GLOBAL BUSINESS REPORTS

INDUSTRY EXPLORATIONS

SINGAPORE CHEMICALS

2016

Economy - Chemical Production - International Trade - Logistics
Internet of Things - Construction - Water & Environment - Industrial Gases

about the Singapore Chemical Industry Council

Mission Statement

The Singapore Chemical Industry Council is committed to playing its part in providing the people of Singapore with a quality of life that is second to none. To achieve this mission, the Singapore Chemical Industry Council will be:

- The body to promote the Chemical Industry into a major pillar of Singapore's economy for the benefit of its members
- The partner in progress with the Government of Singapore in its effort to enhance growth for the Chemical Industry for investors, safety in the workplace for the workers and an environmentally friendly Singapore for all the residents, and
- The body to represent the Chemical Industry domestically, regionally and internationally with the aim of enhancing trade and attracting foreign investments into Singapore for continued growth and prosperity for its people

History

The Singapore Chemical Industry Council (SCIC) is the official body representing the Chemical Industry of Singapore in the private sector.

SCIC is also the national administrator of the Responsible Care initiative, endorsed by the International Council of Chemical Associations, to promote the spirit, principles and practices of Responsible Care to the Singapore Chemical Industry. Through advocating Responsible Care, the chemical industry in Singapore can make a valuable contribution to the sustainable development and improvement of lives and the environment.

SCIC
SINGAPORE CHEMICAL INDUSTRY COUNCIL

For more information, please visit:
http://www.scic.sg

Dear Reader,

We are pleased to partner Global Business Reports once again in developing an in-depth look into Singapore's energy and chemicals sector. The world is moving at a much faster pace than it was when we collaborated with GBR back in 2013, after which Singapore has changed considerably. As technology and innovation disrupt the way we think and do business, the chemicals industry too remains vulnerable to these changes. Singapore recognizes the need to keep pace and continue to deliver value to companies that are looking to invest here, as well as those that have already established a base on the island.

Despite uncertain global macroeconomic conditions, the Asia growth story remains a compelling one, and companies continue to emphasize the importance of 'being in Asia, for Asia.' Megatrends such as urbanization, water, food security and a growing middle class are driving demand, and more companies are utilizing Singapore as a conduit to orchestrate various functions from manufacturing to R&D in the region. Developing a robust and resilient chemicals value chain is critical to helping companies realize their Asia strategy. To that end, projects under the Jurong Island v2.0 Initiative (JIv2.0) are targeted at improving competitiveness through feedstock optionality, enhanced logistics capabilities, improved productivity and lower utilities costs. Another exciting technology trend, the industrial internet of things (IIoT), is gaining traction in Singapore as companies leverage the city-state's budding IIoT ecosystem as a testing ground to explore its applications. The JIv2.0 initiative is a long-term journey and roadmap that encourages us to think deeper about what Singapore wants to achieve for our companies in the chemicals sphere.

Singapore's pro-business policies, strong intellectual property protection and extensive free trade agreements contribute to the country's competitive advantage, which we believe will differentiate ourselves from other chemical hubs in Asia. Having generated S$81 billion, or approximately one third of total manufacturing output in 2015[1], serving as home to over one hundred global companies and employing more than 25,000 people, the energy and chemicals sector will continue to serve as a pillar of Singapore's economy.

As you read through the pages of this report, we hope that it not only gives you a better understanding of our chemicals sector but also an idea of how Singapore can be your trusted location from which to write your Asia growth story.

Damian Chan,
Executive Director,
Energy & Chemicals, EDB

Cindy Koh,
Director,
Energy & Chemicals, EDB

[1] *2015 preliminary estimates – Economic Survey of Singapore, Ministry of Trade & Industry*

Chemical production

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Singapore Chemicals 2016
Industry Explorations
Global Business Reports

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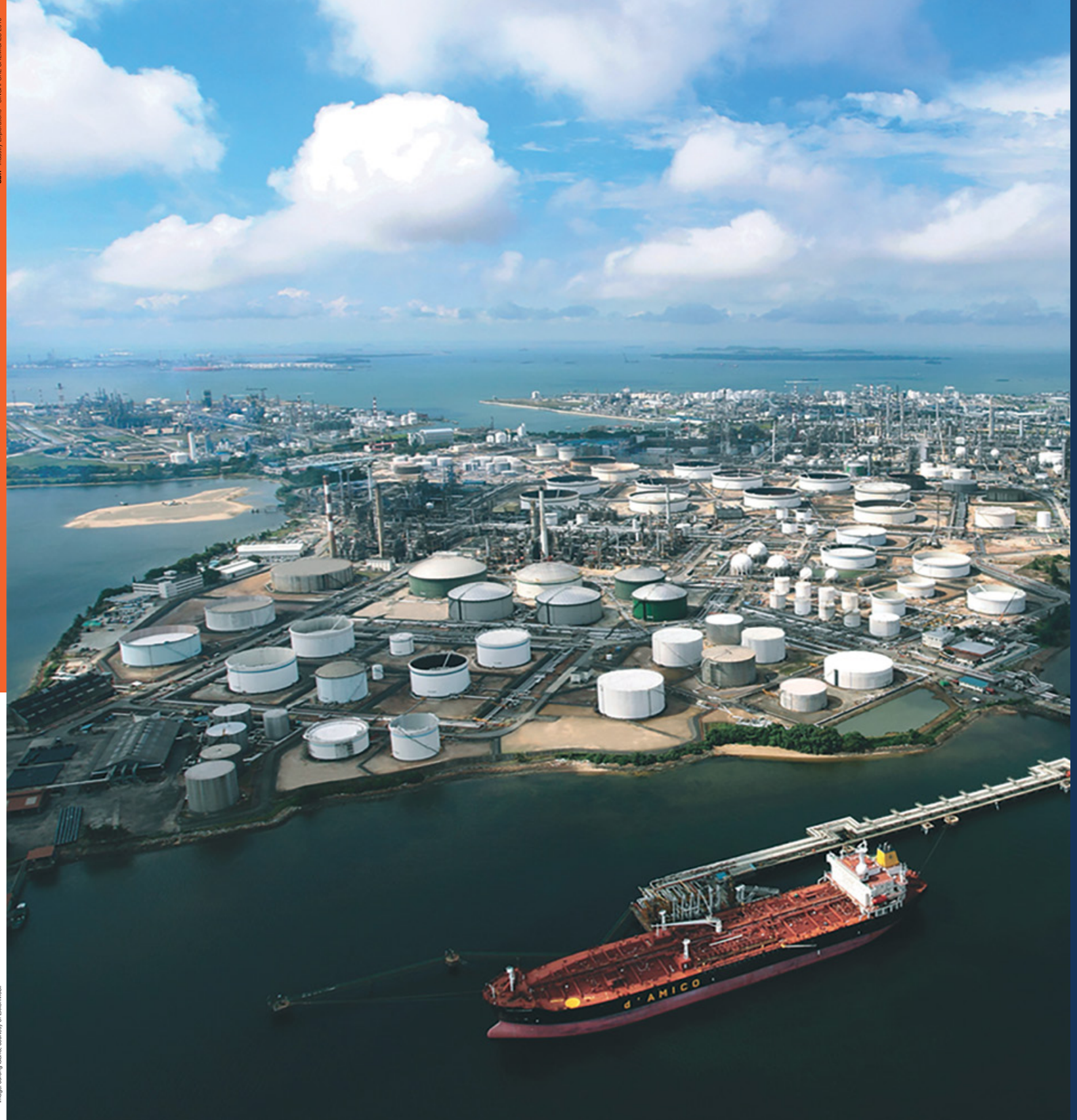


Image: Jurong Island, courtesy of ExxonMobil

INTRODUCTION TO **SINGAPORE**

"Singapore continues to be an attractive location for the chemical industry due to various factors such as its unique geography, logistical connectivity, pragmatic and consultative approach to policy-making, political stability, quality of infrastructure, availability of talent, quality of education and internationally recognized universities and colleges."

