The Future in Chemicals China
Learnings and Opportunities for Capturing Growth
Contact Information

Beijing
Chris McNally
Partner
+86-10-6563-8300
chris.mcnally@booz.com

Houston
Jayant Gotpagar
Principal
+1-713-650-4107
jayant.gotpagar@booz.com

Shanghai
Anna Månsson
Senior Associate
+86-21-2327-9800
anna.mansson@booz.com

Paul Murphy, Matthias Hendrichs, Edwin Tong and Dongye Zhang also contributed to this Perspective.
EXECUTIVE SUMMARY

The chemicals environment has become increasingly competitive over the last 30 years. This has been driven by three main factors: Feedstock advantage in the Middle East, operating cost advantages in Asia, and limited ‘technological market space’—i.e. potential to drive to higher margin areas through new chemical platforms. These factors have increasingly pressurized the high cost regions of US and Europe.

The industry in these regions has adapted in three ways:

1. Geographic expansion—targeting fast growing markets in Asia
2. Improving technology—with a focus on ‘solutions and materials’, as well as looking for new platforms in areas such as biotechnology and nano materials.
3. Operational improvement, particularly in supply chain, manufacturing, commercial and R&T functions.

There are lessons from these developments for Chinese companies, which are particularly pertinent right now as the Chinese industry is facing challenges in increasing innovation to meet market demands for new chemicals, as well as cost pressure as wage and commodity price inflation hits costs.

New approaches to innovation, geographic expansion in nearby markets and operational improvement can help the Chinese chemical industry in addressing these challenges.
General Trends in the Chemical Industry

Major trends and challenges facing the chemicals industry, particularly in the West, can be categorized into four main areas: socio-economic, demographic, customer-related, and resource-related.

On the socio-economic level, the impact of the global financial crisis has led to a resurgence of nationalism and a temptation to pursue short-term protectionist policies to bolster domestic industry in a time of recession or very slow growth. This is harmful to the wider development of international trade. The chemicals industry, whose growth has typically been fairly slow anyway, is particularly vulnerable to such a restriction of international growth opportunities.

The major demographic change is the rapidly growing importance of the emerging economies. China and India are obviously the two largest and fastest growing economies in the world at present, and this has led many of the Western chemicals companies in recent years to develop specific ‘Asia strategies’ to meet the exceptional opportunities in these two countries. Indonesia, The Philippines, Thailand, and Vietnam are also high-potential markets (see Exhibit 1, page 3).

A second important demographic factor is ageing, which has the potential to introduce shifts in product and chemical consumptions patterns.

The industry is increasingly encountering resource constraints, and facing a struggle to compete with MENA producers who have privileged access to feedstock. Some leading players are responding by focusing on the search for alternative feedstocks; PTT, for example, has made the development of bio-pathways a key part of its core strategy. Others prefer to seek safety by concentrating on higher value products further down the value chain (see Exhibit 2, page 3). Nonetheless, while the Middle East maintains substantial cost leadership at present, its costs had increased significantly in the last two years, and are likely to be further impacted by the widespread political instability in the region this year. All other producing regions around the world are starting to achieve significant cost reductions through improved efficiency. It is especially interesting to note that between 2008 and 2010 North America managed to outstrip both South-East and North-East Asia in cost competitiveness for ethylene, while Western Europe is rapidly catching up.
Exhibit 1
Potential Growth Markets for Chemicals

INDUSTRIAL DEVELOPMENT AND FOCUS

Source: Booz & Company

Exhibit 2
Chemicals Industry Developments in Asia

EXPECTED FUTURE DEVELOPMENTS

- Focusing on domestic demand and moving down the value chain
- Technology acquisition to enable value chain to higher margin sections
- Acquisitions overseas—ChemChina in lead

- Emergence of large scale refining petrochemical hubs, with focus on both domestic and export to Asian markets
- Aggressive push into specialty chemicals driven by feedstock resource concern on exposure to export
- Significant push into Indonesian market as industrialization takes hold

- Acquisition orientation
- Feedstock advantage & specialty chemical acquisition creating large scale integrated global chemical majors (SABIC)

Source: Booz & Company
The major Western players have traditionally been vertically-integrated operations. Intensifying competition in the 1990s prompted a shift to horizontal integration, as companies sought economies of scale and efficiency improvements by targeting particular product groups or technologies. The global chemicals market quickly became far more complex and fragmented. Today, the established players have to face the challenge of new major competitors emerging in the Middle East and Asia.

