REGIONS & LOCATIONS GUIDE

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The Global Footprint of the Chemical Industry

Catalyzing Growth and Addressing Sustainability Challenges

A new report, published by the International Council of Chemical Associations (ICCA) and based on a study by Oxford Economics, provides a detailed assessment of the chemical industry's activities across the globe and to quantifies their total economic impact. The findings outlined in this report paint an important picture of the industry's contribution to the global economy. The analysis focuses on two key measures of economic value: the number of jobs sustained each year by the global chemical industry, and its contribution to the amount of gross domestic product (GDP) that different nations generate.

As well as directly creating jobs and economic activity in virtually every country of the world, the chemical industry sustains further employment and growth via "multiplier effects" in the countries' wider economies. To quantify these contributions, the economic impact assessment took into account not only the size of the industry itself (its direct impact), but also its indirect and induced impacts, which relate to economic activity in its supply chain — including complex international linkages — and wage-funded staff spending, respectively.

Global Economic Value

The chemical industry's global economic impact in 2017 was substantial. Its total annual contribution to global GDP was an estimated $5.7 trillion, sustained through a combination of its direct, indirect, and induced economic channels. This equates to 7.1% of the world's GDP in 2017 (see Fig. 1).

Of this total, the chemical industry itself is found to have directly added $1.1 trillion to global GDP in 2017, while directly employing 15 million people. This makes it the fifth-largest global manufacturing sector, in terms of its direct annual contribution to GDP (making up 8.3% of global manufacturing's total economic value). Comparing the chemical industry's direct and total employment impacts implies that, for every person directly employed in the industry, seven jobs are supported elsewhere in the global economy. In terms of GDP, the results show that for every $1 generated by the industry itself, a further $4.20 is generated elsewhere in the global economy.

Companies in the chemical industry have invested an estimated $3.0 trillion with their suppliers in 2017, buying goods and services used in the manufacture of their products. Almost two-thirds of this amount was spent by chemical companies in the Asia-Pacific region. This supply chain spending (indirect impact) supported an estimated $2.6 trillion contribution to global GDP in 2017, and 60 million jobs — spread across goods and services providers in a wide range of industries, from mining to wholesale trade.

The analysis, divided into five global regions, finds that the Asia-Pacific chemical industry made the largest annual contribution to GDP and jobs in 2017. According to the results published in this report, it generated 45% of the industry's total annual economic value, and 69% of all jobs supported (see Fig. 2). Europe made the next most important contribution globally, followed by North America.

On average, every dollar of gross value added (GVA) created directly by the chemical industry supported an additional $4.20 contribution elsewhere in the global economy in 2017.

Furthermore, due to the industry's high levels of productivity, the sector's employment multiplier is even greater. For every employee in the industry itself, seven jobs are supported elsewhere in the global economy. Each and every sector of the global economy benefits from the existence of the chemical industry.

Direct Impacts

Not only do chemical manufacturers transform raw materials into some of the final products consumers use every day, the industry also provides inputs to a broad range of sectors, from agriculture to transportation. In 2017, the chemical industry generated sales (gross output) worth some $4.1 trillion, of which $1.1 trillion represented gross value added (GVA).

Given that the chemical industry supplies inputs to almost all sectors of the economy, its prosperity also has important implications for downstream chemicals users (i.e., the users and buyers of its products). Beyond chemical manufacturers themselves, the biggest industrial users of chemicals are the rubber & plastics, textiles, construction, computer production, and pulp & paper sectors. In all, nearly 58% of the global chemicals sold to downstream users go to other industrial sectors. The remainder goes to other branches of the global economy such as health and social work, agriculture, and services.

Combining all these revenues, the chemical industry directly made an estimated $1.1 trillion gross value added contribution to global GDP in 2017. This direct GVA accounted for 27% of the industry's total sales. Chemicals are thus the fifth-largest component of the manufacturing sector's total value added, after machinery & equipment, high-tech goods, motor vehicles, and food products (see Fig. 3).

By region, Asia Pacific (APAC) lead the way here, creating 51% of the worldwide chemical industry's GVA

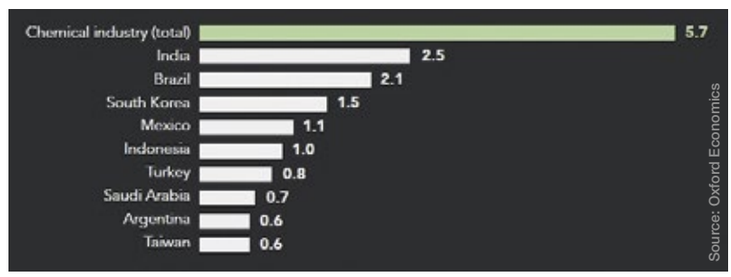

Fig. 1: The global chemical industry's economic footprint in 2017 ($ trillion).

Fig. 2: Total global economic impact by region in 2017.

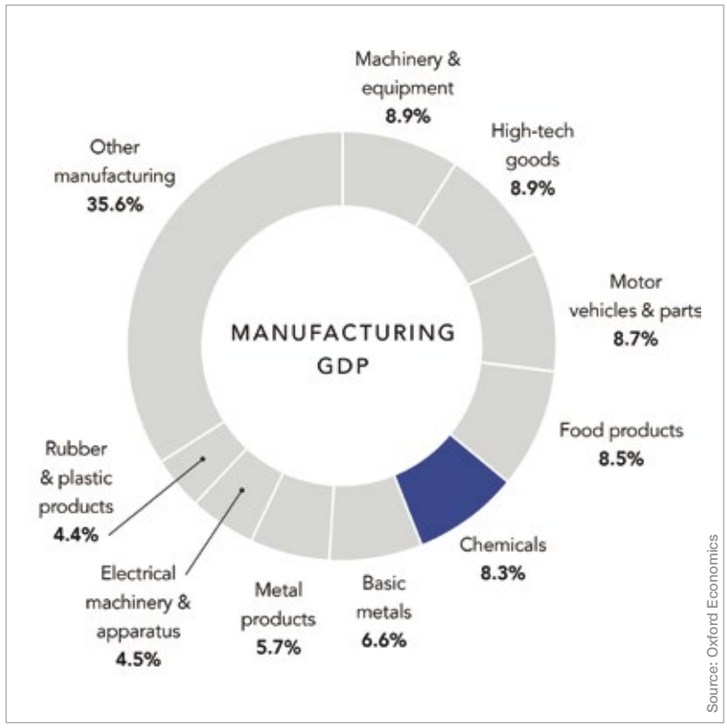

Fig. 3: Sectors' direct contributions to GDP as percentages of total global manufacturing in 2017. Source: Oxford Economics

in 2017. In this region, the industry represented 2.1% of total GDP. North America and Europe follow, with 21 and 17% of the total, respectively. In both regions, however, the size of the industry is just above 1% of total annual GDP.

The chemical industry directly employed 15 million people worldwide in 2017. This included over 11 million people in APAC (77% of the total), almost 2 million in Europe (11%), and over 600,000 in North America (4%). Indeed, it is estimated that 0.7% of all employment in APAC is directly created by the chemical industry.

Indirect and Induced Impacts

The economic impact of the chemical industry extends much further than just its direct impact. The chemical sector spent $3.0 trillion on goods and services from suppliers worldwide in 2017. A third of this spending goes back into the chemical industry (e.g. as chemical firms purchase chemical inputs from other companies to include in their production process), as expected. Other major beneficiaries of the chemical industry's supply-chain spending are mining, including oil and gas extraction (14% of the total), and wholesale & retail trade (11%).

In regional terms, the Asian chemical industry accounted for $1.9 trillion of these supply-chain purchases, followed by the European industry ($0.6 trillion) and North America ($0.4 trillion).

The results show that this supply-chain spending had the greatest impact in the mining, and wholesale & retail sectors, supporting $679 and $445 billion of GVA respectively in 2017 (Fig. 3). The chemical sector supported a further $250 billion in the R&D and other business activities sector. Across all non-chemical sectors, the supply-chain spending of the chemical industry supported a $2.6 trillion contribution to global GDP in 2017 — of which roughly half was in the Asia-Pacific region (Fig. 4).

In addition to the income received by workers employed directly by chemical companies, the industry also sustains labor income in its supply chain and in the consumer-facing global economy, through the induced channel. In 2017, the authors of the study estimate that a further $939 billion and $779 billion in labor income was supported by the chemical industry through its indirect and payroll-induced channels, respectively.

R&D Footprint

The chemical sector invested $51 billion in R&D in 2017. China was home to the largest chemical R&D spend, with an investment of $14.6 billion, followed by the US and Japan, with a $12.1 and a $6.9 billion investment, respectively.

In total, accounting for all the channels of impact, it was calculated that this R&D investment supported 1.7 million jobs and a $92 billion contribution to worldwide GDP in 2017.

The benefits to society of research and development spending, however, are much broader than these jobs and GDP contribution. R&D spending generates long-term benefits for society at large. The chemical sector's research boosts the global economy through the development of new technology, processes, and products that enhance efficiency and productivity, and can have wider social benefits.

While the industry's R&D efforts are obviously aimed at commercialization of research results, societal benefits by far outweigh the private financial returns from innovation. Patents are a formal channel of dissemination of knowledge, processes, and products, as they encourage innovation, and the publication of any invention. In the US, the basic chemicals industry is characterized by above-average patent intensity.

Furthermore, the innovations that emerge from such R&D activity invariably offer "spillover" benefits that spread far wider than the chemical sector itself, raising productivity levels across the global economy. The chemical industry's innovation and R&D activities often lead to the development of new products and processes, and (as explained above) patents are a formal channel for the dissemination of such innovation.

In the US, the chemical sector is one of the most patent-intensive sectors, alongside electronics. US patent data are readily available and therefore frequently used to construct a measure of patent intensity. The patent intensity of the basic chemical industry was recorded to be 0.027 — roughly in line with medical appliances and electric motors, generators and transformers.

It should be noted that chemical products also fuel innovations and patents in other industries, i.e. photovoltaic cells for electricity production, lightweight vehicle parts, germ-resistant coatings for medical instruments, etc.

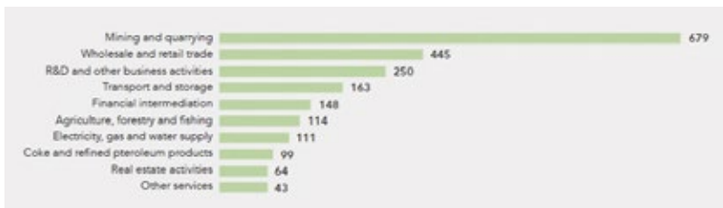

Fig. 4: GDP contribution supported through chemical industry's global supply-chain spending, top 10 industries, 2017 ($ billion).

International Council of Chemical Associations (ICCA)

www.icca-chem.org

Global Competitiveness Index

Building Shared Prosperity and Managing the Transition to a Sustainable Economy

The results of the 2019 Global Competitiveness Index (GCI) reveal that, on average, most economies continue to be far from the competitiveness "frontier" – the aggregate ideal across all factors of competitiveness. Performance is also mixed across the 12 pillars of the index. The report demonstrates that 10 years on from the financial crisis, while central banks have injected nearly $10 trillion into the global economy, productivity-enhancing investments such as new infrastructure, R&D and skills development in the current and future workforce have been suboptimal.

As monetary policies begin to run out of steam, it is crucial for economies to rely on fiscal policy, structural reforms and public incentives to allocate more resources towards the full range of factors of productivity to fully leverage the new opportunities provided by the Fourth Industrial Revolution.

Europe

Denmark (10) can already rely on a stable macroeconomic environment, widespread ICT adoption, modern skills and a robust labor market. An aspect where Denmark took a slight step backward in 2019 is innovation.

France (15) shows strengths in macroeconomic stability, health, infrastructure, financial system development and market size. It is an innovation hub but would benefit from a stronger entrepreneurial culture and a boost in ICT adoption.

Germany (7) boasts the world's best innovation capability. Other strengths include infrastructure, macroeconomic stability, market size, and health. However, the level of ICT adoption is relatively low.

Italy (30) has improved its financial system, access to finance to both SMEs and venture capital, ICT adoption and infrastructure. Its ability to innovate also remains competitive. Yet some bottlenecks, like high public debt, are still limiting Italy's potential.

The **Netherlands** (4) is the most competitive country in Europe. It receives high marks for macroeconomic stability and infrastructure quality. The country's innovation ecosystem benefits from a vibrant business dynamism and high innovation capability.

Switzerland (5) obtains the maximum score on the macroeconomic stability pillar and a near perfect score for infrastructure. In addition, the country is one of the world's top three innovators. However, market efficiency and business dynamism could be improved.

Turkey (6) advances on ICT adoption, infrastructure and labor market pillars. On the other hand, Turkey's progress in this area is counterbalanced by a significant deterioration of its macroeconomic environment, driven mainly by higher inflation.

The strengths of the **United Kingdom** (9) include macroeconomic stability, infrastructure and financial system development. Business dynamism and innovation capability have weakened, and market efficiency has dropped sharply – a result of lower domestic competition and trade openness.

Eurasia

The macroeconomic environment of the **Russian Federation** (43) has improved substantially. In addition, it has enhanced its innovation capability which is also supported by increased ICT adoption. On the other hand, insufficient access to finance is limiting the competitiveness of Russian firms.

East Asia and Pacific

China (28) is by far the best performer among the BRICS economies, driven by the size of its market and macroeconomic stability. In several areas, China's performance is almost on par with OECD standards and it has been rapidly increasing its innovation capability. However, the country would benefit from a more intense competition and better allocation of resources.

Australia (16) features strengths that include macroeconomic stability, skills and financial system development. Its performance is largely in line with the OECD average.

Hong Kong SAR (3) is leading on four pillars: macroeconomic stability, health, financial system and product market. Furthermore, it ranks high on the infrastructure and ICT adoption pillars. Hong Kong's biggest weakness is its limited capability to innovate.