- Tay Kin Bee,
Chairman,
Singapore Chemical Industry Council (SCIC)

The Little Red Dot Shines Brightly

An overview of Singapore's chemical industry

Comfortably situated on Jurong Island, Singapore's chemical sector serves as a pillar of the global chemical industry. In 2015, grossing over S$80 billion and employing more than 25,000 people, the sector accounted for 28.6% of Singapore's total manufacturing output, according to the Ministry of Trade and Industry. The city-state continues to perpetuate its "home for business" motto, impressing the world with its top-class facilities, regulatory transparency, and innovative policies. Positioned among high growth markets such as Indonesia, Malaysia and India, Singapore is well aware that it must reinvent itself to stay afloat and, more importantly, ahead. This will be especially important in the midst of a current global economic downturn that has muted demand and slowed the advent of new projects. Today, a new set of dynamics is at play, keeping Singapore and its chemical industry on their toes.

292.7
BILLION USD
GDP

2.0%
GDP growth (2015)

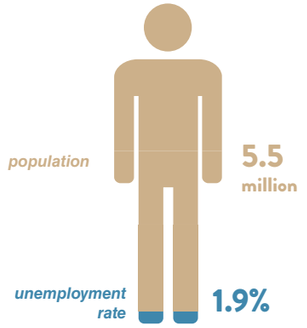
The first factor on everyone's mind is oil. The disconcertingly low price of crude is weighing on many players and fostering a muted outlook across jurisdictions and industries. Singapore is no exception to this trend, as its total merchandise trade dipped 9.5% to S$884.1 billion in 2015 (according to statistics released by IE Singapore), largely due to the contraction of oil trade by 36%. A broader economic malaise is beginning to set in, as new plant projects have been put on hold, majors such as Teijin Limited have left the island altogether, and others like Jurong Aromatics Corp. have yet to start up again. Other challenges such as rising business costs and difficulties associated with labor continue to pose as obstacles for multinational corporations (MNCs) and small and medium sized enterprises (SMEs) alike. "Rising costs of labor and land, coupled with a shrinking manufacturing base, are pushing Singapore's SMEs through the cracks," said managing director of Unilite Chemicals, Nicholas Lim.

The year 2016 will call for caution and good business acumen across all segments of the chemical industry. "Attracting and retaining talent is a lingering concern in Singapore's oil and gas and petrochemical sectors. This, coupled with an expected 20% to 30% decrease in demand from 2015, means that our company needs to bring a very competitive, value-added proposition to our clients in all our services so that we can navigate the current turbulent waters safely until the business cycle improves," said general manager of local maintenance company Ad-Meth Mech-Field, Shaun Pang.

Well aware of current hurdles, Singapore's stakeholders are taking active measures to galvanize the industry. Most notably, as part of the Jurong Island Version 2.0 (JIv2.0) initiative, policymakers have put a series of infrastructure developments in place to ▸ 10

SINGAPORE IN FIGURES

Source: IMF (2015 data)



-0.5%
inflation rate

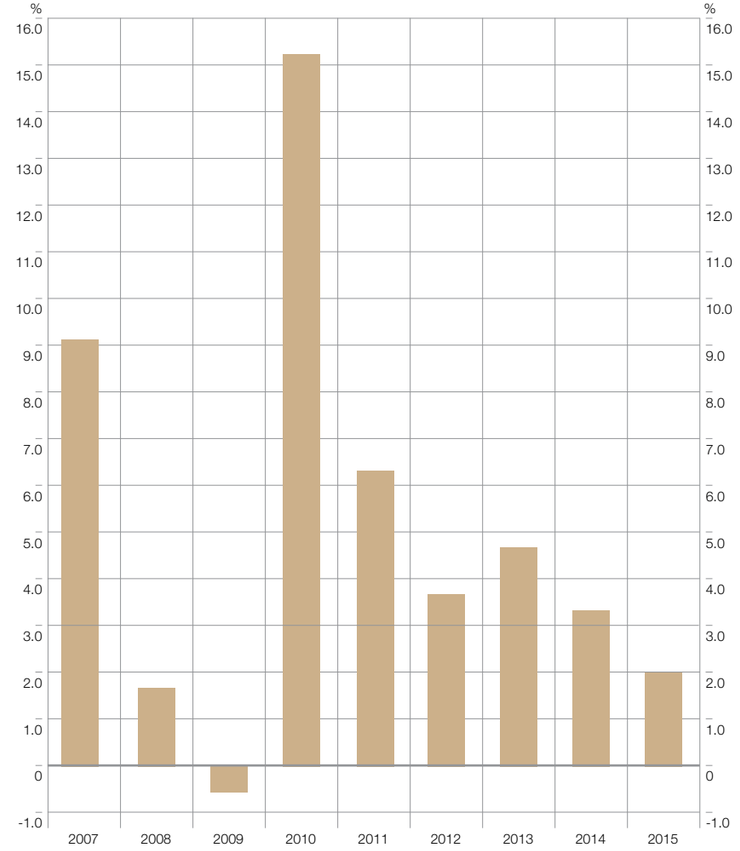
19.6%
current account balance (% of GDP)

52,888 USD
GDP per capita

85,253 INT.$
GDP per capita (PPP)

SINGAPORE'S GDP GROWTH

Source: IMF



THE ENERGY & CHEMICALS SECTOR AT A GLANCE

Source: Singapore Economic Development Board

S$81B

TOTAL OUTPUT (2015)

 # OF ENERGY & CHEMICAL COMPANIES

>100

Home to more than 100 global chemicals companies highly integrated across the value chain

ASIA'S LEADING OIL HUB

TOP 5

Exporting refining hub

4.13%

COMPOUNDED AVERAGE GROWTH RATE

DEDICATED INFRASTRUCTURE

>S$47bn

of investments on Jurong Island

TOTAL EMPLOYMENT

>25,000

Ready pool of highly skilled talent

strengthen the country's chemical ecosystem. The program kicked off in 2010, addressing the following areas: energy, feedstock optionality, logistics and infrastructure, productivity and data analytics. With regards to a shortage of labor, for instance, industry-wide initiatives have been put in place to increase productivity among existing workers. As an example, the Association of Process Industry (ASPRI) is collaborating with Centurion Corporation to set up the island nation's first integrated development, comprising a workers accommodation and training center to cater to the needs of workers from the process, construction and maintenance industry. "Labor management is an issue on everyone's minds. Our new workers accommodation is a 12-minute express lane bus ride to the Jurong Island Checkpoint, and is designed to enhance the wellbeing and productivity of foreign workers. Together with ASPRI, the facility will make a palpable difference in helping to alleviate some of the chemical industry's labor challenges," said group chief executive officer at Centurion, Kong Chee Min.

On a wider scale, the industry is working towards the production of high value-added derivatives in order to ensure the long-term competitiveness of the nation's chemical cluster. Characterized by wider margins and increasing demand, the specialty chemicals market is at the top of everyone's agenda. Japanese chemical heavyweight Mitsui Chemicals Asia Pacific (MCAP), for example, is turning towards healthcare and packaging. "Diversification is key for Mitsui Chemicals Group and placing Singapore at the forefront as one of the regional headquarters, MCAP integrates various regional strategies to meet market needs. With shifting market conditions, MCAP is diversifying its products from base petrochemicals to specialty chemicals areas, as the increasingly sophisticated consumer base is linchpin to our business. We are also collaborating with institutions such as A*STAR and its institutes to develop new technologies for innovation," said managing director and CEO, Shigeharu Matsuzaka.