In China, till now, the focus has been on infilling the huge, and rapidly growing and diversifying, domestic demand, while seeking to acquire more advanced technologies to gradually migrate down the value chain into higher margin products. Now, however, the leading players are starting to look beyond China’s borders, both to export to some of their regional neighbours, and to acquire overseas assets. ChemChina’s recent purchasing of MAI and Rhodia signals an important new trend.

In India, Reliance and HPCL are currently building huge refineries and petrochemical plants. With a supply of Middle East crude oil, these large-scale complexes will be highly cost-efficient, and will have the capacity not only to meet rising domestic demand but to export to other parts of Asia as well. Meanwhile, in South-East Asia, Thailand’s PTT is transforming itself into a globally significant supplier of specialty chemicals, and closer collaboration with China is heralded by the recent opening of a Beijing office.

Although Indonesia is not yet a major player in the chemicals industry, its resource base and population are both large, giving it enormous potential. The state-owned Pertamina, already the world’s largest producer and exporter of LNG, is well placed to lead a rapid growth of the industry in this country over the coming decade.

In the Middle East, SABIC, long a leading regional player, has emerged as a global force, transforming itself from a local supplier of commodity chemicals into an international specialty chemicals company. Its policy of aggressive expansion and diversification through acquisitions in recent years is likely to continue. In this changing industry landscape, the coming decade is likely to see players follow one of four routes (see Exhibit 3, page 5):
1. ‘Integrated majors’—companies with strong resource bases will be able to rely mainly on their feedstock cost advantage, but will also look to extend down the value chain into higher margin products.

2. ‘Portfolio managers’—other companies will focus on diversity, acquiring a range of different chemical producers, and securing profitability not only by seeking synergy and integration between them, but also through the ability to identify astute acquisitions and to divest themselves of underperforming assets.

3. ‘Large-scale specialty chemicals producers’—some companies may focus on high-margin products and divesting themselves of lower-margin upstream businesses; innovation and marketing capability will be key to competitiveness in this field.

4. ‘Niche producers’—a few companies, perhaps sheltered by their location or by advantage in a particular technology, may be able to prosper in high-value product niches.

**Exhibit 3**

*Changing Industry Structure*

**DEVELOPMENT OF COMPETITIVE LANDSCAPE IN CHEMICALS**

<table>
<thead>
<tr>
<th>Oil &amp; Gas</th>
<th>Petrochemical</th>
<th>Basic Chemicals</th>
<th>Specialty Chemicals</th>
<th>Fine Chemicals</th>
<th>Life Science / Customer Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level of integration and value chain coverage</td>
<td>Diversified landscape due to different value chain coverage—emergence of new integrated players</td>
<td>Integrated majors - Highly integrated level up to feedstock - Some new large players</td>
<td>“Portfolio” managers - Portfolio manager</td>
<td>Large-scale specialties - Focus on few large segments</td>
<td>Straightened segmentation driven by consolidation—increased transformation of chemical companies</td>
</tr>
</tbody>
</table>

Source: Booz & Company
Major technology development is relatively static, with the main production platforms for polymers having been developed in the 1960s, and those for specialty chemicals in the 1970s and 1980s. The focus in recent decades has been on smaller innovations. In the 1990s, life sciences became the hot trend in research and development, along with a focus on meeting the needs of the rapidly growing Asian market. By the end of the 1990s, attention was shifting more specifically to the Chinese market, and also to the expansion of specialty chemicals production.