The main strengths of **Indonesia** (50) are its market size and macroeconomic stability. It boasts a vibrant business culture, a stable financial system and a high rate of technology adoption. Innovation capacity remains limited but is increasing.

Japan (6) is one of the most technology-savvy nations in the world and its financial sector is large, deep and stable. The country also benefits from its large market size. On the downside, risk aversion and rigid corporate culture undermine Japan's business dynamism and innovation capability.

The **Republic of Korea** (13) leads the world in ICT adoption and macroeconomic stability, and is one of the world's innovation hubs. The weakest aspect of Korea's performance is market inefficiencies, due primarily to the lack of domestic competition and high trade barriers.

Singapore leads this year's GCI 4.0 rankings. The country tops the infrastructure, health, labor market and financial system pillars, and achieves a nearly perfect score for macroeconomic stability. Performance in terms of market efficiency is driven by the fact that Singapore is the most open economy in the world.

Top 10 Countries in the Global Competitiveness Index 2019

Rank	Economy	Score[1]	Diff. from 2018 Rank	Diff. from 2018 Score
1	Singapore	84.8	+1	+1.3
2	United States	83.7	–1	-2.0
3	Hong Kong SAR	83.1	+4	+0.9
4	Netherlands	82.4	+2	–
5	Switzerland	82.3	–1	–0.3
6	Japan	82.3	–1	–0.2
7	Germany	81.8	–4	–1.0
8	Sweden	81.2	+1	–0.4
9	United Kingdom	81.2	–1	–0.8
10	Denmark	81.2	–	+0.6

East Asia and the Pacific · Europe and North America

[1] Scale ranges from 0 to 100

Source: World Economic Forum (WEF) Global Competitiveness Report 2019

South Asia

India (68) is among the low-performing BRICS countries. It ranks high on macroeconomic stability and market size, and its financial sector is relatively deep and stable. It performs well when it comes to innovation. ICT adoption is limited but has improved sharply, and product market efficiency is undermined by a lack of trade openness.

Middle East and North Africa

Israel (20) is an innovation hub and spends the most of any country on R&D. It can also rely on a highly educated workforce. Market efficiency suffers from a relative lack of competition and barriers to entry.

Saudi Arabia (36) continues to diversify its economy. ICT adoption and

innovation capability are gradually improving. However, business dynamism is still limited by regulations that slow the entry and exit of new companies.

The **United Arab Emirates** (25) significantly improves on the ICT adoption and skills pillars, complementing the stable macroeconomic environment, sound product market and infrastructure. Further, the financial system is well-developed.

Sub-Saharan Africa

Mauritius (52), still the regional leader, is well-positioned in terms of institutional quality. It has further imroved its infrastructure and ICT adoption and is one of the most open countries in the world. However, the country's macroeconomic stability has slightly decreased.

South Africa (60) is a regional financial hub. It has also one of the most advanced transport infrastructures in the region and is among the top countries in Africa for market size. Its competitiveness is being held back by relatively low business dynamism.

Americas

Despite **Argentina's** (83) recent efforts to stabilize its economy, resurging inflation and increasing deficits have led to a less stable macroeconomic context. Resolving the duality of labor market and strengthening the financial system is high on Argentina's economic agenda.

The score of **Brazil** (71) has been driven mainly by a significant simplification of regulations to start and close a business and by lower inflation. In addition, it also benefits from a relatively high innovation capability and from the size of its market.

Canada's (14) economy has been hit by global trade tensions. However, it remains a competitive economy with very stable macroeconomic conditions and a sound financial system. Greater investments in R&D and collaboration between companies, universities and research centers would improve Canada's competitiveness.

Chile (33) maintains a steady performance and leads the Latin America and Caribbean region. It can count on a stable macro-economic context, thanks to low inflation and low public debt, competitive and open markets and a strong financial system.

Mexico's (48) competitiveness performance is mixed, but at least it has achieved some progress on all its four lowest-ranked pillars: institutions, labor market, skills and ICT adoption.

The performance of the **United States** (2) in several pillars is affected this year. In particular, product market, domestic competition and trade openness rank lower than in 2018. Despite an overall weaker performance, the US is still an innovation powerhouse, boasting the second-largest market, and has one of the most dynamic financial systems in the world.

This article is based on the Global Competitiveness Report 2019, issued by the World Economic Forum (WEF). The complete report is available at bit.ly/GCR-2019.

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Capturing Sales Opportunities in a Downturn

Five Forward Strategies for the Chemicals Industry

At the end of the third quarter, the chemical industry continues to face an economic slowdown, compounded by international trade conflicts, increased political uncertainty, and fundamental changes to the value chain (e.g. the case of electro-mobility.) The higher the dependency on the automotive industry, the more German chemical producers are in a waiting mode on how the economy develops. Martin Brudermueller, CEO of BASF, described the current visibility on the business situation like "driving through a wall of fog".

Andrea Maessen, Simon-Kucher & Partners

Jan Haemer, Simon-Kucher & Partners

Profit warnings such as BASF's have resonated beyond the industry. Such downturns usually lead to defensive strategies such as consolidation, cost-cutting, and strategic realignments. Unlike the financial crisis of 2009, the conditions for M&A activities remain favorable thanks to high liquidity and low interest rates. But the most promising profit levers — according to Simon-Kucher's recent survey of private equity firms — are to be found on the revenue side rather than on the cost side.

In other words, there is still untapped potential in sales, and a downturn offers chemical companies ample opportunities to improve their offense. Five strategies that can help to seize those opportunities on the revenue side are described below.

Increase Active Selling Time for Sales Reps and Technicians

Chemical companies know from the production side of the business that short response times are key to success, to solve distress faster than competition, to protect the business, or win a deal. The same standards should apply to the commercial side. Yet, a recent Simon-Kucher study revealed that efficient use of selling time is seen as the most important improvement lever in sales.

Take the situation at a producer of specialty aromatics. Salespeople used to spend 50% of their day dealing with administrative tasks and internal meetings, which significantly delayed a quick reaction to customers. The answer to help the salespeople was a set of clear prioritization rules for customers based on margin and growth potential, combined with a standardized process flow to create more "room to operate" for the day-to-day business.

Meanwhile, the majority of technicians' time was spent sampling and testing before the first commercial offer is submitted in the last third of the sales cycle. During this stage, the limited customer contact of technicians led to a considerable loss of efficiency. Increasing the customer-facing time from 10% to 30% and encouraging closer cooperation between sales reps and technicians helps to significantly shorten the sales cycle and grow revenues faster than planned.

Direct the Sales Activities more Pro-actively

Another of our studies showed that two thirds of chemical companies are not satisfied with how they direct the activities of their sales force. Four out of five say that they spend too much time explaining results and target deviations and too little time on forward looking sales activities. In addition, the data landscape remains a challenge due to limitations of the CRM set-up or usage, where sometimes even basic functionalities are not sufficiently covered for effective steering.

Early transparency on leading indicators such as the value and number of outstanding offers in the sales pipeline and expected win rates is vital for proactive direction and for taking corrective measures if needed.

Furthermore, companies need to have a clear view of what their most attractive market segments are and use activity benchmarks to drive higher sales efficiency. For example, a manufacturer of additives mobilized its sales force by providing simplified and mobile access to real-time data, such as incoming orders and steer its pipeline more effectively.

Strengthen Customer Focus and Value-selling

In a recent survey, we found that some 85% of chemical companies admitted that they feel their sales teams sell more on price rather than on value. An economic slowdown intensifies this price pressure even further. More than half of the companies surveyed said that their sales teams lack basic understanding of the added value of their own offerings relative to the competition. This makes their value messaging unclear and inconsistent, and creates an acute need for action.

One manufacturer of packaging solutions equipped its entire sales team with a value calculator, so that salespeople could systematically align sales talks with customer needs and elements of added value. The tablet-based tool helped calculate the potential cost savings per customer

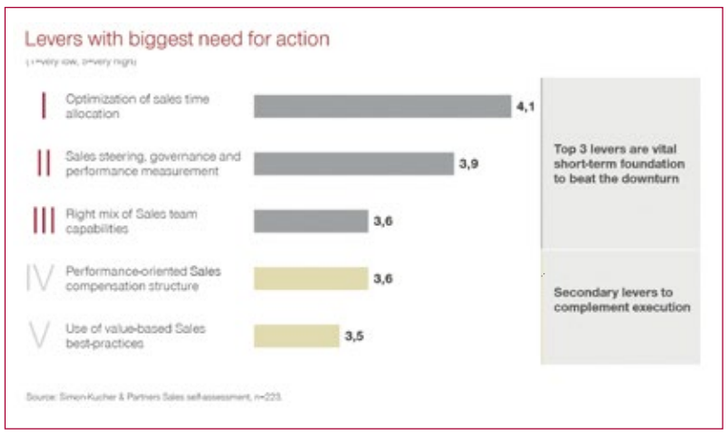

Fig. 1: Levers with biggest need for action in chemicals sales

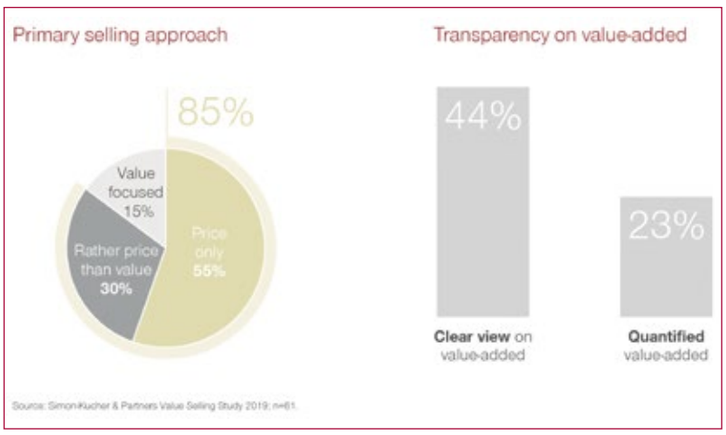

Fig. 2: Value selling in chemicals

from applying the proposed product solution. By providing a structured basis for customer communication, the company boosted the confidence of the sales team in implementing customer-specific price increases with minimal volume losses.

Market and Monetize Innovations even faster

Innovation is an important pillar of the chemical industry's competitiveness. But when it comes to taking commercial aspects of innovations into account, the most appropriate description of how chemical companies usually behave is "too little, too late." A popular excuse for not including the customer perspective early on is that the company lacks the resources. But without taking commercial considerations into account, the innovation pipeline usually gets so full that it can render the whole stage gate processes ineffective. This, in turn, is reflected in the results which miss their targets.

A fiber manufacturer recently introduced a project classification that helped to differentiate between a "quick & dirty", a "pragmatic" or an "exhaustive" commercial approach to innovations. The classification was based on several criteria: the size and competitive intensity of the target market; the company's own technological know-how; the budgets required; and the risk from product portfolio effects and cannibalization. Resources are then allocated per category. The "quick & dirty" approach relies on existing available information, expert judgement of cross-functional teams, and the use of internal benchmarks. The "pragmatic" approach supplements "quick & dirty" with customer workshops or exploratory interviews with prospects as well as an extensive quantification of value. This helps to shorten the time to market, especially for a number of smaller customer projects. For the groundbreaking innovations, additional resources support the development of full-scale launch strategies.

Upgrade the Sales Model with Digital Marketplaces

Digital marketplaces are rapidly gaining importance in the chemical industry. Beyond industry-vertical players like Chemondis and Chembid, ecosystem market players like Alibaba and Amazon Business are taking aim at chemicals. The benefits of digital marketplaces for your sales model are twofold: they help to optimize cost-to-serve and to accelerate growth.

Let's start with cost-to-serve: Assume that selling, general and administrative (SG&A) costs are below 4% of sales in upstream chemicals and 5-7% further downstream. Commissions range from below 0.5% to about 5% of sales on online platforms like Alibaba, depending on the service level. The potential cost-savings are huge.

Digital marketplaces can also help accelerate growth, because they cater to mid-sized and small customers much more efficiently and thus free up resources. Beyond this, platforms also enlarge the accessible profit pool by serving distributors' customers directly.

There is plenty of opportunity from forward defensive strategies in sales. If the chemical industry were as precise in optimizing sales processes as it is in production, safely navigating through this economic slowdown won't be an issue.

Details of the studies mentioned in this article can be requested from the authors.

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Russian-Chinese Project Takes Shape on the Baltic

Plans for a giant Russian-Chinese ethane cracker and polyethylene complex are taking shape in the Russian Baltic seaport of Ust-Luga.

Two crackers with capacity of 1.4 million t each and six polyethylene plants, each with capacity to produce around 480,000 t/y, are part of the plans, along with facilities to process linear alpha olefins. The first development phase is scheduled to go online in 2023, the second in 2024.

The project is being billed as the largest ethylene integration project in the world. Russian gas oligarch Gazprom and RusGasDobycha are additionally building gas processing facilities thre to absorb excess ethane.

China National Chemical Engineering Company (CNCEC) will build the infrastructure of the Baltic Chemical Complex, as the project expected to cost €12 million is being called.

McDermott International's Lummus Technology division will supply both the Process Design Package (PDP) engineering and the license for its olefin production and recovery technology. RusGasDobycha has secured Unipol licenses for polyethylene production from technology owner Honeywell. (dw, rk) ■

Wacker Starts Silicon-Metal Plant in Norway

Wacker has started up a new €100 million silicon-metal plant at its production site in Holla, Norway.

The Munich, Germany-based group said the facility's new furnace is one of the largest of its kind worldwide and increases the site's total capacity by more than 40%. The plant's state-of-the-art design is claimed to make it particularly efficient, requiring little maintenance.