Policymakers are also actively promoting research and development (R&D) in Singapore in order to draw more companies to the island's shores. Earlier this year, the government announced a Research Innovation Enterprise 2020 Plan (RIE2020) through which S$19 billion will support R&D efforts over the course of the next five years. This is the city-state's largest R&D budget to date, and is an 18% increase from RIE2015's S$16.1 billion commitment. R&D will enhance the city-state's role not only as a manufacturing hub but also as a center for innovation and technology. Thus far, Mitsui Chemicals, Syngenta, BASF and many more chemical players have all set up research facilities in Singapore. Additionally, a number of strategic initiatives have been implemented to optimize Singapore's chemical infrastructure. In September of 2014, Prime Minister Lee Hsien Loong officially opened phase one of Southeast Asia's first underground oil storage facility, Jurong Rock Caverns. Located beneath Jurong Island, the caverns provide additional capacity for the storage of crude oil, condensate, naphtha, and gas oil. Given the island's limited land space, Jurong Rock Caverns support petrochemical giants' operations by providing them with 60 hectares of additional space.

Speaking of space, Singapore's most advanced Pasir Panjang Terminal is undergoing an expansion that is slated for completion by 2017. The development known as Phase 3 and 4 will increase container-handling capacity by upwards of 40%. On the other side of the island, officials are cooking up plans for a new terminal in Tuas with the hopes of consolidating PSA's entire portfolio by the year 2040. Such investments demonstrate the government's commitment to Singapore's industry, and will ensure the local chemical sector's competitive advantage for the long term.

To further boost capacity on land, European tank storage firm Vopak Terminals Singapore recently unveiled Southeast Asia's first liquefied petroleum gas (LPG) facility on Jurong Island. The new import and storage terminal will help the industry diversify its feedstock and increase competitiveness. Depressed feedstock prices are already bolstering global petrochemical manufacturers' margins, and Vopak's investment will hopefully serve as an additional boost.

While hesitations over depressed fuel prices and China's slowing growth abound, Singapore's key players are confident in the underlying mega trends that will drive the industry forward long into the future. Southeast Asia remains an attractive growth market, given its rising middle class and consequently increasing purchasing power. But more importantly, Singapore's innovative policymakers are always one step ahead, working to ensure the future prosperity of their small but mighty island. For these reasons and more, multinationals will continue to see reason to set up shop in the city-state. "Singaporeans do not rest on their achievements and are constantly looking ahead. The country's astounding development over the last 50 years has proven that its policymakers had indeed crafted a good master plan. The Economic Development Board (EDB) is attentive towards the industries and companies coming to Singapore that can contribute to the further development of the country's industry and possibly other industries, which is a unique and effective strategy," said managing director of Helm Asia, Andreas Woschek.

Here we find ourselves in an ever-evolving landscape, engaged in thought-provoking conversations with some of the country's leading business minds. While Singapore's poet Edwin Thumboo once called Singapore a "quiet island with a name," beneath the calm and order of a well-running society, the industry's cogs and wheels are perpetually in motion. 2016 may have brought economic uncertainty, but Singapore is rising to the challenge.

Damian Chan & Cindy Koh

DC: Executive Director, Energy & Chemicals
CK: Director, Energy & Chemicals
SINGAPORE ECONOMIC DEVELOPMENT BOARD (EDB)

Many investments have been made on the island over the past three years. What continues to incentivize multinationals to come to Singapore?

DC: Firstly, Singapore's infrastructure capabilities have been critical: over the past 20 years Jurong Island has come to serve as a centerpiece for all energy, petrochemical, and specialty chemicals activities. Jurong Island's key value proposition is integration, from the perspective of being connected to both customer and supplier, often literally over the fence through pipes. This significantly reduces time and costs. Another contributing factor to Jurong Island's plug and play infrastructure is the presence of service providers such as third party logistics providers (3PLs) and utilities players.

Secondly, Singapore's business environment plays an important part in the city-state's competitiveness equation. Chemicals is a capital intensive, and in many cases technology intensive, industry. Hence, predictability with regards to government policies, rule of law and Intellectual Property (IP) protection, make Singapore a trusted and secure environment. However we cannot rest on our laurels. In today's environment—whether in the context of commodity markets, business growth, or political developments around the world—there is a great deal of uncertainty. Consequently, being able to provide some degree of resilience, or flexibility to respond to changes, becomes increasingly important. The Jurong Island v2.0 initiative will be of paramount importance to this.

In 2014 specialty chemicals comprised 9.7% of Singapore's chemical cluster's total output. How are initiatives such as the joint industry sectorial planning (JISP) for specialty chemicals affecting the growth of this segment?

CK: JISP is a joint initiative between EDB and the Agency for Science, Technology and Research (A*STAR) that spans across multiple research institutes including the Institute of Chemical Engineering Sciences (ICES), the Institute of Materials Research and Engineering (IMRE) as well as the Institute of High Performance Computing (IHPC). We realize that there is increased pressure to improve R&D yield for specialty chemical companies, and hence a need to keep costs down. This is where IHPC comes in with modeling and simulation, for example. JISP is a deliberate effort to identify scientific and technology areas in which companies have capability gaps, and where A*STAR and EDB could invest public funds.

The global specialty chemicals market will grow at a compound annual growth rate (CAGR) of about 5.4% from 2015 to 2025, with Asia Pacific growing at a CAGR of 6.35% and contributing 45% of the global market share. While Singapore is a small market, the country has a dense ecosystem of specialty chemical companies' customers, which are looking beyond Singapore and innovating for the Asia Pacific market. The ability to respond quickly is crucial. Over the last five years, we have seen specialty chemical companies leverage Singapore's strengths to set up their strategic hubs here. The co-location of commercial, innovation and manufacturing activities in Singapore has a strong reinforcing effect and make these companies more nimble in meeting customers' needs.

Have you identified any more opportunities in the Asian supply chain that Singaporean manufacturers could potentially fill?

DC: We are actively working on developing the higher olefins chains, such as C5s. While typically one cracker does not produce enough C5s to result in a world scale C5 complex, the island has the benefit of having four crackers. Hence we could aggregate C5s to produce a world-scale C5 complex, which is something that we are keen to develop.

Global Business Reports

How are the Jurong Rock Caverns being utilized, and what other innovations for space optimization are in the pipeline?

DC: The Jurong Rock Caverns underground storage facility was conceived for the purpose of storing crude and condensates, and has stocked condensates for one of the aromatic complexes on Jurong Island. The next stage is to see how we can use the caverns for crude storage, which would add another degree of resilience to our refineries.

When it comes to chemical plants, because of safety, there is some limit to the extent they can optimize space. On Jurong Island however, there are logistics facilities and warehouses that are exploring ways to better utilize automation technologies such as robotics to help with space conservation. The EDB is also working to be more judicious with projects, and taking care to ensure a high level of land productivity.

CK: JTC is developing a new chemicals hub, which is the first of its kind in Singapore, in Tuas. The facility is catered towards specialties and small footprint type plants, serving as a multi-storey facility for chemical companies to set up some of their blending and packaging activities. It is unique in that it includes shared facilities and services, which helps companies save costs.

How successful have the different initiatives been in combatting the shortage of workers?

DC: We launched the Process Construction and Maintenance Management Committee (PCMMC) to bring together plant owners and contractors represented by the Association of Process Industry (ASPRI) and identify ways to improve productivity and save on labor, especially reliance on foreign labor. This would also reduce maintenance and construction costs. Worker housing should ideally be proximate to Jurong Island; the EDB has worked with ASPRI on this front, which is currently constructing a new foreign worker dormitory with an in-house training facility close to Jurong Island.

> DC:
> Jurong Island has come to serve as a centerpiece for all energy, petrochemical, and specialty chemicals activities. Its key value proposition is integration, from the perspective of being connected to both customer and supplier, often literally over the fence through pipes. This significantly reduces time and costs.

