counts for about US\$ 220 billion.

Similar to trends in the West, in China a thorough restructuring of the chemical industries is taking place. Sinopec is the world's biggest holding in the chemistry branch with 40 subunits and about 150 joint ventures. In 1997, four major Chinese companies merged—Yizheng Chemical Fiber, Yangzi Petrochemical, Jinling Petrochemical, and Nanjing Chemical Industry—forming the biggest chemical conglomerate in China with a joint turnover of about 33 billion yuan (US\$ 4 billion).

Nearly known in the Western world is Chinese biotechnology, expected soon to belong to the leading research centers in the world. Under state coordination, the Chinese National Center for Biotechnology Development has assembled about 200 universities and research institutes with 15 000 scientists. As far back as 1986, the former President Deng Xiaoping gave priority to biotechnology in his so-called 863-program for development. The manner and speed in which the Chinese policy pushes such projects forward shall make it quite plain that China shall soon occupy one of the first places in biotechnological sciences.

13 Outlook

The chemical industries worldwide are in a process of total reorganization that will have a deep impact on the industry structure itself in Western countries as well as on marketing. In recent decades the structure of companies oscillated between centralization and decentralization, and consultants each time found a new terminology for the same effect. Now, however, it seems that for the first time the “squaring of the triangle” will be successful, and centralization of market power with decentralized structures of business units and core competencies will happen. Most chemical companies will soon face the limitations of mere size, and must organize themselves in the form of holdings, thereby having numerous centers of excellence as more or less independent legal entities under one roof. Only in this way market power, innovation, and flexibility can be maintained. Management will also recognize that growth mainly based on acquisitions is limited and rather risky. The multinational enterprises will have the chance to act more as organizers and sponsors of young, dynamic entrepreneurs in science and offer them possibilities for collaboration without implementing their own corporate culture.

The specialization will proceed much further than currently envisaged and many current strategies shall have to be revised. The “lifescience concept” is still too unclear and has shown less synergies than expected, since the marketing channels differ too greatly, as seen in the case of plant-protection agents and pharmaceuticals for example. The pressure to specialize and to enter the premium-price sectors is enforced by the simultaneous shift of medium-price chemicals to commodities due to newly emerging Internet markets. Prices will collapse for all standard products and services which do not have (or need) any added value. The lowest purchasing limit will not be determined by price but by the logistics of availability, that is a mix of price, quality, reliability, and rapid delivery. Companies which remain in the middle with their marketing concept will face severe problems or may even be squeezed out of the market.

The value chain will dissolve and be substituted by an irregular network, a network of collaborations, joint ventures, and virtual marketplaces. Like no other branch, the chemical industries will have to work together because of the nature of their combined production processes. Economies of scale will continue to be a key factor of success but only for those who are really global players and are present in the triad of America, Asia, and Europe, namely the most important economic regions in the world. Present, in this context, means producing, purchasing, and selling. Creating value will be a process among partners in a network, partially a tangible network and partially a virtual network of companies and institutions.

In this network, marketing has to find a new place. The importance of marketing will increase greatly and become a core competence of the same quality as research. The scientist may not like that but have to admit that their salaries are paid by the customers, and marketers create this link. Marketing as well as other functions will split up into core competencies, mainly into the marketing of distribution and the marketing of product image and social credibility; for what the company “stands for” will be the question of the future. The traditional approach, that each company has its own sales staff, unequally trained, will change. Marketing becomes increasingly a job of experts and professionals. The management of distribution channels may be outsourced, shared with other companies, or performed by a partner in the network. Customers will be ranked according to their contribution to monetary or skill-based profit, and the most attractive ones will enjoy a privileged service. Customer relationships will try to achieve a win-win situation for all partners in the network.

The market places of the future are Asia and some countries of the former Eastern European block. The most rapidly developing area in the above-mentioned triad is China, which has by far the greatest potential, and its dynamic markets will most probably continue to expand at high speed. In the near future especially China will be a strong competitor on the world markets, and also for high-technology industries. In some areas, China may even outperform traditional technology-oriented countries. The so-called Asian crisis, a result of immense but insecure market speculation, will not prevent Japan and other countries releasing pressure on the world markets; they are still strong and will recover soon. Western Europe will enter into a most critical situation, where policy has to decide whether to deregulate state and economy, or fall into a technology-antagonistic society of doubters. At least a few business areas, which traditionally have been believed to be strongholds of Western technology, will become lost because of above-mentioned reasons.

14 General References

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