Used to produce silicones and hyperpure polysilicon, silicon metal is one of Wacker's most important raw materials. Production in Holla now covers about a third of the captive demand from the chemical producer's German sites.

The expanded silicon-metal capacity is a key strategic step in the group's sourcing of raw materials, said Rudolf Staudigl, CEO of parent company Wacker Chemie.

Increases in captive production makes the business more independent of raw material price fluctuations and enhances its supply security, both during times of peak demand and shortages that could stem from mounting trade barriers worldwide, the CEO added. Wacker acquired the Holla site near Trondheim in 2010. (dw, rk) ■

A Journey into the Future

The Chemical Industry Can Pave the Way to a Sustainable and Successful Europe

The new political framework, set out by the Strategic Agenda and the Political Guidelines, has set bold priority areas for the next five years. In preparation for the new policy cycle, CEFIC, the European Chemical Industry Council, has launched its Mid-Century Vision which paints a plausible path towards a prosperous, more sustainable Europe in the year 2050.

Future trends are transforming the world we live in and shaping the current political dialogue. As digitalization revolutionizes our lives, Europe will grasp digital opportunities within safe and ethical boundaries, filling a skills gap for much-needed jobs. As climate change transforms our planet, Europe aspires to zero pollution, a circular economy, net neutrality, and more, through its ambitious Green Deal. And meanwhile, as global politics, trade and economies are becoming increasingly fragmented, Europe will build a strong and vibrant economic base, equipped with an industrial policy fit for the future, stepping up investments in skills, education and more.

World trade will shape the future of the European chemical industry. With an extra EU export reaching €155 billion in 2017, our industry is an important player in the global market, closely followed by our biggest trading partners, China and the US. Global trade dynamics are set to shift, as China works to take its chemical industry to the next level, and by 2030 will likely account for more than half of global chemical production. The US, on the other hand, is expected to significantly increase its production, driven by shale gas.

Marco Mensink, CEFIC

European Solutions to Global Challenges

As set out by the Mid-Century Vision, Europe will need to define its own "European Way" forward; one which capitalizes on its unique strengths by offering European solutions to global challenges and helps the chemical industry blaze a trail for European industry.

The "European Way" means putting the protection of human health and the environment at the center of the political agenda. It also means leading on new societal and industrial models while aiming for net-zero greenhouse gas emissions by 2050; driving the circular economy to the point that almost everything that can be recycled will be recycled; converting waste to new raw materials, right here in Europe; embracing digitalization and investing heavily in science, technology, engineering and mathematics education; and putting the United National Sustainable Development Goals and its

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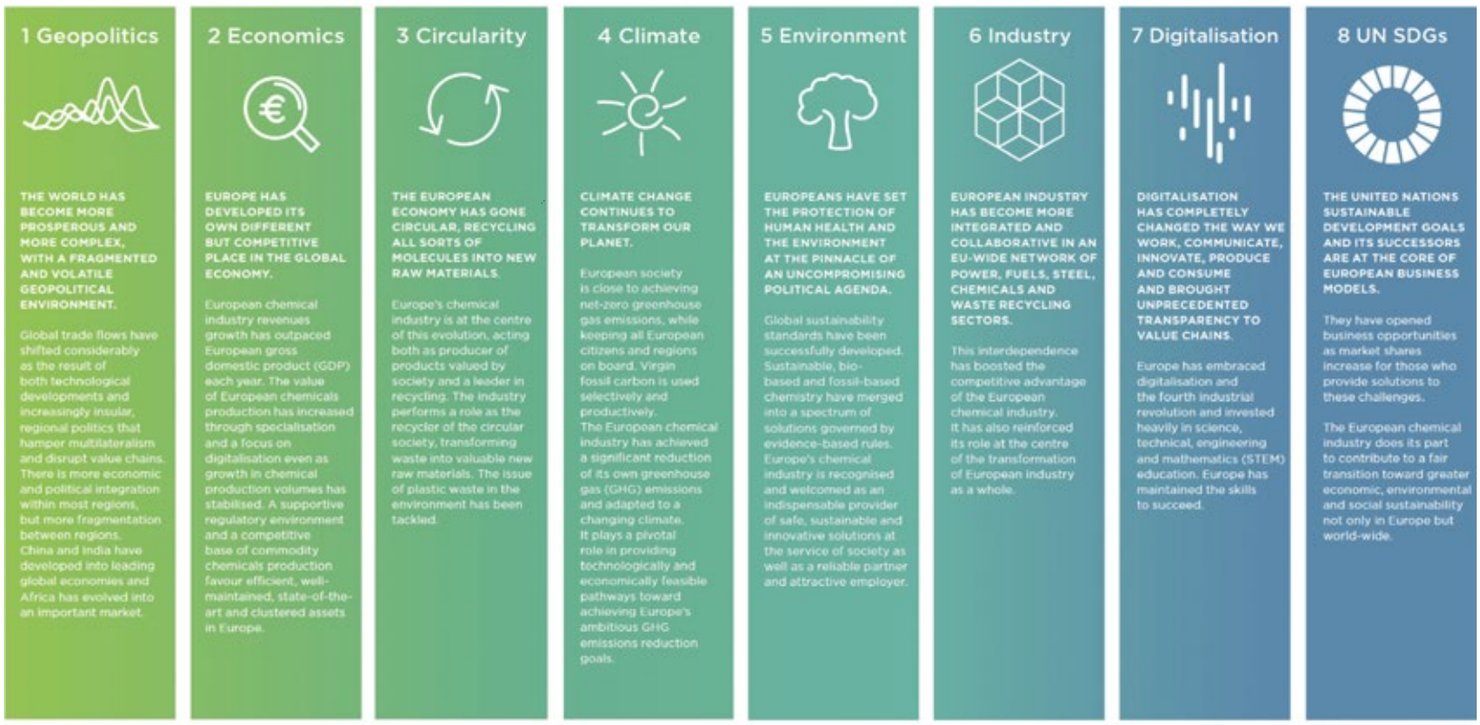
CEFIC's 8-point vision of a successful, competitive European chemical Industry in 2050



Source: CEFIC report "Molecule Managers: A Journey into the Future of Europe with the European Chemical Industry"

successors at the core of European politics and business models.

We believe the European chemical industry can flourish as it helps Europe achieve its highly ambitious political goals.

Driving Innovation

The outreach and scope of the European chemical sector is far-reaching; employing 1.2 million highly qualified people directly in 28,000 companies, our sector supports around 19 million jobs across all supply chains. We supply the fundamental building blocks to almost every other industry, and our technologies can drive exponential innovation. For instance:

"We believe the European chemical industry can flourish as it helps Europe achieve its highly ambitious political goals."

New technologies like chemical recycling and hydrogen for fuel cells will help us to move to a sustainable society.

Digital technology will have a big impact on production efficiency and transparency and will enable to track molecules throughout their life cycle, ensuring chemistry can help Europe produce more with less.

It also means collaborating with other industries to create greater economies of scale and make efficient use of raw materials and resources.

Plastics recycling remains a key challenge for our industry, and society at large. When it comes to creating solutions for every step of the life cycle of plastics and many products, our industry is highly engaged, and will be increasing its efforts. There are several ways to do this: mechanical, physical and chemical and molecular recycling. While mechanical recycling is the most common technology used today, it has some limitations: alone it is not sufficient to deal with the quality required by specific applications such as food packaging; it is not applicable to multi-material items or mixed plastics; and after a certain number of cycles, the plastic material starts to degrade. For these reasons, it is fundamental to develop new processes, allowing to bring the material back to the earlier stages of its life cycle.

Closing the Loop of Plastic Life Cycle

Chemical recycling enables plastics to return into new raw materials suitable for all applications, including food contact, which represents the most ambitious level of circularity. It also offers the possibility to handle multilayer and mixed plastics waste, and also plastics that have lost their initial quality due to multiple cycles of mechanical recycling. The development of innovative chemical recycling technologies capable to turn waste into new plastics identical to virgin plastics represents a real game changer to close the loop of plastic life cycle.

Chemistry has a significant role to play in building the pathway for low-carbon and circular economy, by investing into realistic technological solutions. New and disruptive technologies can enable our economy to grow while reducing its environmental footprint. We must now support these innovative efforts, and make sure these solutions are developed in Europe, rather than imported.

"Chemistry has a significant role to play in building the pathway for a low-carbon and circular economy."

The potential is huge, and the truth is, while our industry is working on this, we don't have all the answers and we can't do this alone.

Building a Better Future

The European chemical industry shares the same goals and fundamental values as most people: a world that is cleaner, healthier and more inclusive, a world in which the transition to climate neutrality is fair, and in which Europe — and the European chemical industry — remain global leaders.

We will need to work together with governments, industry and society at large, to find the best answers to our common challenges. We hope you'll join us to build the future we all want and need: a "European Way" that leads to success.

Marco Mensink, director general, CEFIC, Brussels, Belgium

https://cefic.org

The Evolution of the European Chemistry Start-up Scene

Accelerators are Becoming a Crucial Part of the Chemistry Innovation Landscape

In various high-tech industries start-ups occupy an important place in the innovation ecosystem. Various statistics show that this holds increasingly true for the chemical sector. In particular, there are an increasing number of interdisciplinary chemistry start-ups, and especially accelerators play a central role in supporting the development of start-ups.

Marie Asano, High-Tech Gründerfonds

Tobias Kirchhoff, BCNP Consultants

During the last 10 to 15 years, the start-up landscape in the chemical sector has been steadily evolving. Since 2007, the number of yearly established innovative chemical start-ups in Europe has doubled on average per year, totaling between 30 and 35 new companies incorporated per year. The leading seed investor in Germany, High-Tech Gründerfonds (HTGF), has also observed a steady increase over the years. In 2005, only 26 chemistry start-ups were recorded, whereas in 2018 this had increased to 60 start-ups active in the field of traditional chemistry. The percentage of chemistry start-ups observed per year — in comparison with the total observed HTGF deal flow — has remained mostly constant at an average of 3% (2005-2019). From 2017 to Q3 2019, the total share of chemistry and chemistry related start-ups increased up to a total of 4.8%. This indicates that the industrial sector make-up of the start-up market has not changed drastically, despite a steady increase in the total number of start-ups observed yearly. However, a slight increase could be observed in the total number of start-ups that are active in chemistry and chemistry-related fields due to the increasing number of interdisciplinary chemistry start-ups.

Is the Future Digital and Interdisciplinary?

An interesting trend observed by HTGF from 2017 onwards is that the number of "traditional" chemistry start-ups (chemicals, processes and materials science) has decreased, despite the total number of chemistry and chemistry-related start-ups increasing in general. The number of start-ups active in the area of traditional chemistry decreased from 77 in 2017, to 60 in 2018, and finally to 40 up to Q3 in 2019. On the flip side, the percentage of interdisciplinary chemistry start-ups has steadily increased. Interdisciplinary start-ups are defined as start-ups active in the area of digital chemistry, agritech, biotech, 3D printing, recycling, quantum chemistry — among other adjacent sectors which offer new innovative solutions for the chemical industry. In 2017, only 8% of all chemistry start-ups were defined as interdisciplinary. By 2018 this has increased to 34%, and in 2019 over 40% of chemistry start-ups observed by HTGF were active in a field which is not traditional chemistry. During industry events, such as European Chemistry Partnering, an increasing proportion of companies among the start-ups are active in the digital area, offering solutions to optimize business models and processes in the chemical industry.

> *"Germany is the hotspot for the chemical industry in Europe. Not surprisingly, accelerator programs gather here."*
>
> Frank Funke, managing director, 5-HT Digital Hub

Speed up — with Accelerators

Start-up accelerator programs are a vital part of the innovation ecosystem that support young companies by speeding up their business development and time-to-market with the help of industry specialists. When talking about accelerator programs in the context of start-ups, the word incubator is often utilized synonymously as the differentiation between the two is often blurred. To our understanding, accelerators are start-up programs that are characterized by intensive mentoring, training and workshops in specific topics with the aim to rapidly scale-up young businesses in a limited and defined time period.

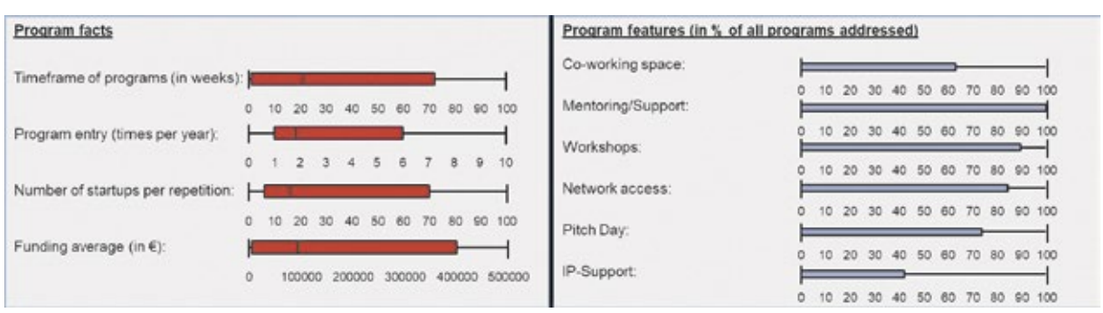
In most cases, the program duration only ranges up to a few weeks or months, and the possibility for entering such a program is offered several times a year. Having accelerators that are industry-specific is beneficial as they offer a substantial network of industry experts, investors and corporates.

Over the last decades, many start-up accelerators were established all over the world. However, most of them were either focused on information and communications technology (ICT)-related topics or had no specific technological focus. Accelerators with a clear industrial focus in chemistry, or a program with a high ratio of participants with a focus on providing solutions for the chemical industry, were largely unknown until a few years ago. The vast majority of the 19 top chemistry and chemistry-related accelerators identified by BCNP Consultants and HTGF were established only within the last 4 years.