We have also set up a turnaround scheduling system to smooth out peaks and troughs in demand. Often times there are increased costs for maintenance or construction due to the sheer number of jobs. Other initiatives such as mechanization will take longer to implement. A productivity council has been formed as a result of PCMMC. Additionally, we are making efforts in the field of worker certification. Lastly, an important component moving forward is benchmarking. We are currently working with the Construction Industry Institute (CII) at the University of Texas at Austin on benchmarking of projects.

How can data analytics increase the competitiveness of the petrochemical sector?

DC: The Industrial Internet of Things (IIoT) is potentially transformative for many industries. Even for a sector that is rightfully conservative —due to the importance of health and safety— there are many opportunities for new technologies to boost competitiveness and sustainability. For example, we can use data analytics to improve energy efficiency. Emerson, for instance, has set up a pervasive sensing center of excellence in Singapore. Yokogawa has also just set up a co-innovation center with the aim of working with companies in the chemicals industry to deploy IoT technologies. However, IoT is still relatively new and, given the nature of the industry, education efforts have to be made to help companies better crystalize the benefits of adoption.

What will continue to set Singapore apart in the international chemical industry for the long term?

DC: We have to go beyond the hygiene factor, and no matter how commodity prices shift, work to ensure that Singapore remains competitive. Eventually oil prices will increase again, and we have to shield ourselves against volatility. Developments such as the LNG terminal, increasing the number of LNG aggregators for greater energy security and competitiveness, along with efforts put towards feedstock diversification such as Vopak's new LPG terminal on Jurong Island, all contribute to this goal.

We believe that Asia will continue to be the world's long-term growth story. Consequently Singapore's status as a hub due to its location in the heart of Southeast Asia will continue to hold us in good stead. Furthermore, we will leverage key attributes that we have built over the years, such as strong financial institutions and logistics networks to complement our manufacturing capabilities.

What is your outlook and vision for Singapore's chemicals sector over the course of the next three to five years?

DC: We hope to continue to be vibrant from a growth perspective. We observe a great deal of growth stemming from specialty chemicals. With more technologies emerging, the nature of jobs will also evolve, and there will be a demand for more IT-savvy talent, as well as analytics-trained capital. Technology enablement of the sector is a critical part of how we see it transforming. Another key part of Singapore's vision is for the energy and chemicals sector to grow in a sustainable way.

Satvinder Singh

Assistant CEO
INTERNATIONAL ENTERPRISE (IE)

> Singapore is the biggest trade finance hub in Asia, and the third largest financial center and foreign exchange hub with the best USD liquidity in the region. It is also the leading RMB clearing hub in the world outside of China.

Can you introduce our readers to the historical evolution of IE and its role in Singapore today?

IE was formed in 1983 as the Trade Development Board (TDB) under the Ministry of Trade and Industry to promote and grow Singapore's trade. At the time, TDB's primary focus was to enable trade and help Singaporean companies export their products. In the 2000s, the agency's mandate was expanded. TDB was renamed IE Singapore in 2002, with the added mission to drive the growth of Singapore companies overseas. IE celebrated its 30th anniversary in 2013, and today has a presence in 39 locations across the world.

What is your assessment of the current trading environment?

Trade has always been an important part of our existence as a nation. In a country of 5.5 million people, our total merchandise trade is valued at approximately S$900 billion, often on par with some major OECD countries.

Singapore has attracted some of the world's largest companies to establish their marketing, trading, risk management, financing, and supply chain management activities in the country. This is due to five factors that contribute to the successful attraction of these companies. Firstly, Singapore is located in an open and neutral marketplace. Secondly, Singapore is undisputedly the biggest trade finance hub in Asia, with 25% to 35% of all trade finance volumes coming from the local financial market. The city-state is the third largest financial center and foreign exchange hub with the best USD liquidity in Asia, and the leading RMB clearing hub in the world outside of China.

The third contributing factor is Singapore's strong rule of law as well as mediation and arbitration environment. The fourth factor is a highly skilled workforce that is able to manage operations efficiently. In fact, the country's second highest expenditure is education. Lastly, Singapore offers a high quality lifestyle and a favorable environment that is easy for anyone to integrate into.

IE recently launched an International Trading Program (ITP) with Nanyang Technological University (NTU). Can you elaborate on this?

We have gauged a high demand within technical industries for young people to possess more in-depth and practical knowledge of industry operations. Consequently, over the last 10 years, IE has been working with various institutions to build programs that will enhance technical training. The ITP program with NTU involves integrating the business school and the engineering school to expose business, engineering and maritime students to all aspects of the industry, including international trading. Students will then graduate with double degrees. This globally unique program has launched in 2015. If Singapore wants to continue to be the global trading hub in Asia, we must invest in our human capital.

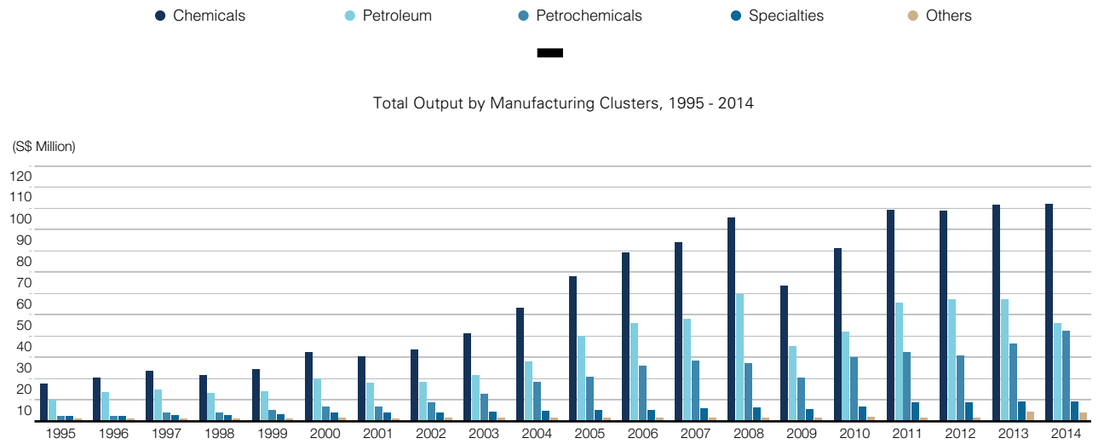
How important a role do you see LNG playing in the country's growth strategy?

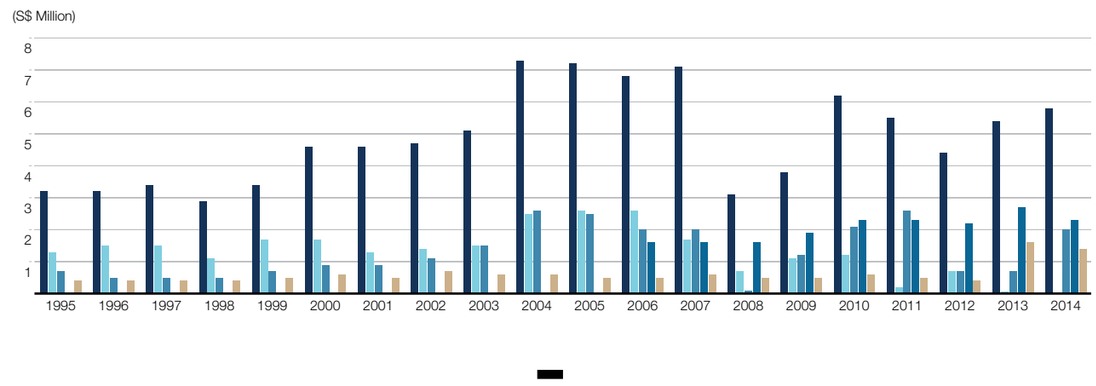
Singapore already has a vibrant LNG ecosystem and great aspirations moving forward. This is why we have invested significantly in building our gas infrastructure. The expansion is not only about energy security, but also supporting our position as a trading hub. LNG consumption in Asia is sure to become prolific and Singapore has the potential to become an LNG pricing hub.