The most recent trend, part of the move towards enhanced customer intimacy, is ‘Solutions and Materials.’ ‘Solutions’ involves a focus on value creation beyond chemicals production, developing new offerings that combine the delivery of chemicals with the provision of other services such as consultancy on applications. ‘Materials’ are high-value products that meet highly specific customer needs: one example is a fire-resistant polyurethane insulation from BASF which is able to contain the heat of an oil fire, and was developed for use in the walls and floors of ships, particularly bulk crude carriers, to improve safety.

In recent years, though, ‘blue sky’ research has been making a comeback. New technology platforms have begun to emerge which may provide the scope for an industry-changing breakthrough, an innovative process that could perhaps be worth hundreds of millions or even billions of dollars (see Exhibit 4). Biodegradable materials, biotechnology, genetic modification, and nanotechnology are the new frontiers of technological innovation. Enzyme-based pathways to chemicals are especially promising: the OECD has recently predicted that 35% of the world’s chemicals and industrial products could be produced through biological pathways by 2030.

The potential of leapfrogging technology developments is also increasing, as chemical producers in China and other developing nations become more commercially formidable and more capable of innovating.

Exhibit 4
New Growth Technologies

<table>
<thead>
<tr>
<th>STAGE OF TECHNOLOGY DEVELOPMENT</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Biological Pathway to Chemicals</td>
<td>- By 2030, 35% of world chemicals and other industrial products is expected to be made through biological pathway (OECD forecast Aug 2011)</td>
</tr>
<tr>
<td>- Forecast for Biological manufacturing market in China 2015: 156 billion USD production value, 3% of GDP</td>
<td>- Around 40% of world current industries can provide opportunities for bio manufacturing</td>
</tr>
<tr>
<td>- Nano Materials</td>
<td>- Total Nano material market is expected to reach 2.5 trillion USD by 2015 (Lux Research)</td>
</tr>
<tr>
<td>- Alternative Materials for Bio Degradable</td>
<td>- Global bio degradable market is estimated to reach 3.94 Billion USD in 2016, 22% CAGR, with package, textile, and food top 3 segments</td>
</tr>
<tr>
<td>- 30% of the plastic parts in TOYOTA autos are made by degradable plastics</td>
<td>- 30% of the plastic parts in TOYOTA autos are made by degradable plastics</td>
</tr>
</tbody>
</table>

Source: Booz & Company
IMPROVEMENTS IN INTERNAL EFFICIENCY

In recent decades, for Western players, innovation has been more in management practice and business models than in technology. There have been major changes in particular in the approach to commercial, supply chain, R&T and manufacturing areas.

There are implications for China through adopting best practices across all these functions.

1. Supply Chain Management

Supply chain management has become an intricate science, with major improvements and cost benefits being achieved in procurement and inventory, which in turn contribute to enhanced levels of customer service.

Most Western chemical companies have installed functional supply chain organizations, installed ERP systems to manage the supply chain, and run a set of defined supply chain processes (see Exhibit 5).

Exhibit 5
Optimizing the Supply Chain

- Separate supply chain function at same level as manufacturing and commercial to focus on optimizing the whole value chain
- Optimal sales & operations planning system to coordinate supply / capacity planning and demand planning
- Companywide ERP system to provide backbone integration from forecasting / demand planning to manufacturing scheduling
- End to end aligned supply capabilities and sales policies
The organization running these processes is often part of the commercial department, sometimes an independent function at the same level as commercial and manufacturing. In these models the supply chain manager takes responsibility for margin, and optimizes the business across the commercial and manufacturing departments.

If done properly, reductions in distribution costs of 10-15% can be achieved, while inventory can often be cut by as much as 25% whilst increasing service levels by 10-20%.

When benchmarking Chinese chemical companies against best practices we see a significant potential to improve competitiveness of the Chinese industry.

2. R&T
R&T has become a critical tool for differentiation, and a way of fighting competition from price driven producers. Enhanced R&T focus on Product and Application Development allows producers to keep a close link to customer needs and to tighten technical, as well as commercial, links.