Chemistry Accelerators in Europe

70% of these 19 accelerator programs are located either in Germany or Austria. A possible reason for that is the strength of Germany's chemical industry, which is the third largest in the world with an estimated €4.2 billion having been spent on innovation alone in 2017. Therefore, it is not surprising that the accelerators would benefit from being near the chemical industries that are potential clients and valuable proof-of-concept partners for many of the start-ups. In particular, Merck and BASF have either their own accelerator programs or are corporate sponsors of accelerators.

Additionally, the 19 identified accelerators could be clustered into three groups. 30% of the programs were fully dedicated to chemistry-related topics, 40% had chemistry as one of several technological focuses, and 30% did not have a specific tech focus but



Program facts and features of European accelerators for chemical start-ups.

Comparison criterion	Incubators	Accelerators
Timeframe	Mid- to long-term timeframe	Mostly 3-6 months
Objective of the program	"Incubate" disruptive ideas to develop a business model and company	"Accelerate" growth of existing company by active coaching
Stage of startup	(Very) early stage	Development stage
Characteristics of start-up	Good idea	Rapidly scalable
Application process	No stringent application process	Stringent application process
Shift of location	Permanent	Temporary
Infrastructure	Fully equipped spatial infrastructure	Specific infrastructure
Assistance	"In house" support	External tailored support
Funding	Funding is not common	Often (mostly up to a five-digit sum)
Return for support	Rarely a share of profit or equity stake	7-10% equity stake common

Comparison of incubators and accelerators.

were also open to chemistry-related start-ups. The most important topics were identified to be Energy and IT.

Mentoring, Support and Networking are Key Elements

No two accelerators are the same. And yet, there are key elements in the programs that all, or almost all, accelerators offer. All programs organize mentoring by various industry specialists. This can be done as part of either a mentoring day or week by external experts. In the Merck Accelerator, mentoring is provided for the duration of the program on-site by internal experts across different specializations ranging from production to product management. Approximately 90% of the accelerator workshops address specific topics such as the business model. Another important feature is that almost all accelerators offer access to a relevant network, especially an industrial one. The access to feedback from relevant market participants is especially valuable for developing products and the technology further. In addition, a pitch day is often organized to complete the program, where all start-ups can showcase their business to the industry and investors.

The duration of the programs varies greatly and can span from 2 to up to 70 weeks. Depending on the length of the individual program, program intakes for new applications can range from once per year up to 6 times per year. Some of the programs also offer grants and investments for start-ups. From the 19 identified programs, 10 offered an average sum of funding totaling approximately €100,000. The maximum observed funding available was up to €400,000.

Challenges of a Typical Chemistry Start-up

According to a study by the Handelsblatt Research Institute, 42% of all start-ups fail due to the lack of a relevant market or product-market fit. This can be said to be especially true for chemistry start-ups, which often have a very strong "tech-push" led by a team with a strong technological background. In these cases, the danger is that the market assessment and customer outreach play a secondary role in comparison to improving the technology for the sake of scientific excellence. In the end, a clear market need, a product-market fit, scalability and market access are vital for success.

„Accelerators in chemical industry are supporting close relationships at eye level, where corporates contribute experience or market access and start-ups add creativeness and acceleration by passion."

Thomas Renner, Vice President Consortium Corporate R&D, Wacker Chemie

As business models are usually B2B, sales cycles are long and the barrier to entry often depends on whether the new product is a "drop-in-solution", able to be seamlessly integrated to already existing process/production streams. Products where existing processes need to be modified or disrupted, face an even greater barrier for acceptance. The adoption into mainstream production also depends on the ability to produce large quantities (usually in the hundreds of kilograms if not tons). Having early access to relevant customers and proof-of concept partners is fundamental to be successful in a market often dominated by a handful of medium and large players.

Chemistry Innovation Landscape

It is too early to evaluate the influence of accelerators on the start-up scene. But with the increasing number of chemistry accelerator programs being observed to date, they are expected to play an increasingly important role to help start-ups quickly find their product-market fit and to accelerate market entry. The chemical market is both challenging and lucrative as well as eager for innovation. Since market-entry barriers are high, once you're in it's difficult to be displaced. However, cutting-edge interdisciplinarity, especially in topics such as digitalization and the circular bioeconomy, could bring completely different business models and market participants into a hitherto traditional industry. In today's dynamic chemistry landscape there are ample opportunities that can be seized, especially regarding implementing solutions in order to come closer to achieving a truly circular economy. This is imperative if we are to fulfill our responsibility as an industry by adhering to the 17 UN Sustainable Development Goals.

References to this article can be requested from the authors.

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More Pragmatism, Less Ideology

Switzerland Enjoys an Excellent Reputation Worldwide as a Chemical and Pharmaceutical Location

The chemical, pharmaceutical and life sciences industries in Switzerland — organized in the Scienceindustries trade association — account for 45% of total exports with around 70,000 employees and are thus the undisputed largest export industry in Switzerland. The members of Scienceindustries generate 98% of their turnover in international competition. Approximately half of their exports go to the EU. As a small nation, Switzerland is therefore dependent on good economic relations with the EU and countries from all over the world.

Switzerland enjoys an excellent reputation worldwide as a chemical and pharmaceutical location. Basel and thus northwestern Switzerland, where traditional groups such as Roche and Novartis have their headquarters, are of international importance as locations. With Sika, Bayer, Pfizer and Vifor Pharma, the economic metropolis of Zurich is just as well positioned as the Mittelland canton of Aargau with its numerous production sites for the agrochemical and pharmaceutical industries. Central Switzerland, with the cantons of Zug and Lucerne, is also home to international companies such as AstraZeneca, Biogen, Jansen, MSD, Roche Diagnostics and Shire. The canton of Valais with Syngenta and Lonza is also important. In particular, Lonza and other companies in the Valais produce chemical ingredients for pharmaceutical production. The Bassin Lémanique with the cantons of Geneva and Vaud and the companies Firmenich and Givaudan have also become an integral part of the international life sciences map.

The chemical-pharmaceutical industry has a great demand for highly qualified personnel due to its lively research and development activities and is therefore dependent on access to the international labor market. The Agreement on the Free Movement of Persons as part of Switzerland's bilateral agreements with the EU secures Switzerland's access to European professionals. In addition, Switzerland's proximity to the world's leading universities, ETH Zurich and EPF Lausanne, as well as stable political conditions, are of great importance for its attractiveness as a globally important chemical, pharmaceutical and life science location.

Key Success Factor: Bilateral Agreements with the EU

Switzerland is a first-rate export nation. With 45% of the exports from Switzerland, the chemical and pharmaceutical industry is the largest exporter and thus a central pillar of the Swiss economy. In 2018, the chemical, pharmaceutical and life sciences industries alone exported products worth around 104 billion Swiss francs to the whole world, around 50% of which was supplied to the EU. The bilateral agreements are a prerequisite for regulated access to the EU internal market and thus an important location factor for international companies in Switzerland. In addition to the Agreement on the Free Movement of Persons, the Bilateral Agreements I include the five market access agreements, which make unhindered market access possible in the first place. These existing agreements are therefore an important location factor for research-intensive, export-oriented Swiss companies.

The agreements with the EU also closely link Germany and Switzerland economically. Germany is by far Switzerland's largest trading partner, ahead of the USA. The economic importance of Switzerland for German foreign trade is also significant, with Switzerland ranking 9th in exports and 8th in imports in the ranking of Germany's most important trading partners. Outside the European domestic market, Switzerland is surpassed only by the USA and China.

In terms of Switzerland's chemical and pharmaceutical industry, Germany is the second most important customer country. In 2018, goods worth 16.6 billion Swiss francs were exported to our neighboring country. A quarter of the imports for our industry come from Germany. Our northern neighbor also benefits considerably from the bilateral agreements with Switzerland. Therefore, it should also be in Germany's interest to increase its efforts within the EU to maintain the bilateral path with Switzerland. Scienceindustries for its part consistently supports the Federal Council's proposal for an institutional framework agreement with the EU, which should guarantee more efficient application of the agreements in the area of market access.

Matthias Leuenberger, Scienceindustries

Protection of Intellectual Property is Essential

In addition to secure relations with the EU, an expansion of cooperation with other regions of the world through free trade agreements — especially with the USA and Mercosur — is essential for the future success of the chemical and pharmaceutical industry in Switzerland. The recognition and application of the international TRIPS protection standards for the protection of intellectual property is mandatory for the research-oriented industry.

The chemical, pharmaceutical and life sciences industries welcome the free trade agreement between EFTA and the common market of South America, the Mercosur states. The agreement enables the member companies of Scienceindustries to comprehensively reduce the tariffs of their products in the common market of the South. This includes Brazil, Argentina, Paraguay and Uruguay — Venezuela is currently suspended — and is a very interesting market with

With 45% of the exports, the chemical and pharmaceutical industry is a central pillar of the Swiss economy. Photo: The Klybeck site, jointly operated by Novartis and BASF at last, has a unique heritage as the nucleus of the chemical industry in Basel.

290 million inhabitants. At the end of the transition period, 96% of existing Swiss exports to Mercosur will be duty-free in the chemical and pharmaceutical sectors.

Research and Innovation Help to Solve Current Challenges

Each year, the member companies of Scienceindustries contribute almost 40% to the private expenditure on research and development in Switzerland, i.e. more than 6 billion Swiss francs each year. In discussions in Switzerland and throughout Europe, however, we have noticed a crumbling acceptance of scientific findings in broad sections of society. The ongoing debates about new technologies and progress in general should not only take into account the real and supposed dangers and risks, but also the benefits and opportunities of these new technologies. A general zero-risk attitude is the death of all progress.

Restrictions or even prohibitions are the wrong way for an open society. In the field of plant protection products, for example, research can make an important contribution to a more sustainable approach to the environment. By investing in research, our member companies in the agricultural sector promote the development of sustainable and gentle active ingredients for crop protection.

Society and Industry Dealing with the Environment

The climate debate has gained importance in Switzerland, as in many other countries worldwide, over the past year. This public discussion on climate change dominated the national parliamentary elections in Switzerland in autumn 2019 and led to a historic victory for the ecologically oriented parties. However, sustainable management has long been a matter of course for our global industry. Since 1991, the chemical and pharmaceutical industry has voluntarily committed itself to the "Responsible Care" global initiative to ensure the safe and sustainable handling of its products throughout their entire life cycle. In Switzerland, Scienceindustries is actively committed to compliance with these global Responsible Care principles.

Consequently, Scienceindustries supports the agreement to link the Swiss emissions trading system EHS with that of the EU. The target agreement to exempt the CO_2 tax has proven to be a successful model. Companies in the target agreement system often significantly exceed their emission reduction targets: since 1990, Swiss EHS companies have achieved a 14% reduction in greenhouse gases. These reductions represent a significant contribution to achieving Switzerland's emission reduction target by 2020. For this reason, the target agreements should in future also be open to all companies outside the emissions trading system. Scienceindustries is committed to making the targets more flexible at home and abroad, because reduction measures and the corresponding investments in their own operations remain more attractive for industrial companies even if foreign measures are fully taken into account.

Matthias Leuenberger, president, Scienceindustries — Business Association Chemistry Pharma Life Sciences, Zurich, Switzerland

www.scienceindustries.ch

Innovative Chemistry Between Mountains and Lakes

The Chemical and Life Sciences Industry of Switzerland is Characterized by Specialized Regional Clusters

Swiss chemical, pharmaceutical and life sciences companies help drive research around the world, and major players have research activities in the US, Singapore, Japan, as well as EU facilities in the United Kingdom and Germany. But do not underestimate the role of the domestic regional clusters and industrial sites.

As outlined in the article by Scienceindustries on the previous pages, the chemical, pharmaceutical and biotech industry of Switzerland is characterized by specialized regional clusters industries.

Pharmaceuticals companies that produce prescription and over-the-counter drugs are predominantly located in North-western (Basel) and Central Switzerland (Zug and Lucerne). Central Switzerland (Zug and Lucerne) is home to the diagnostics industry that manufactures healthcare products which aid physicians to diagnose diseases.

Major players in the flavors and fragrances market which synthesize ingredients for manufacturing food, cosmetics and perfumes call the area around Lake Geneva in Western Switzerland their home base.

Well-known manufacturers of vitamins used in manufacturing or pharmaceuticals, foodstuffs and animal feed are located in the Basel area, as are producers of crop protection agents such as herbicides, fungicides and insecticides including their active ingredients, primarily used in agriculture; the latter do also operate production sites in the canton of Valais in Southern Switzerland.

The specialty and fine chemicals industry that is supplying intermediates and ingredients and providing tailored solutions involving intensive research and development to all the sectors mentioned so far is spread throughout Switzerland. The global annual demand for some of these specialties is often below a few metric tons, thus production sites can be located in more remote areas as the requirement to handle bulk logistics is less important than, for instance, the attractiveness of the region or life and labor conditions for skilled and highly qualified workers.

An industry cluster of chemical and pharmaceutical companies focused on the life sciences sector can be found in the canton of Ticino. Located south of the Swiss Alps, Ticino is the Italian-speaking region of Switzerland. The canton's strategic geographic position represents a bridge between northern and southern Europe and between the dynamic economic areas of Lombardy in Northern Italy — with Milan at its heart — and the Basel-Zurich area in Northern Switzerland.

Basel Area: Reorganization of Industrial Locations

Effective December 31, 2018, Clariant sold the Infrapark Baselland and its activities at the Muttenz site to Magdeburg, Germany-based energy service provider GETEC. In addition, GETEC also acquired the production and infrastructure facilities of Novartis, located on the nearby Schweizerhalle site. While Clariant's industrial park was already spun-off into Infrapark Baselland, a legal entity, Novartis' industrial park business was just established via a carve-out as an initial step of the sales process. GETEC is now in a position to integrate and develop the two adjacent parks. The neighboring industrial parks east of Basel cover a total area of 51 ha, thus making the combined sites the biggest independent industrial park in Switzerland.