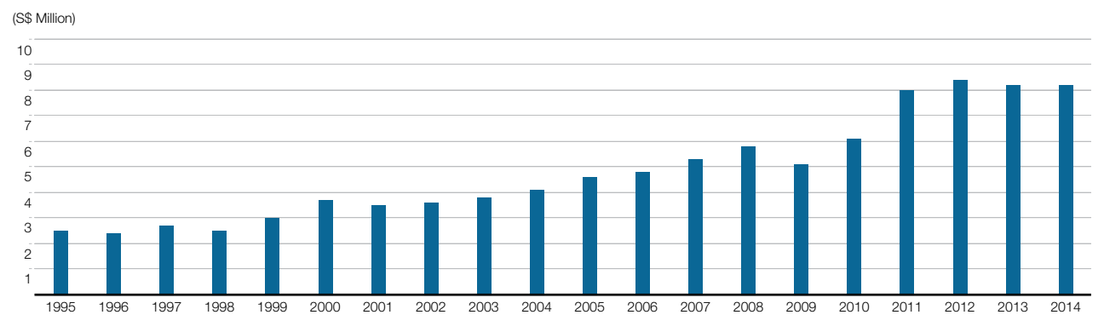
The Singapore LNG terminal (SLNG) currently has three tanks with a throughput capacity of 6 million metric tons per annum (Mmt/y). With the ongoing construction of the fourth tank and additional regasification capacities, this will bring the throughput capacity to at least 11 Mmt/y by 2018. The terminal can potentially accommodate seven storage tanks, with a throughput capacity of 15 Mmt/y. In order to help create a marketplace, not all of the storage will be used for domestic needs and there will be storage available for international trading companies.

What is IE's vision for Singapore's commodity trading sectors for the next three to five years?

The existence of business hubs such as Singapore is critical in challenging economic spells such as the one we are witnessing today. Companies worldwide must focus on managing risks and being efficient to survive the down cycle. Most players in the energy sector have not decreased their activities, but grown their production volumes as a result of increased efficiency. In the current cycle, a significant number of players come to Singapore because they have identified the marketplace as 'here to stay'. There are currently about 50 prominent petrochemical traders actively trading in Singapore. Within the next five to 10 years, I expect the country to attain a leadership position in the other energy clusters such as LNG, LPG and crude.







Total output refers to total value of goods and services derived from a production process and ancillary activities such as management or marketing. As such, it includes manufacturing output and other operating income.
With effect from 2002, the data included ALL manufacturers operating operating in Singapore.
Data for 2001 and before were based on manufacturing companies employing 10 or more workers. Hence, the data are not strictly comparable.
The above data is based on SSIC 2015.

Global Business Reports
FACTSHEET

Jurong Island

HOW JURONG ISLAND'S COMPETITIVENESS IS ENHANCED BY THE JIV2.0 INITIATIVE

Shell Refinery
Shell Cracker

1m
tonnes of C2

Singapore is Shell's largest petrochemical production and export centre in the Asia Pacific region

Electricity costs in the sector have been reduced by **30% since 2013** through the addition of nearly **3,000MW of generation capacity** and diversification of energy sources to LNG

Together with the decrease in oil price, the total cost of utilities has been **reduced by about 50%** almost half of what it was 3 years ago

Four companies have been shortlisted by Energy Markets Authority (EMA) to participate in Stage 2 of the request for proposal to appoint up to two LNG importers to supply Singapore's next tranche of LNG

This will help keep the price of gas competitive and also ensure supply security

LNG Terminal

MERANTI

Jurong Rock Caverns

*Southeast Asia's first underground storage facility, with **1.47m m3** of capacity for liquid hydrocarbons*

BANYAN

ANGSANA

SAKRA

PCS (Petrochemical Corporation of Singapore) Cracker

1m
tonnes of C2

*As a core part of Singapore's chemicals industry, PCS decision to invest S$110m in naphtha import facilities will have a **positive knock-on effect** for the industry*

MERBAU

CHAWAN

The development of an LPG import facility on Jurong Island by Vopak will offer an alternative feedstock option to naphtha

Vopak LPG Terminal

*With an initial capacity of **80,000 cubic metres**, the new facility provides crackers with the flexibility to use LPG to produce chemical products that are high in demand*

TEMBUSU

Jurong Barging Terminal

Operating capacity:
160,000 TEU per year

Reduce carbon emissions **by 30%** compared to conventional trucking

SERAYA

MERLIMAU

Exxon Mobil

Refinery

2 crackers (2m tonnes of C2)

PESEK

*The Singapore Chemical Plant (SCP) is ExxonMobil Chemical's **largest integrated petrochemical complex in the world***

SRC (Singapore Refining Company) Refinery

Process Construction Maintenance

PCM Management Committee formed in 2013 to raise productivity in the sector

Productivity Council formed in 2015, *3-year partnership* with **Construction Industry Institute (CII) Texas**

Process Construction Maintenance

Implemented turnaround scheduling – smoothen manpower demand and reduce peak-induced costs

Dormitory – centralised dormitory for workers on Jurong Island helps reduce travel time & fatigue, which improves worker productivity on-site

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SINGAPORE CHEMICALS 2016

Image courtesy of Evonik

Regulations

The adoption of the new Safety Case regime will strengthen Singapore's chemical ecosystem

Singapore has maintained its stature as one of the most sophisticated hubs in the world for petroleum refining and chemical manufacturing for decades, but as a number of global incidents have illustrated, the chemical trade remains an inherently risky business. Inspired by an impetus to continually evolve, Singapore's industry stakeholders are taking concerted actions to ensure the longevity of its precious industry. In a population-dense city-state, this calls for staunch attention to workplace safety and health in order to protect the industry, its surrounding communities and the environment as well as to ensure its competitiveness.

Thus far, Singapore's chemical industry is fortunate to boast a stellar safety record: it serves as the country's leading industry in terms of health and safety and has avoided any accidents such as those that have tarnished the image of the industry elsewhere. However, while Singapore's current workplace safety and health management system is stringent, its regulators are working to introduce a new framework to even better manage risk, prevent major accidents and limit their potentially grave consequences.

Accordingly, in March 2014, the Ministry of Manpower (MOM) set up an inter-agency taskforce to review and enhance Singapore's existing regulatory framework for major hazard installations (MHIs) with the goal of being in line with international best practices. MHIs include petroleum refining and manufacturing facilities, chemical facilities, chemical processing plants and facilities where large quantities of toxic and flammable substances are stored or used—accounting for thousands of companies across the oil and gas, chemicals and process sectors. MOM, along with the Ministry of the Environment and Water Resources (MEWR), the Ministry of Home Affairs (MHA), the Ministry of Trade and Industry (MTI), the Singapore Civil Defence Force (SCDF), National Environment Agency (NEA), the Economic Development Board (EDB) and JTC Corporation (JTC), have been working alongside the industry to implement the Safety Case regime.

The Heart of the Matter

The Safety Case regime is not new to the chemical industry, but has only recently made its way into the local regulatory framework. Singapore's avid regulators have travelled across Europe to study the ways in which other jurisdictions, such as the United Kingdom, Germany and the Netherlands, manage their MHIs, returning to the homeland inspired by a more flexible and comprehensive approach to safety.