In Western companies there has been a shift away from long-term innovation, and an increased focus on Product Development, Applications Development, and Process Technology—in order to be able to respond swiftly to market changes and short-term opportunities.

Key aspects of long term research are increasingly being done in collaboration with external parties to allow producers to concentrate on their core skills—understanding customers and reacting to their needs with new products. Indeed, most large specialty chemical companies have eliminated or significantly reduced their central research and opted for a decentralized approach to R&T in close cooperation with the customer.

The highest R&D spend does not necessarily guarantee the best performance, even though there is a minimum threshold. More important factors for success are an effective alignment between innovation strategy and overall corporate strategy, establishing a streamlined R&D pipeline to maintain a regular supply of appropriate innovation that can bring new products to market swiftly, and effective portfolio management to enable the timely retirement of unprofitable products.

Innovation and R&T is an area with significant potential in China as R&D spend still is low, and oriented to long term research and process technology.

3. Manufacturing
In the field of manufacturing, the Western chemicals companies have continuously focused on improving productivity in order to combat rising costs and shrinking margins. Quality management philosophies such as Six Sigma have been universally adopted. ‘Lean’ programs have systematically eliminated waste, and highlighted concepts like ‘Customer Pull’ and ‘Continuous Flow.’ Expert ‘de-bottlenecking’ initiatives have led to asset optimization which can produce cost reductions of up to 25%.

Further improvements in efficiency have been achieved by the use of tollers and the outsourcing of non-core activities. Many European and US companies now operate through a network of their own plants, and also contract arrangements with toll processing manufacturers. This allows increased flexibility in
the manufacturing footprint, so optimizing cost. Chinese companies generally perform very well on cost management. They are, however, facing increasing challenges in managing cost as inflation in raw materials and labor remains high (see Exhibit 6). In this environment, learning from manufacturing best practices will be increasingly important.

4. Commercial
In the commercial area, new customer service models have been developed to attain competitive advantage through increased client satisfaction. Thorough needs-based analysis enables segmentation of the customer base. Optimizing the level of service for each identified customer type helps to minimize cost and maximize revenue potential. Such tailored customer interaction not only better meets customer needs but can lead to improvements in supply chain.

Exhibit 6
Cost Development in China and Its Implications

<table>
<thead>
<tr>
<th>CHINA PRODUCER PRICE INDEX</th>
<th>1990-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>40</td>
</tr>
</tbody>
</table>

- Western Companies have continuously focused on productivity improvement in Manufacturing to cover increasing cost, and lower margin, e.g:
  - “De-bottlenecking”: Asset optimization by expert teams which can lead to up to 25% cost reduction
  - Six Sigma: As a vehicle for change through an organizational approach to performance excellence, covering both transformational change and transactional change
  - Lean: The systematic elimination of waste, and the implementation of the concepts of “Continuous Flow” and “Customer Pull”
  - Outsourcing: Use of Tollers and outsourcing of non-core operations
- Expected cost increase in China indicates the increased importance of capturing learnings from manufacturing best practices

efficiency and to a closer connection between the technology and commercial organizations.

There have also been moves toward direct collaboration with customers to increase value creation. This increasing prioritization of customer intimacy has impacted on organizational structures; in specialty chemicals, in particular, there has been a move away from product-based business units toward business units centred around market-facing platforms.

A recent Booz & Company study showed that companies who directly engage their customers had 3 x higher Operating Income growth than companies with an indirect insight approach (see Exhibit 7).