The two sites house large Clariant and Novartis production facilities as well as manufacturing facilities of other well-known pharmaceutical and chemical companies such as Bayer and BASF. Recently, mid-October 2019, Novartis sold one of its chemical production facilities located on the Schweizerhalle site to Syngenta Crop Protection that will manufacture agrochemical active ingredients in the plant in the future.

By selling the respective stakes to one professional operator, a new and diversified industrial park with economic significance for the entire region will be created. The objective of the transaction is to further incre-

ase the competitiveness of Infrapark Baselland as a chemical life science park and to create better growth opportunities for new companies operating on the site.

In May 2019, Novartis sold its property in the Basel Klybeck area to Swiss real estate developer Central Real Estate Basel. The Klybeck chemical and life science production site covers approximately 30 ha and was jointly operated by Novartis and BASF as the remaining owners. The location with a unique heritage was the nucleus of the chemical industry in Basel and Switzerland. The Klybeck site hosted the headquarters of Ciba-Geigy, through whose merger with Sandoz in 1996, Novartis was created.

With the sale to an experienced real estate developer, Novartis pushes forward the development of the area located close to the city center of Basel and enables to realize the "Klybeck Plus" project, a development initiative launched with the canton of Basel-Stadt. The goal is to establish an urban area that offers space for living, work, leisure and culture.

The character of the site which is located in an urban area has changed fundamentally in the recent past: industrial and pharmaceutical production have lost their relevance, while laboratories and offices remained.

Pharmapark Zofingen: Small Yet Outstanding

Centrally located in the life science cluster of North-western Switzerland, the Pharmapark Siegfried in Zofingen may not be one of the largest, but it is certainly one of the most attractive pharmaceutical parks with a long tradition. Siegfried, founded in 1873, operated as a fully integrated research-based pharmaceutical company until 1991 and is a leading CMO partner for the global pharmaceutical sector today. Headquartered in the Pharmapark Zofingen, Siegfried operates nine production sites in six countries in total.

The life science cluster of Northwestern Switzerland takes the lead worldwide. It represents a large reservoir of skilled and well-trained employees in the chemical and pharmaceutical industry, which is decisive for the success of every company operating in this field.

In addition to Siegfried, two pharmaceutical companies, Celgene Chemicals and Elvetix Pharma, run a production facility at the Zofingen site. The cooperation is tailor-made and not subject to any fixed parameters.

The individual needs of the Pharmapark companies are identified and met accordingly.

Since April 2019, NovoMOF, one of the most observed and respected start-up companies in Switzerland active in the field of advanced materials with focus on metal-organic frameworks (MOFs), also produces at the Pharmapark Siegfried.

Maintenance, repairs, issues concerning safety, health and environment, and security services at the site are taken care of by Bilfinger Industrial Services Schweiz. More than 50 Bilfinger staff members work at the Zofingen site. Supply and waste disposal is carried out by Primeo Industriecontracting, a subsidiary of Münchenstein-based Primeo Group. Primeo provides all utilities, such as power, gas, steam and pressurized air as well as resources such as water.

Visp: Expansion and Development into a High-tech Center

Founded in 1897 in the small Swiss town of Gampel in the canton of Valais, Lonza initially produced electricity used to manufacture chemicals such as calcium carbide. In 1909, Lonza moved to nearby Visp (photo on this page), where it started to transform itself from an electricity-generating through a chemical company to one of the world's leading suppliers to the pharmaceutical, healthcare and life science industries. Even today, the plant in Visp with a workforce of approx. 3,200 employees is still Lonza's largest site and one of the most significant for production and R&D.

For the Life Science Ingredients division, the Visp site produces a number of chemical intermediates and ingredients — including some of Lonza's most established products, dating back to the first decades of the 20th century — for a broad range of end-applications, including pharmaceuticals, vitamins, nutrition products, agrochemicals, dyestuffs, adhesives, as well as for the electronics, aerospace and automotive industries.

In the Custom Manufacturing division, the Visp site specializes in the production of microbial biopharmaceuticals, as well as in the production of regulated intermediates and active pharmaceutical ingredients (APIs), highly potent active pharmaceutical ingredients (HPAPIs), antibody drug conjugates (ADCs) and peptides for pharmaceutical applications.

In July 2019, Lonza announced the start of an expansion to its bioconjugation facility in Visp. Building on 12 years of experience in the exacting bioconjugation space, Lonza's expansion will meet the development and manufacturing needs of pharma and biotech companies developing a new generation of therapies. The Swiss contract development and manufacturing organization (CDMO) is currently building a biopark at the Visp site for its Ibex Solutions-branded offerings. Ibex will be a campus of five state-of-the-art manufacturing complexes that provides biopharma customers with agile capability from late discovery to clinical and commercial manufacturing. The biopark will be built in a stepwise fashion. Two of the five 6-floor buildings are currently under construction and due for commissioning in mid-2020.

The expansion that is part of Lonza's strategy to develop Visp into a leading high-tech center by 2030 will span the next two years. Bringing bioconjugates to market remains complex and Lonza is working at all stages of development and manufacturing. From 2020, all elements will be available at a single site through Ibex Solutions and the newly expanded HPAPI facility.

Ticino: Life Science Valley in the Heart of Europe

In Ticino the pharma industry plays an important role, and top-quality niche producers in the life sciences field located in the canton cover the entire pharma supply chain. The Farma Industria Ticino (FIT) association of chemical and pharmaceutical industries, founded in 1980, is a private organization that currently counts 31 member companies, with a combined workforce of 2,900 employees and a total annual turnover of approximately 1,7 billion Swiss francs.

Activities of the associates range from preclinical and clinical drug development to chemical and formulation process development to industrial manufacturing of different classes of APIs and of a great variety of drug products forms. The vast majority of FIT companies also offer services such as contract research and manufacturing. Several investments accounting for almost 500 million Swiss francs have been realized by FIT member companies in Ticino in recent years, mainly in R&D and innovation.

Ticino's biggest city, Lugano (photo on the opposite page), is home to Cerbios, a privately held company and FIT member and one of the three founding members of the Proveo alliance. The collaboration of Cerbios with AGC Biologics and Oncotec formed in 2015 provides efficient solutions to the market for the process development and manufacture of antibody drug conjugates (ADCs). Proveo combines industry experience and competencies with proven capabilities and the latest in technological innovation. The global collaboration that operates two more sites in Seattle, WA/USA, and Copenhagen, Denmark, respectively, will benefit from Cerbios' investments at the Lugano location. As announced earlier this year, the Swiss CDMO further invests in its high-potency API (HPAPI) manufacturing capacity. Following the completion of a new conjugation suite for ADCs a new HPAPI production line due in the second half of 2020 will enable Cerbios to accommodate larger volumes and batch sizes. These investments also benefit the Proveo alliance and help to develop the Lugano site into a hub that can cover the entire bioconjugation/monoclonal antibodies supply chain.

Michael Reubold, CHEManager

Tradition and Future: Industriepark Höchst

Infraserv Höchst is at the Forefront of Sustainable, Innovative Site Development

If you drive into Frankfurt from the west, the towering smokestacks of Industriepark Höchst will spring into view long before the bank skyscrapers in the city's downtown. This 4.6 km² industrial estate is one of Europe's largest research and production sites for the chemical and pharmaceutical industry and has a storied history.

Industriepark Höchst's future is promising, too: Year after year, its roughly 90 tenants, who employ around 22,000 people, sink large sums into research facilities, production plants and infrastructure: Since 2000, they have invested more than €7.7 billion. One of the latest big projects aims to upgrade the site's energy generation infrastructure and shrink its environmental footprint: Infraserv Höchst, the operator of the industrial park, intends to phase out coal as a fuel by 2022. By modernizing its gas turbine plant and commissioning two new gas turbines, it will improve the already remarkable efficiency of its energy generation infrastructure and reduce CO_2 greenhouse gas emissions.

Infraserv Höchst is investing a nine-digit sum not only in energy production, but in sustainability as well. The gas turbine units will use natural gas to produce steam from waste heat and generate an additional 170 MW of electric power, or roughly 60% more electricity than before — electricity that can be supplied to the companies at the park or exported to the public grid in order to offset voltage fluctuations, thus improving the stability of the region's power supply.

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Michael Müller, Infraserv Höchst

Focus on Energy Efficiency

Energy and resource conservation are in the site operator's DNA. Infraserv Höchst, who supplies the companies at Industriepark Höchst with eight grades of water, fluids and raw materials, also provides safe, environmentally responsible waste disposal, facility management solutions, logistics support and services in environmental, health, safety and many other fields. Provadis, Hesse's largest private training company with its own university, is part of the Infraserv Höchst Group, as is Infraserv Höchst Prozesstechnik.

Energy efficiency has deep roots at Industriepark Höchst. Chemical companies have long harnessed cogeneration to meet their high demand for heat in the form of process steam. No wonder Infraserv Höchst's energy generation plants have much higher

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Fig. 1: Infraserv Höchst's energy generation plants have much higher energy efficiencies — over 90% — than conventional coal-fired power plants.

energy efficiencies — over 90% — than conventional coal-fired power plants that only produce electricity and reject their waste heat to the atmosphere. Cogeneration alone slashes CO_2 emissions by around 300,000 metric tons a year; in other words, conventional coal-fired power plants would emit that much greenhouse gas if they were to produce the same amount of energy. In addition, the consistent use of waste heat from production plants and incinerators cuts another 200,000 metric tons of CO_2 emissions every single year.

Phasing out coal is another big step toward a healthier environment. Around 1 million metric tons of CO_2 emissions can be eliminated each year by switching to cleaner natural gas and making energy-generating units even more efficient.

Industriepark Höchst is home to cutting-edge energy solutions. Hydrogen is a prime example: A chlorine production plant at the park generates vast quantities of hydrogen as a byproduct, making the site an ideal location to house supply infrastructure for clean fuel cell technology. Infraserv Höchst's involvement in hydrogen began over 10 years ago, when it participated in pilot projects for an EU initiative to develop fuel cell-powered vehicles. It even opened the first public hydrogen fueling station for fuel cell vehicles in the southern sector of the park.

The time has come for the next milestone in the evolution of hydrogen as a transportation fuel: Rhein-Main-Verkehrsverbund, the public transit authority for the Rhine-Main Region, has decided to purchase 27 fuel cell-powered locomotives to travel on non-electrified tracks in the area. These ecofriendly trains will need a new fueling station — which will be built at Industriepark Höchst. The park, filled with innovative companies who combat disease or world hunger with new medicines, high-performance plastics or innovations in crop protection, is thus helping to tackle urgent challenges around energy use as well.

Advancing Digitalization

Speaking of innovation: Infraserv Höchst also pushes the digitalization envelope. It has developed and built a wide array of cutting-edge solutions. For example, many facility surveys, maintenance calls and inspections are handled digitally using an app and a cloud system. That simplifies workflows and gives customers transparent access to the data in real time. The approach speeds up maintenance calls by roughly 40%. In addition to documenting work with a smartphone or tablet, Infraserv employees often put on augmented reality head-mounted displays (HMDs). There are several benefits to these systems: They can be operated hands-free with the voice control system; the environment is automatically documented; and required follow-up work can be discussed with the client immediately. That optimizes scheduled maintenance and improves documentation quality since it eliminates the need to re-enter data in a different system.

Fig. 2: The use of augmented reality head-mounted displays (HMDs) optimizes scheduled maintenance and improves documentation quality.

Seamless Logistic Connection

Another key success factor of Industriepark Höchst is logistics: Situated in the heart of the Rhine-Main Region, the site is easy to reach with excellent access to the German highway system. 57 km of tracks connect to the public German railroad network, and the site's dedicated port allows customers to replace truck transports with more ecofriendly barges. The port is trimodal with two large gantry cranes, too, and so seamlessly connects roadways, railways and waterways. And for all the multinational corporations at Industriepark Höchst, its close proximity to Frankfurt Airport is another locational advantage — the continent's biggest air hub is located only a few kilometers away.

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Fit for the Future

The Chemical Industry in Eastern Germany

The chemical industry is one of the most important in Eastern Germany and, about 30 years after German reunification, is now viewed as a showcase sector. However, it would have been impossible to predict this in 1990. The number of employees fell to rock bottom at 40,000 after the fall of the Berlin Wall — due to the structural switch from a planned to a market economy — but since this time the number has been constantly increasing.

"The chemical and pharmaceutical industry in Eastern Germany is in a very strong position nowadays. Many small and medium-sized enterprises have emerged from the huge industrial combines that were uncompetitive, and they now form the backbone of the chemical industry in the east. A large number of companies have taken root and are very successful with their products around the world," says Nora Schmidt-Kesseler, managing director of the North-East Chemical Associations.

The chemical and pharmaceutical industry in Eastern Germany involves the five federal states of Brandenburg, Mecklenburg-Vorpommern, Saxony, Saxony-Anhalt and Thuringia as well as the city state of Berlin. The companies based there, which employ about 57,000 people, generated turnover amounting to €26 billion in 2018 — about 12% of the overall German turnover in the sector. The Eastern German chemical industry focuses on producing special chemicals. The proportion in this segment is slightly higher than the average figure for the whole of Germany. The share of the pharmaceutical business in the east is also about 4% higher than the average figure for the whole country. In terms of chemical exports, the north-east region is sixth in the federal state rankings. Saxony-Anhalt is, however, the largest chemicals exporter in the region and Europe is the most important export destination, accounting for more than 60% of products that are shipped.

Chemical Parks Form the Sector's Heart

The chemical parks — which are an Eastern German development, by the way — form the heart of the sector and two of the ten largest chemical sites in Europe are located in Eastern Germany — at Bitterfeld-Wolfen and Leuna. The Bitterfeld-Wolfen chemical park covers an area measuring about 1,200 hectares and is situated in the Central German chemical triangle in the Halle/Leipzig business region. The Leuna chemical park is even 100 hectares larger than the site in Bitterfeld-Wolfen and is also Europe's eighth-largest chemicals base. It is about 40 minutes away from Leipzig and Halle/Saale by car. The site, which measures 1,300 hectares overall, produces about 12 million tons of goods every year.