A Safety Case regime will allow MHIs greater flexibility to tailor risk mitigating measures to best suit their own needs, moving away from a prescriptive one-size-fits-all regulatory approach. This means that MHIs will assume greater responsibilities to identify and manage safety, health and environment (SHE) risks, and demonstrate that they are safe. Essentially, Safety Case will call for the integration of all SHE protocols onsite as well as a formal demonstration to regulators that all MHI risks have been reduced to as low as reasonably practicable. MHIs will have to make a case to convince regulators that their unique strategy for managing safety is satisfactory. Adoption of the Safety Case regime will lead to the improved understanding of hazards and risks, an enhanced knowledge of technical and managerial controls, and better oversight in general.

> "I believe the Safety Case regime offers Singapore the opportunity to both efficiently and effectively regulate Major Hazards Installations (MHIs). It presents an overarching framework that is very clear on the why and the how; it puts a lot of emphasis on the operator actively demonstrating they are safe."
>
> - Stephen Fowler, Director, SCIC / General Manager, Shell Jurong Island

Ring Up the Curtain

Along with an introduction of Safety Case regime, the inter-agency taskforce also recommended to establish the Major Hazards Department (MHD), to serve as the single and easily accessible regulatory body overseeing the new safety protocol. The MHD will be responsible for Safety Case assessments, inspections and investigations. The department will be led by MOM, and comprise officers from SCDF and NEA.

New MHI regulations are being introduced under the Workplace Safety and Health Act to put the Safety Case regime into effect. To ease the industry into adoption, there will be a grace period until mid-2017, when the Safety Case regime for MHIs will formally take effect.

Working Hand in Glove

The implementation of new MHI regulations is a result of close cooperation between a number of aforementioned government agencies and the industry in order to tailor the framework to a Singaporean context. In addition to various industry consultations and capability-building initiatives led by regulators, the Singapore Chemical Industry Council (SCIC) has established an MHI committee for the sole purpose of supporting the enhancement of the new framework. The entire regulatory process is a testament to Singapore's transparent and consultative way of doing business and the widespread belief that collaboration leads to better outcomes. "We work together for the betterment of Singapore, that is why our economy can grow," said executive director of SCIC, Terence Koh.

In fact, agencies are continuing to work closely alongside the industry to co-develop specific guidelines, including technical guidance for the Safety Case regime. Additionally, with the introduction of the regime, regulators are prepared to further streamline existing SHE regulatory requirements. In sum, all of Singapore's stakeholders—from multinationals to local producers and regulators—are investing time and resources into preserving the city-state's competitiveness. Together they are doing what Singapore does best: taking a long-term view, and working tirelessly for the betterment of their chemical industry.

Tay Kin Bee

Chairman
SINGAPORE CHEMICAL INDUSTRY COUNCIL (SCIC)

What is the status of the Global Harmonized System (GHS) and the Responsible Care program, and what additional initiatives is SCIC currently spearheading?

The Responsible Care program continues to be the flagship program for the chemical industry. This voluntary program helps drive continuous improvements in the areas of Health, Safety & Environmental (HSE) performance of the industry. It is well recognized and supported by local government agencies. In recent years, SCIC has also launched two collaboration schemes with several agencies to recognize companies that have achieved good implementation performance. 2015 was a significant milestone as we celebrated 25 years of Responsible Care in Singapore.

The GHS implementation took effect in July 2015 for manufacturers and suppliers and in July 2016 for users of chemicals. Now that the legislation and standards to comply with GHS have been put in place, the focus moving forward has shifted to promotion, engagement and capability building for all industries affected. SCIC has trained more than 5,000 personnel since 2006, including regulatory officers.

Some additional initiatives we are spearheading include productivity improvement, the ASEAN regulatory cooperation project, and the development of a process safety regulatory framework. SCIC has been tasked to lead the facilitation and support of the national productivity program. This three-year national implementation project is expected to help the process industry improve productivity through the introduction of best practices, mechanization and a benchmarking study.

The ASEAN Regulatory Cooperation Project formed as a result of SCIC, the American Chemistry Council (ACC) and the Japanese Chemical Industry Association (JCIA) coordinating efforts to help advance chemical regulatory cooperation in the ASEAN region. As new regulations are being developed, the enhancement of regulatory cooperation among these economies would help maintain high levels of health, safety and environmental standards, while promoting resource and cost savings for both governments and the industry through a more efficient and effective interaction between different regulatory regimes.

Lastly, SCIC has recognized the need for an effective PS regulatory framework. SCIC put forth a proposal on a process safety framework at the end of 2014, which includes support for Safety Case regime implementation in Singapore as well as the formation of a government-industry joint work group (JWG) —consisting of experts from the industry and agencies— to develop the Safety Case Technical and Assessment Guidance documents for the MHI regulatory requirements. Efforts would be focused on capability building within the industry to equip MHIs with adequate knowledge, and secure resources needed for Safety Case implementation.

What are the main issues currently facing chemical companies from a regulatory perspective today?

SCIC has been working closely alongside various regulatory agencies in a consultative and collaborative manner to address key matters pertaining to the chemical industry. A recent example would be the development of the process safety regulatory framework in Singapore. SCIC is also addressing regulatory requirements for pipeline and storage of petroleum and flammable materials, manpower, productivity and energy efficiency. The joint government-industry approach has proven to be effective in delivering outcomes for both the government and the industry.

Other challenges include the high cost of energy and a tightening labor market. What is your take on these trials?

The tightening of the labor market is an impetus for our strong focus on productivity improvements in maintenance and construction activities, as well as our efforts to raise the attractiveness of career opportunities within the chemical industry.

SCIC is managing the PCMMC's Productivity Council, which was formed in mid-2015. The timeline for the national implementation project is from 2015 to 2018. Upon completion, the project is expected to introduce best practices, metrics and benchmarking for the PCM industry.

Many industry initiatives have been undertaken by SCIC as part of our ongoing involvement with student outreach programs to raise awareness about careers in the energy and chemical industry. In October 2015, we launched two new initiatives including a microsite on careers in the chemical industry and a booklet on career progression pathways in the energy and chemical industries.

What is your medium term outlook for the sector?

We are optimistic about the medium to long-term outlook for the sector, based on the expected increase in demand for petrochemical products from a growing middle class in the Asia Pacific region.

Singapore continues to be an attractive location for the chemical industry due to various factors such as its unique geography, logistical connectivity, pragmatic and consultative approach to policy making, political stability, quality of infrastructure, availability of talent, quality of education and internationally-recognized universities and colleges.

Chantal Quek

General Manager
ASSOCIATION OF PROCESS INDUSTRY (ASPRI)

Can you walk us through ASPRI's evolution over the last years? What is your current mission as a representative body of Singapore's process industry?

ASPRI has been making continuous efforts over the past three years to strengthen our relationships and partnerships with the government, plant owners and ASPRI members in order to most efficiently represent the interests of our members. We have also achieved another milestone, and grown our member base to over 500 companies. ASPRI has been conscientiously creating and delivering value-added benefits to our member companies. In 2015 ASPRI began a rebranding campaign and adopted the "Connect – Engage – Grow" logo, mirroring our resolution to fulfill our renewed vision: "To be a credible and visible partner in the process industry."

How is ASPRI collaborating with the Singapore Chemical Industry Council (SCIC) to better support SMEs?

SCIC is another one of our valued industry partners. We are working more closely with SCIC as we sit on the Productivity Council together with some of their members, our members and relevant government agencies, to continuously seek productivity improvement, efficient optimization of resources and promote the adoption of improved mechanization.

ASPRI engaged in setting up a dormitory training facility. Can you elaborate on the training and education initiatives ASPRI is involved with, as well as any other projects?