---

**Exhibit 7**

**Impact of Direct Customer Engagement**

<table>
<thead>
<tr>
<th>DIRECT CUSTOMER ENGAGEMENT VS. INDIRECT CUSTOMER INSIGHT APPROACH</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDUSTRY INDEXED MEDIAN VALUE</td>
</tr>
</tbody>
</table>

- **3Y Operating Income CAGR**: 1.0 vs. 0.3 Direct Customer Engagement vs. Indirect Insight Approach
- **3Y Total Shareholder Return**: 0.7 vs. 0.4
- **3Y Return on Assets**: 1.5 vs. 0.7

Source: Booz & Company
CONCLUSION:

LEARNINGS AND OPPORTUNITIES FOR CHINA

We have described a number of trends and developments in Western Chemical companies, as well as in the overall industry structure which provides challenges, but also major opportunities for Chinese companies. Chinese companies would do well do examine and capture opportunities to leverage the changing industry structure, thereby potentially leapfrogging technology trends, as well as to optimize internal operations such as supply chain, R&D, Manufacturing, and Sales & Marketing so as to reduce cost and increase customer satisfaction (see Exhibit 8).

Industry Structure

In China, local producers have mastered commodity chemicals, but the fine and specialty chemicals market segments are still mostly dominated by overseas players, though certain sectors such as pharma, agrochemical and photovoltaic are developing rapidly. Chinese producers are progressively migrating down the value chain to displace these foreign imports and increase margins. Technology acquisition is thus a high priority; often, sourcing this from overseas is easier than self-development, with many overseas companies

Exhibit 8
Summary of Learnings & Opportunities for China

<table>
<thead>
<tr>
<th>Learnings</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry Structure</td>
<td>- Acquisitions of technology to displace imports</td>
</tr>
<tr>
<td></td>
<td>- Increased market share beyond China</td>
</tr>
<tr>
<td></td>
<td>- Possible move into new or “white spot” segments</td>
</tr>
<tr>
<td>M&amp;A</td>
<td>- Acquisitions of technology &amp; assets overseas</td>
</tr>
<tr>
<td></td>
<td>- Partnerships with emerging players to assess</td>
</tr>
<tr>
<td></td>
<td>new markets and resources</td>
</tr>
<tr>
<td>Technology</td>
<td>- Technology acquisitions from western companies</td>
</tr>
<tr>
<td></td>
<td>- “Leapfrogging” on new technologies and</td>
</tr>
<tr>
<td></td>
<td>alternative pathways</td>
</tr>
<tr>
<td>Supply Chain productivity</td>
<td>- Trend to reduce complexity and streamline supply</td>
</tr>
<tr>
<td></td>
<td>chain to capture Asian growth</td>
</tr>
<tr>
<td></td>
<td>- Implementing Supply Chain functions with</td>
</tr>
<tr>
<td></td>
<td>system driven process to improve service,</td>
</tr>
<tr>
<td></td>
<td>reduce inventory, and decrease cost</td>
</tr>
<tr>
<td>R&amp;D productivity</td>
<td>- Focus to improve innovation productivity</td>
</tr>
<tr>
<td></td>
<td>- Adapting best practices in innovation across the</td>
</tr>
<tr>
<td></td>
<td>business (idea generation portfolio</td>
</tr>
<tr>
<td></td>
<td>optimization)</td>
</tr>
<tr>
<td>Manufacturing productivity</td>
<td>- Internal operation optimization as a response to</td>
</tr>
<tr>
<td></td>
<td>increased cost pressure and competition</td>
</tr>
<tr>
<td></td>
<td>- Applying e.g. Lean six sigma programs and</td>
</tr>
<tr>
<td></td>
<td>de-bottle necking to reduce cost and increase</td>
</tr>
<tr>
<td></td>
<td>efficiency)</td>
</tr>
<tr>
<td>Sales &amp; Marketing Productivity</td>
<td>- Focus on gaining greater customer</td>
</tr>
<tr>
<td></td>
<td>understanding and intimacy</td>
</tr>
<tr>
<td></td>
<td>- Developing needs-based segmentations to</td>
</tr>
<tr>
<td></td>
<td>improve customer service</td>
</tr>
<tr>
<td></td>
<td>- Increased connection bw. technology &amp;</td>
</tr>
<tr>
<td></td>
<td>commercial…</td>
</tr>
</tbody>
</table>

Source: Booz & Company
being willing to divest themselves of technology resources in times of economic hardship. ChemChina has already launched a trend of seeking not just technology acquisition but opportunistic buyouts of weakened Western players like the French specialty chemicals concern, Rhodia. Securing feedstock supplies through overseas partnerships and acquisitions is also likely to be a rising trend; in 2007, for example, Sinopec brought in Saudi Aramco as a partner in the development of a new refinery and cracker complex in Fujian province on condition of its guaranteeing a supply of Saudi crude oil.