More than 600 companies have established business operations at the six Eastern German chemical parks since the mid-1990s. Most of them are small and medium-sized enterprises focusing on production and services. Then there are large corporations from Germany and abroad, which have built new production sites in Eastern Germany. BASF has a centre in Brandenburg (Schwarzheide), Bayer in Berlin, Saxony-Anhalt (Bitterfeld-Wolfen) and Thuringia (Jena) or Dow Chemical with an olefins network involving business sites in Saxony-Anhalt (Schkopau) and Saxony (Böhlen).

Fabian Hoppe, Nordostchemie-Verbände

Synergy Effects between Business Sites

One of the key features of the highly specialized chemical parks is their close connection with the broadly-based academic world in Central Germany. However, the chemical parks are also closely linked to each other and this has created synergy effects. CeChemNet forms the network of chemical firms and site companies. The network pools skills and expertise in the field of chemical park management, coordinates the ongoing exchange between the worlds of business, academia and politics and provides supports for marketing the chemical park areas in close cooperation with the business development corporations at federal and state level. The following companies belong to the network: Chemiepark Bitterfeld-Wolfen, InfraLeuna, Dow Olefinverbund, Infra-Zeitz Servicegesellschaft and BASF Schwarzheide. The partnership is completed by the involvement of the North-East Chemical Associations.

The generous space that is still available for companies to set up business operations and expand their production is another major advantage of the chemical parks in Eastern Germany. The infrastructure, which is geared towards chemical production, enables chemical companies to focus on their core skills. Well-deve-

© Horst Fechner / Infraserv Leuna

loped and complex material networks — both at individual sites and at different locations — provide companies with many opportunities to become an integral part of regional value-added chains.

Pioneers in Hydrogen Liquefaction

Providing supplies of hydrogen is just one example of the pioneer role being played by the Eastern German chemical sector in new technologies. It is worth looking at the situation in Leuna. The site is increasingly becoming the European center for hydrogen liquefaction. There are currently three hydrogen liquefaction facilities operating in Europe — one of them at Leuna. Linde started constructing another extremely modern facility at the end of October 2019 and it is due to go into service as early as 2021. Linde will double its liquefaction capacity at the site with this new plant, which will be the most modern of its kind in Europe. It will soon be able to produce up to ten tons of liquid hydrogen per day instead of five up to now. Both facilities are currently supplied with the gaseous raw product via a pipeline from the hydrogen production units nearby. It will be possible to process "green" hydrogen from the planned "experimental laboratory" at Leuna in future too and this will be used to supply hydrogen fuel stations.

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Ground-breaking ceremony for Linde's new hydrogen liquefier plant in Leuna, Germany.

Saxony-Anhalt's State Premier, Reiner Haseloff, held a spade too during the ground-breaking ceremony to mark the official start of the building work. This support represents the broad, cross-party backing from politicians for the chemical and pharmaceutical industry in Eastern Germany. Cooperation during the last few decades has created the conditions to ensure an ideal environment to attract new businesses and continue developing the infrastructure. What is more, the local population has a favorable outlook, particularly towards the chemical industry.

Attractive Working Conditions

The attractiveness of work in the Eastern German chemical sector is increasing all the time — partly through innovative wage agreements that envisage flexible working hours; they are unique in Germany. "This is extremely important for the current generation — not just the pay," says Schmidt-Kesseler and points to the so-called "Potsdam model", e.g., which has been negotiated with the IG BCE trade union.

However, one of the greatest challenges facing the Eastern German chemical industry involves finding qualified workers. The process of demographic change is particularly affecting the companies in Eastern Germany, as the number of people in work in the Eastern German non-city states will decline by about 30% in relation to the population by 2060, according to a study by the Dresden Ifo Institute. The industry is therefore making huge efforts and is already starting to use events in nursery schools and other schools, e.g., to create enthusiasm for chemicals in the young generation.

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Growth at the Center of Fine Chemistry

The East German federal states offer attractive conditions for the chemical and pharmaceutical industry. The infrastructure of the chemical parks situated in this area, the central location in Germany and Europe, the good transport connections, the large pool of skilled workers and the density of public research and development facilities make the region interesting for new settlements and extensions of chemical companies.

One of the industrial parks at the heartland of the East German chemical industry is Chemiepark Leuna in the federal state of Saxony-Anhalt. The infrastructure of the chemical park, the central location in Germany and Europe, the good transport connections, the large pool of skilled workers and the density of public research and development facilities make the region interesting for new settlements and extensions of chemical companies.


© Minascent

One of the companies that are located at the Chemiepark Leuna is Minascent, which emerged 25 years ago as a management buy-out from the research area of the German Leuna-Werke.

The company belongs to the Belgian Minafin Group and is specialized in very technical chemical reactions used to synthesize fine chemicals. It serves the pharmaceuticals, feed additives, cosmetics and many specialty applications markets and is the only Europe producer of di-tert-butyl dicarbonate (DiBoc), which is used in numerous syntheses for life science products.

Minascent is well equipped with laboratories, reactors, pilot and production facilities with a total capacity of 100 m^3. So far, the company made investments in the double-digit million-euro range, but wants to expand its capacities even further.

The Chemiepark Leuna is also home to 4Chiral, a unique network of manufacturers of specialty and fine chemicals as well as scientific institutions in Eastern Germany (see also p. 23 of this issue). Minascent is as well part of this network.

The BioPharmaPark in Dessau, another industrial park, is one of the twelve Centers of Excellence in Saxony-Anhalt which are characterized by excellent conditions for business and science, and as places for investment and ideas.

In September 2016, a new production facility for dermal fillers based on hyaluronic acid was put into operation here by pharmaceutical company Merz. The modern, three-storey building has had €15 million invested into it. The development of the facility enables Merz to meet the growing global demand for dermal fillers, said facility manager Björn Niemczak.

It was because of this option for expansion, and not least because of the technical competence on site, that Merz decided on BioPharmaPark in Dessau-Roßlau as their future location in March 2002.

The pharmaceutical companies based here benefit from the site's infrastructure and service network. He also speaks of synergies with the other pharmaceutical companies.

The proximity to the science cities of Leipzig, Halle, Magdeburg and Berlin offers the possibility to cooperate with research institutes and provides access to a pool of highly skilled experts. (rk) ■

Chemical Parks in China

Push Towards Relocation of Chemical Production May Open up Opportunities for Acquisitions

At the end of the year 2018, China had a total of 676 chemical parks. Of these, 57 are classified as national-level parks, 351 as provincial-level parks and 268 as municipal-level parks, the lowest level. While these parks are spread all over China, there is a higher concentration of parks in specific regions and provinces of China.

To be more specific, 32% of the chemical parks are in China's Eastern region followed by 25% in the Western region, 22% in the Northern region and 21% in the Central region. As the map (Fig. 1) shows, Shandong province and Jiangsu province are the two provinces — both in the Eastern region — with the largest number of chemical parks.

The chemical parks also vary greatly by annual sales. 14 chemical parks can be classified as having extremely high sales of more than 100 billion RMB (about €12.7 billion), 33 have sales between 50 and 100 billion RMB, 224 are of medium size with sales between 10 and 50 billion RMB while the remaining parks have annual sales below 10 billion RMB.

Importance of Chemical Parks in China Increased

The importance of chemical parks in China greatly increased within the framework of the 13th Five-Year Plan, which covers the period from 2016 to 2020. The plan aims at concentrating chemical production in chemical parks in an effort to allow better supervision of the industry and facilitate the implementation of tightened environmental protection. It mandates the massive relocation of chemical plants into such parks.

> *"It is likely that the number of chemical parks in China will shrink."*
>
> Kai Pflug

Somewhat ironically, some of the most serious recent accidents in China's chemical industry have occurred in chemical parks. On Mar. 21, 2019, an explosion at the Xiangshui Eco-chemical Industrial Zone in Yancheng of Jiangsu Province killed 78 people and injured an additional 617. Government reports later uncovered showed that an earlier inspection by the State Administration of Work Safety found 13 safety problems, including extensive leaks, a lack of safety training, poor site management and a shortage of operating procedures and technical specifications. On the other hand, a gas factory which was the site of an explosion in July 2019 in which at least 15 people died was on Henan's provincial list of top safety-compliant workplaces and had received a China Chemical Safety Association award for extraordinary contribution to chemical industry safety standards.

Kai Pflug, Management Consulting — Chemicals

While these events point to chemical parks alone not being the sole solution to solving the environmental and safety issues of China's chemical industry, government policy will clearly continue to shift chemical production into chemical parks. In addition, the government aims to put pressure on existing chemical parks to upgrade their standards and to reduce the number of parks. This may

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4chiral: The Chemistry Cluster in Central Germany

Already in 2006, the cluster 4chiral was founded in Bitterfeld-Wolfen — a town in Central Germany's chemistry triangle. Starting with only seven locally established SMEs, today, this horizontal network comprises 30 companies and about 10 research partners of public institutes and universities. The common subject is "(bio)chemical synthesis" — or in other words: "To create value by transforming matter". The companies of 4chiral not only share the same activity fields, but — as independent, mainly staff-owned SMEs — also a comparable culture, flexibility and customer focused approach.

Together, nearly every request regarding the development of new syntheses or the manufacturing of fine chemicals can be addressed. These activities comprise everything from consulting, research, computational modelling to enzymes and GMP or ton scale production as the following compilation shows.

Abbreviations: GMP=GMP syntheses; cR&D=contract research & development; BIO=bio- and enzyme technology; PD=process development; C=consulting; PR=non-exclusive products

- Arevipharma: GMP, PR, API, g to tons
- c-LEcta: enzymes, BIO, PR, <50 kg
- Chiracon: GMP, PR, <50 kg
- ChiroBlock: cR&D, PD, C, mg-50 kg
- CreativeQuantum: quantum mechanics, computer simulations, C
- Emp Biotech: BIO, PR, bio-chromatography
- Enzymicals: BIO, PD, PR, enzymes
- Hapila: GMP, mg to <50 kg
- IBZ-Salzchemie: cR&D, C, PR, nano particles
- Laborchemie Apolda: GMP, PR, >50 kg to tons
- Leibnitz Institut für Katalyse: C, cR&D
- Merseburger Spezialchemikalien: organometalics, PD, PR, mg to >50 kg
- Miltitz-Aromatics: fragrances, PR, >50 kg to tons
- Organica: PD, PR, >50 kg to tons
- Orgentis: PD, PR, mg to 100 kg
- Synthon Chemicals: PD, PR, g to <50 kg
- TGZ Bitterfeld-Wolfen: C, support, labs

Top-ranked chemical parks in China in 2019

Rank	Name of Chemical Park	Province
1	Huizhou Daya Bay Economic and Technological Development Zone	Guangdong
2	Ningbo Petrochemical Economic and Technological Development Zone	Zhejiang
3	Nanjing Jiangbei New Material Science and Technology Park	Jiangsu
4	Ningbo Daxie Development Zone	Zhejiang
5	Zibo Qilu Chemical Industry Zone	Shandong
6	Ningxia Hui Autonomous Region Ningdong Energy and Chemical Industry Base	Ningxia
7	Yangzhou Chemical Industry Park	Jiangsu
8	Dongying Port Economic Development Zone	Shandong
9	China Chemical New Materials (Jiaxing) Park	Zhejiang
10	Jiangsu Taixing Economic Development Zone	Zhejiang
11	Cangzhou Lingang Economic and Technological Development Zone	Hebei
12	Maoming High-tech Industrial Development Zone	Guangdong
13	Jiangsu Changzhou Binjiang Economic Development Zone	Jiangsu
14	Quangang Petrochemical Industrial Park	Fujian
15	Hangzhou Bay Shangyu Economic and Technological Development Zone	Zhejiang
16	Zhejiang Yinzhou High-tech Industrial Park	Zhejiang
17	Jiangsu Changshu New Material Industrial Park	Jiangsu
18	Wuhan Chemical Industry Park	Hubei
19	Changshou Economic and Technological Development Zone	Jiangsu
20	Jining New Material Industrial Park	Shandong
21	Zhenjiang New District New Material Industrial Park	Jiangsu
22	Zhuhai Economic and Technological Development Zone	Guangdong
23	China Petrochemical (Qinzhou) Industrial Park	Guangxi
24	Panjin Liaodong Bay New District	Liaoning
25	China Chemical New Materials (Liaocheng) Industrial Park	Shandong
26	Daqing High-tech Industrial Development Zone	Heilongjiang
27	Yantai Chemical Industry Park	Shandong
28	Quanhui Petrochemical Industrial Park	Fujian
29	Taizhou Binjiang Industrial Park	Zhejiang
30	Rudong Yangkou Chemical Industrial Park	Jiangsu

Note: Shanghai Chemical Industry Park chose voluntarily not to participate in the ranking after ranking first in the previous years

be necessary given that in June 2019, China's proclaimed Safety Production Month, the Ministry of Emergency Management claims to have made unannounced visits to 34 chemical parks — only 5% of the total number. It seems that the current number of parks is too high for effective supervision.

"Chemical parks alone may not be the sole solution to solving the environmental and safety issues."