ASPRI-Westlite Papan is scheduled to be completed by mid-2016 and will cater to the accommodation and training needs of workers in the process industry. The facility has the capacity to house 7,900 workers, in addition to a 3,000-square meters training center. The goal is to improve the skillsets of the workers residing in the dormitory by providing comprehensive training courses right at their doorstep. The ASPRI Integrated Training Centre (AITC) is the first initiative of its kind, which we are proud to be involved with. The dormitory's value-added training and facilities are designed to improve the wellbeing of foreign workers, leading to the minimisation of fatigue and increased productivity. The facility will also help upskill workers so that they can undertake greater job responsibilities. This will help form a leaner workforce, bring about better skills and higher salaries, ultimately helping Singapore retain its skilled workforce and sustain its competitiveness.

SMEs have voiced concerns over growing challenges. What is your assessment of the current business environment?

It is true that some ASPRI members might have experienced a decline in their business as a result of the current economic situation. As oil prices are lower, a significant amount of plants have put their projects on hold and work volumes have declined significantly, resulting in a very competitive market. Associations and the government have responded to this by offering more schemes such as the Lean Development Management Scheme (LEDS) and encouraging better synergy within the industry. On the other hand, productivity requires commitment and effort on the part of of all parties. We hope to strengthen the spirit of partnership within the industry to drive productivity collectively and more effectively through innovation and transformation of business models, work processes and methodologies.

What is your outlook for the process industry in Singapore and what goals does ASPRI hope to achieve within the next three to five years?

Despite finding ourselves in uncertain economic times, Singapore remains a growing center for doing business with a stable political climate, reliable rules and regulations and, most importantly, a high level of trustworthiness at both the individual and corporate levels. All these factors support the process, construction and maintenance (PCM) industry, which is ready to offer its value-added services. ASPRI is currently encouraging its members to collaborate more with one another in an open-minded manner, paving a smoother path towards economic recovery.

As Southeast Asian neighbors present investors with lower-cost alternatives, Singapore needs to innovate and enhance its cost-competitiveness with its high-quality and efficiency-driven service offering. We should enhance our engineering capabilities, which we need to continue to hone and leverage. This year, ASPRI is excited to be working alongside the government and the industry, linking arms in an effort to solidify Singapore's competitive advantages through connecting the right people, engaging industry stakeholders and propelling the growth of the industry by embracing a strong spirit of partnership.

Image courtesy of ExxonMobil

CHEMICAL PRODUCTION

"Demand for commodity products is growing at a slower rate than GDP growth, while growth in demand for select specialty chemical and lubricant products is taking place at a faster rate than GDP growth. Hence, over time we want to upgrade our molecules and add capacity to be able to convert commodity fuels into products such as lubricants, chemicals and specialty chemicals."

- Gan Seow Kee,
Chairman and Managing Director,
ExxonMobil Asia Pacific

Manufacturing

Jurong's heavyweights continue lifting

Singaporeans and foreigners alike are attune to the Lion City's high cost of living and doing business. While the country's delicious hawker fare might cost a hungry tourist just a few dollars, setting up shop here begs a much larger investment. Today, increasingly high costs of doing business on the island are taking center stage, especially in the midst of an economic downturn. In fact, according to the Economic Development Board (EDB), Singapore's manufacturing output contracted by 5.2% in 2015, the first annual decline since 2009. It is no surprise that the world economy has heavily impacted the local chemical landscape. Today, Singapore's producers are vulnerable to China's slowing demand and oversupply. Low oil and energy prices have not stimulated demand for petrochemicals in Asia to a great extent, and a weaker Singapore Dollar is unlikely to boost exports in the face of poor external demand and a weaker Yuan. Consequently, the first three quarters of 2015 saw a 0.2% y-o-y average increase in the local petrochemical index, down from 13.3% in 2014. More broadly, these blows are exacerbating what is already a shrinking manufacturing base. The share of manufacturing as a percentage of Singapore's GDP has been declining consistently over the past ten years, from a high of 27.8% in 2005, to 19.8% in 2015. Hence, the key question today is, what actions are being taken to counter this contraction and boost homegrown production, and will they succeed?

While the signs pointing south abound, we have discovered a sense of resilience among some of Singapore's chemical players that hopefully will keep the island's industry afloat. Brave investors remain confident in the city-state and continue to pour capital into the local chemical cluster, one of Singapore's three sectors that attracted the highest fixed asset investment commitments in 2015. "Investments made in the last two years were not made with a short-term view, but rather with a 20 to 30 year timeline in mind. It is very clear that Singapore does not offer the lowest costs in terms of manufacturing but boasts advantages in other areas. Hence, Singapore needs to continue to work towards differentiation, which will help companies like Dow remain competitive," said country manager at Dow Chemical Pacific (Singapore), Suiniaty Basirun.

Differentiation is the name of the game today, especially in an environment where increasing supply of basic petrochemicals from lower cost production centers are weighing heavily on margins. China's move to self-sufficiency has created supply gluts in the marketplace, as the country is transitioning quickly from a net importer to a net exporter of many petroleum products and chemicals for the first time. According to ICIS, China's capacity as a percentage of consumption of PTA, for example, has risen from 72% in 2010, to 164% in 2016. Staggering Chinese capacity increases are compelling Singaporean producers to alter their strategies entirely.

"Today in Southeast Asia, 70% of MCI's businesses depend on basic petrochemicals such as phenol, BPA or PTA, which are suffering from severe global competition in the region due to the growing supply from China. As a result, we are turning to more specialty areas such as specialty polymers and healthcare materials," said managing director & CEO of Mitsui Chemicals Asia Pacific, Shigeharu Matsuzaka. ►27

Suiniaty Basirun

Country Manager
DOW CHEMICAL PACIFIC (SINGAPORE)

Asia Pacific Business Director
DOW HOME, INSTITUTIONAL & PERSONAL CARE SOLUTIONS

What major milestones has the company achieved in Singapore over the last three years?
In December 2015 Dow announced that the joint venture with Saudi Aramco, Sadara Chemical Company, began polyethylene production. This was a key milestone achievement, enabling us access to increase volume to meet our aggressive growth targets in the region. Singapore is well positioned as a key logistics hub, and will play a seminal role in moving material across Asia Pacific. Dow Singapore recently celebrated the arrival of new products at the beginning of this year, which we shipped from Singapore to customers in Asia Pacific. Secondly, we have strengthened the role of our manufacturing plant in Singapore that produces impact modifiers used in packaging and construction industries globally. Today, our local plant plays an important role in our global supply chain.

What impact will Sadara have on the company's regional operations?
Together with Saudi Aramco, Dow announced the joint venture Sadara in 2011 to produce more than 3 million metric tons of high-value performance plastics and specialty chemical products per year at full operation. Sadara comprises 26 manufacturing units and is one of the largest integrated chemical facilities in the world. In order to continue growing, we need to continue to have a product, and Sadara will help Dow grow aggressively in segments such as water, packaging, energy, transportation, infrastructure and consumer products. With an emerging middle class in Asia Pacific, there are many consumer goods to be produced, and Sadara is definitely allowing us to capitalize on these opportunities.

How will Dow be affected by the Safety Case regime for Major Hazard Installations?
Dow is an active board member of the Singapore Chemical Industry Council (SCIC). SCIC is actively trying to ensure that its members are ready for any upcoming reforms. While the regulatory changes will have an impact, it will vary across companies, and there will be more catch-up required for small and medium sized enterprises (SMEs) than for multinational corporations (MNCs). Through capacity building, SCIC takes on the role of leveling out the playing field and preserving the future of the chemical industry.

Given cost and labor-related challenges, do you believe Singapore will remain competitive in the long term as a chemical hub?
Investments made in the last two years were not made with a short-term view, but rather a 20 to 30-year timeline in mind. It is very clear that Singapore does not offer the lowest costs in terms of manufacturing, but boasts advantages in other areas. Hence, Singapore needs to continue to work towards differentiation, which will help companies like Dow remain competitive.