The emergence of strong new regional players represents not only increased competition for China’s producers but also provides the chance for new collaborations. PTT is keen to enter the China market, and may be willing to offer joint venture projects in Thailand in exchange. Pertamina is looking to lead the development of Indonesia’s nascent chemicals industry, and would welcome both technology transfer and capital investment from China. HPCL is also seeking technology and investment partners to help with its large-scale developments in India. Collaborations such as these can help to realize China’s ambitions to start developing a substantial chemicals export market among its regional neighbours.

**Development of Technology**

Spending on R&D in China is still relatively low, and has thus far been orientated mainly towards process technology or longer-term research. China can learn from the best practices in innovation systems developed by leading Western players, in order to enhance its capabilities right across the innovation value chain. In particular, China can benefit greatly from exploring the ‘Solutions and Materials’ business model, and improving product development through greater customer intimacy. Given China’s resource constraints, an R&D emphasis on frugal engineering processes would also be advantageous.

Enhanced innovation capacity may give China the opportunity to leapfrog ahead of the West in some new key technologies. Chinese companies are already developing strong positions in coal-to-chemicals pathways, although opportunities for growth in this area are limited at present by the heavy demand for coal to be used in electricity generation. In the future, the development of alternative energy resources, notably shale gas, may liberate more of China’s substantial coal reserves for chemicals use. Biopaths to chemicals and nano-materials are also extremely attractive avenues for research.

**Internal efficiency**

In the past, Chinese producers have generally performed well on cost management and productivity. Nevertheless, this record is coming under threat, as inflation in both raw materials and wages has become high in the last few years. The Producer Price Index in China more than doubled between 1990 and 2010, with a particularly sharp rise in the last 5 years. Thus, Chinese companies would do well to learn from the best practices of overseas players in improving management efficiency. In particular, awareness of logistics and supply chain management is as yet in its infancy in China, and very substantial savings could be achieved in these areas, to enhance the international competitiveness of China’s chemicals producers.

In summary, there is a wide range of opportunities for Chinese Chemical companies. These are particularly important pursuing right now as the Chinese industry is facing challenges in increasing innovation to meet market demands for new chemicals, as well as cost pressure as wage and commodity price inflation hits costs.
About the Authors

Chris McNally is a partner with Booz & Company based in Beijing, where he focuses on the Energy and Chemicals sectors. His project experience covers strategy development, M&A, strategic transformation, and operations improvement.

Jayant Gotpagar is a principal with Booz & Company in Houston. He focuses on business unit growth strategies, operating model design, innovation management, and operational improvement programs in the firm’s chemicals and downstream oil and gas sector.

Anna Månsson is a senior associate with Booz & Company in Shanghai. She specializes in operations management for the Chemical, Automotive and Consumer industries.
Booz & Company is a leading global management consulting firm, helping the world’s top businesses, governments, and organizations. Our founder, Edwin Booz, defined the profession when he established the first management consulting firm in 1914.

Today, with more than 3,300 people in 61 offices around the world, we bring foresight and knowledge, deep functional expertise, and a practical approach to building capabilities and delivering real impact. We work closely with our clients to create and deliver essential advantage. The independent White Space report ranked Booz & Company #1 among consulting firms for “the best thought leadership” in 2010.

For our management magazine *strategy+business*, visit [www.strategy-business.com](http://www.strategy-business.com).

Visit [www.booze.com](http://www.booze.com) to learn more about Booz & Company.