Kai Pflug

Stricter Regulation

Provincial governments are also getting stricter in regulating chemical parks. For example, Jiangsu province not only closed down the Xiangshui chemical park mentioned above but plans to close a total of nine chemical parks. Other provinces including Shandong have also announced to reduce the number of chemical parks, and several have issued provincial guidelines tightening regulation of chemical parks and chemical production. Guangdong province in June 2019 issued a draft "Regional Safety Risk Assessment Guidelines for Chemical Industrial Parks", which mandates a regional safety risk assessment for chemical industry parks at least once every 3 years, from the previous 5 years. In contrast to the past, it thus seems that the careers of provincial government officials now may benefit from tightening supervision. Indeed, industry representatives see this crackdown on the chemical industry as a substantial threat to the industry. For example, in August 2019, Fu Xiangsheng, the vice-chairman of the China Petroleum and Chemical Industry Federation (CPCIF), stated that "Blanket cuts at petrochemical industrial parks have much bigger impacts than the Sino-US trade war."

One way of promoting competition among chemical parks is the annual publication of a list of the top 30 chemical parks (Tab.1). The list is based on a number of criteria such as economic strength of the park, safety standards, innovation, sustainability and infrastructural support. This list gives a good indication of parks that have high standards and are unlikely to be threatened by closures. However, parks on this list will also have relatively high entry requirements for chemical companies, for example regarding investment level.

"A world-class chemical park is an organic ecosystem, not a simple gathering of companies."

CPCIF Chemical Park Working Committee

These top-ranked parks are not evenly distributed (Fig. 2): Almost all of them are on China's coast, and almost half (14 out of 30) are in the two provinces neighboring Shanghai, namely Zhejiang and Jiangsu.

Compared with the overall distribution of chemical parks as illustrated in Figure 1, this shows that the general quality of chemical parks in the more developed provinces particularly in Eastern China is far higher than those in inland provinces, of which only very few make the list.

Concept of Highly Integrated Chemical Parks

On a more holistic note, China also promotes the concept of highly integrated chemical parks. The Chemical Park Working Committee of the CPCIF states that "A world-class chemical park is a soul, an organic ecosystem, not a simple gathering of companies." In typical Chinese fashion, this is to be achieved by the "6 Integrations" (the Chinese like these numbered lists of priorities). Specifically, this includes the integration of raw materials, logistics, safety, environmental protection, data and management services. While the practical effect of such somewhat nebulous, high-level concepts is sometimes hard to judge, it is worth mentioning that China has announced to promote emission treatment by third parties in chemical parks by, e.g., giving qualified businesses a reduced tax rate — potentially a consequence of the promotion of integrated environmental protection and management services.

Looking forward, it is likely that the number of chemical parks in China will shrink. The government has already announced that it intends to stabilize or even reduce the number of chemical parks to around 500.

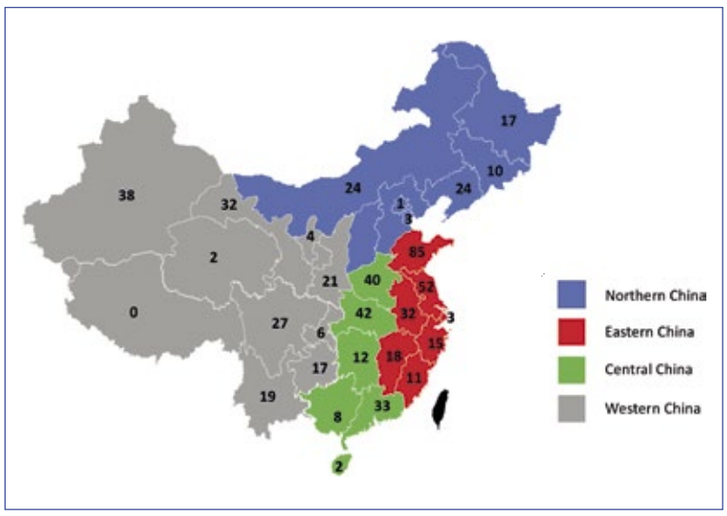

Fig. 1: Number of chemical parks in China by province, 2018

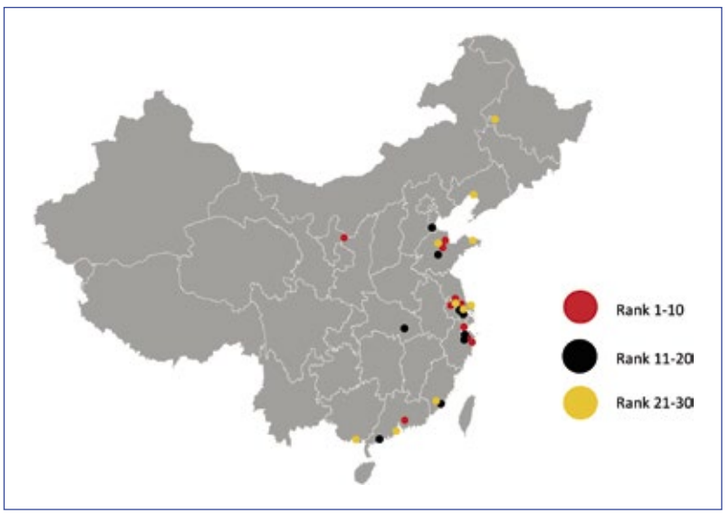

Fig. 2: Location of 30 top-ranked chemical parks in China (approximate location only)

Therefore, unsuccessful and substandard chemical parks face the risk of being closed down within the next few years. An admittedly imperfect back-of-the-envelope calculation comparing Germany with China shows that China would need about 300 chemical parks compared to Germany's 37, so despite the current huge demand for space in chemical parks, the current number may already be somewhat large.

High Standards and Good Reputation Has a Price Tag

Chemical companies searching for production sites in China therefore need to have a clear understanding of the current situation. While it will be mandatory to locate new production in chemical parks, this alone will not be sufficient to guarantee long-term site stability. Chemical companies are well advised to look for chemical parks with high standards and good reputation, even though such parks are likely to have higher investment and environmental protection requirements. The list of top 30 chemical parks issued by the CPCIF may be a starting point. Companies should also keep in mind that the current push towards relocation of chemical production into chemical parks puts substantial pressure on smaller domestic chemical companies, which may lack the funds for such a relocation. Identifying such companies and approaching them may therefore open up promising opportunities for acquisitions in China.

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GCC Chemical Industry's Investment Exceeds $140 billion

Chemical-industry-related investment in the Gulf Cooperation Council (GCC) has exceeded USD 140 billion in the first ten months of 2019 led by consolidation, joint venture agreements and increased number of merger and acquisition (M&A) deals, according to estimates by the Gulf Petrochemicals and Chemicals Association (GPCA).

Multi-billion Dollar Investments

GCC is the political and economic alliance of six Middle Eastern countries — Saudi Arabia, Kuwait, the United Arab Emirates, Qatar, Bahrain, and Oman. The multi-billion-dollar investments made both within the region and international markets in the areas of refining, petrochemicals, distribution, storage supported by a wave of strategic partnerships between regional players and multinational heavyweights, indicating a strong year for M&A deals and a renewed drive by regional producers to consolidate their business, build critical mass, diversify their business portfolio and expand access to high-growth markets.

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In announcing their new organizational structure, Oman Oil Company and Orpic Group have pledged to invest USD 28 billion in next 10 years.

Dr. Abdulwahab Al-Sadoun, Secretary General, GPCA, commented, "The recent series of joint ventures, consolidation deals and acquisitions demonstrate the role of partnerships in the industry's future strategic direction and continue to build on the region's reputation as a reliable, long term partner in the global chemical arena.

Increasing Competitiveness and Accelerated Innovation

These developments will result in greater competitiveness in the regional chemical industry by enabling it to leverage economies of scale, accelerate innovation and greater market leadership. We can expect to see more of these large-scale alliances across the entire value chain, built on strong and stable platforms of leading-edge technologies between partners from across the board, combining resource and feedstock supply, product application know-how, and growth-market access. Partnerships that help chemical players stay agile and resilient and quickly adjust to changes in the worldwide economic picture will be increasingly sought after." (mr) ■

China's New Foreign Investment Law

Implications for Sino-Foreign Joint Ventures in the Chemical Sector

Since the adoption of China's Equity Joint Venture Law in 1979 and the Cooperative Joint Venture Law in 1998, China has maintained separate rules and processes for foreign-invested entities (FIEs) and Chinese-invested ones (CIEs). On Mar. 15, 2019, delegates of the second session of the 13th National People's Congress took action to set aside those distinctions by approving China's new Foreign Investment Law (the FI Law), which will abolish both the prior joint venture laws and the Law of Wholly Foreign-Owned Enterprises (WFOEs) of 2003.

The FI Law will come into effect on Jan. 1, 2020. The content of the new law has been tested in various "pilot zones" in China in recent years, and some of the principles underlying the law have previously been rolled out on a large scale. Nonetheless, the FI Law marks a nation-wide statement of significance for many chemical companies with entities in China.

According to the FI Law, all companies in China, whether foreign-invested or domestically-invested, generally will receive the same "national treatment". In principle, this means that FIEs will be entitled to treatment that is no less favorable than that available for Chinese-invested ones. The key exceptions are industries on the "Negative List", in which foreign investment will continue to be either prohibited or restricted. These industries include, e.g. automobile (until 2022), value-added telecommunications, internet publishing, news broadcasting, movie and show performances, banking and finance (restricted to joint ventures of no more than 51% foreign ownership until 2021), market surveys (joint ventures only), and others. This approach is significantly more convenient and more transparent than the current one in which restrictions on foreign investment may appear in the Catalogue of Industries for Guiding Foreign Investment, China's WTO commitments, and industry restrictions in diverse regulations adopted by different government agencies.

The FI Law expressly extends to FIEs certain rights and privileges, including the right to enjoy State protection of foreign investments, the right to be consulted for recommendations in the adoption and interpretation of laws, the right to equal participation in standard development work, protection from expropriation except in accordance with statutory procedures, and the right to transfer money out of China in accordance with the law. The new law expressly prohibits the forced transfer of intellectual property by a Chinese counterpart in a joint venture or by a government authority. Many of these rights exist under current law. On the other hand, language that the rights enjoyed will be "in accordance with law" could, in effect, constrain the practices currently enjoyed by FIEs. For example, the quota system at times in place by banks in China restricting the conversion to foreign exchange has generally been applied less strictly to FIEs than to CIEs. In that case, equal treatment may not be beneficial. Nonetheless, in principle, articulation of these rights in one particular law is likely to prove helpful for FIEs.

Daniel Roules, Squire Patton Boggs

For many investors in the global chemicals sector, the most relevant feature of the FI Law may be the

mandate that in the future, the existing PRC Company Law will govern the relationship between joint venture partners, not the separate joint venture laws and regulations that currently govern those relationships. As a consequence, every existing joint venture in China must be amended to conform to the PRC Company Law. The FI Law allows a 5-year grace period (to January 2025) to make those changes, but given the challenges of negotiating with joint venture partners in China, international chemicals companies may want to focus on this issue sooner rather than later. The parties will need plenty of time to negotiate amendments to the joint venture agreements and the articles of association well in advance because corporate governance structures under the PRC company law differ materially from the current joint venture structures.

Under the PRC Company Law, the board of directors reports to the shareholders committee/meeting, whereas under the joint venture laws, the board of directors, not the shareholders committee/meeting, is the highest authority. Also under the FI Law, unless otherwise agreed, decisions may be made on the basis of majority vote, whereas the current joint venture laws require unanimous approval at the board level for any decision to (1) amend the articles of association, (2) increase or decrease the registered capital, (3) terminate or dissolve the company, or (4) merge or split the company. Accordingly, the board of directors of a chemicals joint venture under the FI Law will serve much the same function as is common in the West, rather than as the ultimate decision-making authority, with statutory minority protections as is the case currently.

The FI Law makes other important changes to existing law. For example, current laws apply only to the formation of new FIEs, whereas merger and acquisition (M&A) and other activities of FIEs are the subject of other regulations, and there are numerous other industry- and sector-specific regulations that apply only to foreign investors. By contrast, the FI Law applies to all direct and indirect investment, meaning that it will cover even investments in China made by an existing FIE. Also, for the first time, a foreign natural person may be an investor, whereas previously foreigners could invest only through legal entities.

Lastly, the FI Law specifies that if another country adopts discriminatory restrictions on Chinese investment, China may adopt corresponding measures depending on the circumstances. Critics of the new law assert that such explicit reservation of a right to retaliate when combined with the language elsewhere that the rights granted to FIEs are to be applied in accordance with applicable law could mean that in the event of a trade dispute, China has the right to take action against local FIEs. Whether that interpretation will prevail remains to be seen.

In large measure, the FI Law was passed in response to criticism from foreign governments and FIEs. It remains to be seen how it will be applied in practice, and how much change actually occurs. Nonetheless, for international chemicals companies with Sino-foreign joint ventures the new FI Law clearly merits attention. Though the 5-year grace period has been granted to amend existing joint venture contracts and articles of association, given the complex governance issues the new law presents and frequent negotiation difficulties in China, companies are urged to focus early on amending the necessary documents to allow time for negotiation with their joint venture partners in China.

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Perstorp Building new Penta Plant in India

Swedish specialty chemical company Perstorp plans to build a new plant in India's Gujarat state to produce Pentaerythritol (Penta). The world-scale, greenfield facility's output will include the renewable grades of its branded Voxtar, claimed to provide up to a 60% reduced carbon footprint.

Construction began in October, with groundbreaking celebrated in early November. Commercial production is due to start in Q1 2022, and when fully operational the site will employ 120 people. Penta is an essential building block for coatings and is also is used by the synthetic lubricants and antioxidants industry.

Production capacity was not disclosed, but CEO Jan Secher said the new investment would "significantly expand" the company's Penta production output to 40,000 t/y from 2022 onward.

Perstorp currently produces Penta in Germany, the US and Sweden. Secher pointed to India as a strategic market with a growing demand for coatings, where the company has been planning to deepen its footprint for several years. (dw, rk) ■

AstraZeneca Launches China R&D Initiatives

Major drugmaker AstraZeneca has announced plans to launch three initiatives in China to advance global R&D efforts. The plans include establishing global R&D and artificial intelligence (AI) innovation centers as well as creating a "first-of-its-kind" healthcare industrial fund.

CEO Pascal Soriot said China is rapidly emerging as a global scientific powerhouse. He commented: "We will make the most of our global resources and network to strengthen the connections between China and the rest of the world in the field of healthcare innovation and, ultimately, bring the benefits of that work to patients everywhere."

Based in the Jing'an district of central Shanghai, the R&D center will develop potential new innovative medicines and more than double AstraZeneca's headcount in the city to around 1,000 people.The facility's primary focus will be on diseases that are prevalent in China, which the drugmaker said carries around a quarter of the world's disease burden, as well as other parts of Asia. (eb, rk) ■

BASF Kicks off Multi-billion Dollar Chinese Project

BASF has broken ground for the first production facilities of its latest mega investment in Zhanjiang, Guangdong Province, China, expected to be worth as much as $10 billion altogether. The first plants will produce engineering plastics and thermoplastic polyurethane for the southern People's Republic and Asia generally.

By 2022, a compounding plant for unspecified engineering plastics will add capacity of 60,000 t/y in China, bringing BASF's total output capability for these products in Asia Pacific to 290,000 metric t/y. The additional capacity is designed to meet the growing demand from the automotive, electronics and new energy vehicles (NEV) industries.

The entire integrated (Verbund) site is planned to be completed by 2030. Ultimately, the German group said Zhanjiang will be its third-largest site worldwide, behind Ludwigshafen, Germany, and Antwerp, Belgium.

At the new site, BASF will implement a smart manufacturing concept that utilizes automated packaging, high-tech control systems and automated guided vehicles. By employing the latest digital technologies and applying the highest safety standards, the complex will be a role model for sustainable production. (dw, rk) ■

MOL Chemical Tankers Invests in Korean Terminal

Singapore's MOL Chemical Tankers (MOLCT) has agreed to form a joint venture with Korea National Oil Corp. (KNOC) and SK Gas to develop a chemical terminal in the Port of Ulsan, South Korea.

Under the terms of the agreement, MOLCT and SK Gas will invest a total of 616 billion South Korean won in the jv to be known as Korea Energy Terminal (KET).

The facility will provide storage for petroleum products, natural gas and petrochemicals. It is scheduled to start commercial operations in June 2024 with the availability of about 434,000 m^3, or 2.73 million barrels, of tank capacity. MOLCT is currently participating in a storage joint venture in the Port of Antwerp in Belgium. The company has taken a 49% stake in SEA-MOL, a jv with SEA Tank Terminal Antwerp, which owns the majority 51% share. SEA-Mol is investing up to €400 million in a multi-modal chemical storage tank terminal and the first phase is expected to be available in mid-2021.

In February, MOLCT formed a strategic alliance with Netherlands-based Den Hartogh Logistics to jointly develop and streamline liquid chemical logistics services. (eb, rk) ■

Doing Business in China

Navigating the Complexities of Cultural Differences between East and West

This article has been written with the intention of providing readers with a richer understanding and analysis of Chinese mentality by learning some unique philosophical and intellectual perspectives about China. Furthermore, the distinctions made on cultural differences will help the practitioners in the business setting in interacting with Chinese professionals more effectively.

Tina Li,
WestTrifftOst

I was interpreting for a group of German engineers when they were in China to discuss the feasibility of a project with their Chinese counterparts. In the meeting, the German managers took the lead, shared their thoughts, and raised a few questions. In contrast, the Chinese engineers were rather quiet and seemed reluctant to voice themselves proactively. The German engineers were irritated and assumed that the Chinese engineers were not well-prepared. During the break, I talked to the Chinese engineers casually and found out that they had sharp intellects and mentioned a myriad of valuable suggestions. But why did the Chinese engineers seem so passive and apathetic?

It turned out that they were waiting for what they felt was the right moment to speak. In general, Chinese people feel more comfortable to discuss matters in a harmonious way and disagreements are often expressed between the lines. Consequently, the German engineers were perceived as being aggressive and impolite by their Chinese colleagues.

Culture is one man's medium, there is not one aspect of life which is not touched by our national culture. We devote the first 12 years of our lives to learning the world around us, to observe what is accepted and what is forbidden in a society. Even after having lived in a foreign country for a long time, this socialization process experienced at the early age is so powerful that the values are etched into our nervous system.

High and Low Context Communication

Anthropologist Edward Hall proposed that everything in the communication fields is about context and coined the terms of high context (HC) and low context (LC) cultures. A HC communication focuses on the explicit and feeling-focused communication, people in HC are sensitive to situational data, and their priority is to maintain harmony. A LC emphasizes on linear and thinking-focus communication. Communicators in LC are highly responsive to standardized data and the mass of the information is vested in the explicit code.

In HC systems it is very seldom that you will be corrected when you are making an obvious mistake — people would hardly explain things to you. High-context individuals draw greater distinctions between insiders and outsiders. There is a constant information flow within the insider group.

Two years ago, I accompanied a Chinese investor who visited a relatively small German chemical company near Frankfurt. The German CEO was very enthusiastic about his company. He took us to the laboratory and explained how everything works in great detail. The Chinese investor nodded from time to time. Everything seemed fine and the Chinese investor went back to China and never contacted this chemical company again.

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Afterwards I flew back to China to meet the Chinese investor and learned that he had graduated from a prestigious Chinese university with a PhD in Chemistry and felt insulted by the detailed explanation from the German CEO. Individuals from HC culture tend to hide their emotions. It is more difficult to foresee confrontations or problems in HC cultures than in LC cultures. Conflicts are likely to emerge without warning in the LC individual's eyes.

Philosophical Origins

More than 1 billion people worldwide claim to be intellectually influenced by ancient Greece and more than 2 billion say they are the products of ancient Chinese traditional thought. It is important to learn the differences between the origins of East and West to truly understand the contemporary cultural differences in the business context.

Ancient Greece was the coastal trading center in the eastern Mediterranean. The Greek culture was in constant contact with foreign cultures. Individuality, personal efforts to establish effective communications, and the power of persuasion were valued highly. Truth and logical reasoning were the fundamental principles of Greek philosophy.

On the other end of the world, the ancient Chinese civilization were living in a land-bound area near the Yellow River without any contacts to other cultures. Devastating floods frequently affected the harvest and threatened people's life. The harsh conditions forced a more collective rather than individual effort for their survival. They perceived the ever-changing world as being full of contradictions and interconnections.

Daoism and Confucianism

Daoism and Confucianism have had a great impact on Chinese mentality. This influence is still very powerful in China today. Most prominently, both Daoism and Confucianism see preserving harmony as the ultimate goal.

Laozi believed that the universe is fluid and operating in a formless and holistic way and advocates simplicity and abolishment of self-interest to reach a higher level thus creating a peaceful and harmonious coexistence between people and nature. The concept of yin and yang suggests that nature, society and the individual are operating within a constantly changing state of being. Meanwhile, Confucius emphasizes on the importance of family. Everyone has to fulfill their given roles in thus creating and maintaining a harmonious society. The roles deemed inferior — including wife, son, younger brother/sister and younger friend — should respect and obey the superior, namely husband, father, older brother/sister and older friend. In return, the superior should love and care for the inferior.

Mianzi (Face)

Recently, I was involved in a consulting project between German and Chinese companies. The sales manager from a Chinese pharmaceutical company showed great interest in the equipment produced by the German company. They had worked together before and had established a respectful relationship.

The German company sent a sales proposal to the Chinese client and decided to ring the Chinese client since they had received no response. The Chinese client confirmed their interest again on the phone, but the details were not mentioned. The Germans prepared everything, and the equipment was ready to dispatch. The Chinese client learned about this and told them that it was not convenient for them to purchase the equipment now, while asserting they would benefit from this equipment in the future.

The Germans were really annoyed and frustrated — after all the order would be worth €3 million. Later they learned that the Chinese client had a liquidity problem and could not afford it in the first place. The German company started to doubt the credibility of the Chinese client.

A clear and straightforward message here from the Chinese side would have been much appreciated by the German producers. On the other side, the Chinese clients had no intention to mislead the German producer in any way. What they were trying to do was to give Mianzi to the German producer.

Mianzi refers to one's positive image recognized by people within their social circle. Giving Mianzi to others in China plays a paramount role in the social interaction. "Yes" in China has four meanings: Yes, No, Maybe or I am listening. People who are familiar with Chinese culture can grasp the meaning through non-verbal cues.

Guanxi

Guanxi is often mistaken for networks, i.e. purely social connections. According to a recent survey, 80% of jobs are found through personal networks in western countries. Chinese Guanxi can be seen as a system which keeps people in a reciprocal relationship and mutual obligations. Chinese Guanxi is much more complicated than a western network. In the business world, there are personal, cooperative and governmental Guanxi needed to be built, developed and maintained. To do business in China successfully does not only need Guanxi, but your own great capacity and unique competitive advantages are equally important.

Measuring Chinese Culture Using Hofstede's Dimensions

Geerte Hofstede, a Dutch social scientist, generated cultural profiles using "Power Distance", "individualism-collectivism", "uncertainty avoidance" and "masculinity-femininity".

> *"It is never possible to understand completely any other human being and no individual will ever really understand himself. This is the beginning of wisdom in human relations."*
>
> Edward T. Hall, anthropologist

Hofstede defines power distance as "the extent to which the less powerful members of institutions and organizations within a country expect and accept the power is distributed unequally." Compared with Germany, China has a high power distance index (PDI). In China, inequality between the superior and the subordinate is expected and accepted. The social structure is rather hierarchical. The older and more powerful people are respected by the younger and less powerful ones. In the workplace, the countries with large power distance tend to have a centralized organizational system. The employees feel more comfortable taking orders from their managers. Germans in the workplace have more autonomy and are also expected to take their own initiatives.

Individualism versus Collectivism

Individualistic societies emphasize on self-actualization. Personal achievement prevails over loyalty. In contrast, in the collectivist cultures, individuals belong to a "we" society, where the group interest is more important than individual interest. A harmonious environment is desired, and people are more relationship-oriented. According to Hofstede's cultural comparison, China scores 20 on the individualism dimension while the USA scores 91.

Masculinity and Uncertainty Avoidance

Masculinity denotes the distribution of roles between two genders in a society. Germany and China both score 66 on this dimension, compared with Finland with a score of 26. Competition, achievement and success are valued in masculine societies. It is very important to realize that the masculinity dimension influences conflict resolution style. In a low masculine culture, conflicts are resolved by compromise and negotiation and in a high masculine culture, the strongest always win.

Uncertainty avoidance refers to a society's tolerance for uncertainty and ambiguity. There is a widely spread saying: "In England, everything is permitted except what is forbidden. In Germany, everything is forbidden except what is permitted. In France, everything is allowed, even what is prohibited".

China, Japan and Germany score 30, 92, 65, respectively. The countries with low uncertainty avoidance are more open to innovation and are willing to switch product/service brands. People are relatively flexible, and it is easier for them to accept changes within a short period.

In China, it is difficult to imagine living without using electronic online payment on the smartphone. You need to give away your personal details including your bank account and ID number to register to use Wechat payment and Alipay. Many shops in China do not accept cash anymore. In supermarkets, you can also use facial payment. In contrast, in small towns in Germany you cannot even pay with credit cards.

Putting It All Together

There is no list of Dos and Don'ts regarding doing business in a foreign culture. Intercultural competence is a dynamic give-and-take. If you wish to understand your Chinese partners' behavior and build trust with them, you will benefit greatly by conducting research on topics like common types of personalities in China, how family functions, how children are brought up, how the school system works, how the government and political systems are structured, what the dominating religions and philosophies are etc. That knowledge will help you see yourself from a different perspective with a frame of reference for your own values and norms. Consequently, you will be able to react appropriately in difficult situations in China.

Furthermore, if you determine to do business in China as a foreigner, it is paramount for you to learn the Chinese language to truly understand Chinese mentality. The vocabulary and grammar available in our language affect the mental constructs fundamentally. Speaking Mandarin to a point of fluency is of great help for you to embody the perceptions shared in Chinese culture.

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Specialty & Custom Chemicals America

The event, which will take place on Feb. 10–13, 2020 at Fort Worth, TX, USA, will focus on on specialty, custom, fine & industrial chemical markets as well as on suppliers with a North American base but will also welcome global participants.

The mission of Specialty & Custom Chemicals America is to showcase the distinctive value of the American chemical industry and ultimately help support this favorable domestic manufacturing shift.

https://texas.chemicalsamerica.com/

Chemspec USA

This newly created event for companies engaged in pharmaceutical development and manufacturing and related industries, to be launched and co-located at Interphex, will take place on Apr. 28–30, 2020 in New York, NY, USA.

Exhibitors are manufacturers, distributors, regulators, equipment suppliers, raw materials suppliers and traders offering products and services like chemical intermediates, pharmaceuticals, HPAPI/API, polymers, custom synthesis and catalysts.

www.chemspecusa.com

DCAT Week

The event for companies engaged in pharmaceutical development and manufacturing and related industries is to take place on Mar. 23–26, 2020 in New York, NY, USA.

It is organized and hosted by the Drug, Chemical & Associated Technologies Association (DCAT), a not-for-profit, member-supported, global business development association whose unique membership model integrates both innovator and generic drug manufacturers and suppliers of ingredients, development and manufacturing services, and related technologies.

https://dcatweek.org

CPhI North America

The event is the epicenter for pharmaceutical innovation, emerging trends, insights, and community-building connections in North America, bringing together all those seeking powerful partnerships to illuminate the path towards high growth in the ever-evolving industry.

CPhI North America will take place on May 5–7, 2020 in Philadelphia, PA, USA. With over 80% of the industry having an office in the tri-state region around Philadelphia, it is a must-attend event, attracting pharma leaders and powerhouse companies from all over the US and nearly 90 countries.

https://cphinorthamerica.com/

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