How is Dow positioning itself strategically in Southeast Asia?
The cost of production is not getting cheaper in China, and certain countries in Southeast Asia are benefitting from the spillover in manufacturing. Vietnam, for example, has seen significant growth in manufacturing and production; Thailand already has a large manufacturing base that will continue to grow; and the Philippines is a huge domestic consumption economy. Southeast Asia has tremendous potential, especially after the establishment of the ASEAN Economic Community (AEC) in 2015, which Dow is looking to capitalize on with its joint venture Sadara.

How is Dow promoting sustainability through innovation in the region?
To us sustainability is not an initiative; initiatives come and go whereas sustainability is business. Through our 2025 Sustainability Goals, launched in December 2015, we are redefining the role of business in society. We have put forth seven goals, categorized under three pillars, one of which is increasing confidence in chemical technology. While chemicals may not always have positive associations, they are vital, and we want to be able to support their role in society with data. For example in Singapore, through water technology we enabled more efficient filtration. Dow was presented with five prestigious Edison awards, recognizing the company's innovations that address world challenges.
I can confidently say that the future of the chemical industry is bright. Companies are now looking holistically at the ways in which chemistry impacts society, to make sure that we can preserve the planet for generations to come. Dow works to add value to all three pillars in each country we operate. Within our local plant we look at ways to reduce water and energy consumption.

Gan Seow Kee

Chairman and Managing Director
EXXONMOBIL ASIA PACIFIC

Singapore boasts over 120 years of history with ExxonMobil. What role does the city state play in the company's global strategy?

Singapore is a very important strategic location for ExxonMobil, as the company's largest integrated manufacturing complex in the world is located here. ExxonMobil supplies markets throughout the Asia Pacific region and beyond from Singapore, which is also the regional hub for our downstream and chemicals businesses. Over the years, we have invested more than US$15 billion here and we continue to see the island as a very important strategic location for us. Singapore is a good location to conduct business out of given its sound stable government, policies, excellent infrastructure, and great trade connectivity throughout the region and beyond. What is also important is that ExxonMobil continues to receive good support from the Singapore government and its agencies, such as the Economic Development Board (EDB) and JTC Corporation (JTC).

What is the status of your new cogeneration facility?

ExxonMobil is building an 84-megawatt cogeneration facility that is expected to come on line next year. This third cogeneration facility is an important step for ExxonMobil, as it will improve energy efficiency in our Singapore Refinery by 4 to 5% and reduce carbon dioxide emissions equivalent to taking about 45,000 cars off the road. When completed, the facility will bring our generation capacity to 440 megawatts, so that we will be electricity self-sufficient.

In addition to cogeneration, ExxonMobil has been investing in improving energy efficiency through programs such as our Global Energy Management System, and technology. Our expanded petrochemical plant in Singapore is equipped with more than 40 new proprietary technologies, and stands as the most energy-efficient plant we have in the ExxonMobil circuit worldwide. In addition to helping the plant consume less energy and reduce emissions, these advanced technologies enable us to make leading-edge products efficiently and with reduced environmental impact. For example, we produce advanced plastics for packaging or car parts that are more durable and use less material, which help our consumers also minimize their environmental impact.

How is ExxonMobil circumventing the issue of a tightening labor market?

ExxonMobil employs more than 3,300 people in Singapore, of which about 90 percent are Singaporeans and permanent residents. Labor tightness affects our company mostly through vendor companies and contractors. While they are not our direct employees, we have been striving to improve productivity of our contractor workers through cross-industry initiatives such as the Process, Construction and Maintenance Management Committee (PCMMC), a joint effort led by the EDB, the Singapore Chemical Industry Council (SCIC) and the Association of Process Industry (ASPRI). Raising productivity will support Singapore's larger goals of better jobs for Singaporeans, less dependency on immigrant labor, and increased innovation.

What is the ratio of ExxonMobil's production of specialty versus commodity products?

ExxonMobil has been on a journey towards specialty production for a number of years. Demand for commodity products is growing at a slower rate than GDP growth, while growth in demand for select specialty chemical and lubricant products is taking place at a faster rate than GDP growth. Hence, over time we want to upgrade our molecules and add capacity to be able to convert commodity fuels into products such as lubricants, chemicals and specialty chemicals. For example, ExxonMobil already has facilities in place to produce specialty grades of elastomers and polyethylene. Our halo-butyl rubber and hydrogenated hydrocarbon resin plant (to produce adhesives) will be a continuation of our investments in this segment.

What are some of ExxonMobil's longer-term goals?

We are optimistic about the medium and longer-term prospects for our business in Singapore, as well as our view of Singapore's role in the region. The fundamentals of our business remain unchanged whether oil is $100 or $30 per barrel. On a day-to-day basis we continue to focus on operating safely and reliably in the most cost-effective and sustainable manner, and maximizing the value of every molecule across the value chain. We are committed to continue working closely with the government and other industry stakeholders on long-term sustainability and competitiveness of our business. We continue to invest in providing good careers and developing our employees to their fullest potential, as well as being a good corporate citizen.

◂ 24

Mitsui is ramping up production of specialty elastomers and polyethylene, with the hopes of catering to Asia's growing demand for more specialized applications in the automotive and food and packaging areas. Celanese too is bolstering its presence in Singapore with a new vinyl acetate ethylene (VAE) production facility. "We are proud to be the first chemical company to build a VAE emulsions plant in Singapore. The new plant is integrated with our upstream infrastructure, which helped foster quick completion," explained commercial director of Celanese's acetyl chain business, Anna An.

Singapore is not giving in to competition easily. Policymakers and industrialists are taking actions to preserve the island's competitiveness by promoting stability and predictability in a world economy that is laden with uncertainty. On the energy front, for example, while Singapore's costs have historically been among the highest in the region, they have come off by 50% since 2013. This is due to the fall in the price of oil, increased power supply of almost 3,000MW of capacity in the market, and liquefied natural gas (LNG) diversification efforts. The addition of a new LNG terminal by Singapore LNG Corporation in 2014 enables aggregators to import the fuel from all over the world, leading to heightened security and competitiveness of supply.

Such initiatives have bolstered the city-state's attractiveness as a manufacturing base. According to the Ministry of Trade and Industry, the local chemical industry produced S$81 billion worth of output in 2015, accounting for 28.6% of the city-state's total manufacturing output. That year, all clusters except for the chemicals cluster, recorded a decline in output. And the mighty island is not due to float away any time soon. Large multinationals that have called Jurong Island home for decades are strengthening their commitment to the region with increased investments in production capacity expansions and new plants.

But what keeps them all coming back for more, during a period of high market volatility and overall uncertainty? Multinationals undoubtedly remain convinced by Singapore's attractive offering as a chemical manufacturing hub. Instead of moving operations to lower-cost locales such as Malaysia or Thailand, the world's chemical giants continue to be wooed by the city-state's attractive tax schemes, top-notch infrastructure and interconnectivity, pro-business government, legal transparency, highly skilled human capital and academic resources. These factors are especially relevant as more and more firms look to streamline their operations and focus on their core businesses: production and R&D.

While Singapore's chemical industry continues to evolve, petrochemicals still account for the bulk of the island's production, representing 40.2% of total output. Increased competition and lower prices of basic petrochemicals internationally have prompted all stakeholders to recognize the need to continually add value and differentiate their offering. Given the island's sophisticated infrastructure and interconnectedness, there is little debottlenecking to be done. Instead, what manufacturers will have to focus on moving forward is feedstock security, plant and equipment reliability, and overall flexibility and safety. Ensuring all these factors will help keep Singaporean manufacturers afloat during difficult times. As new investments indicate, no one is giving up on Singapore's Jurong Island as a chemicals hub just yet.

Anna An, Eddie Y.W. Luen & Hongwei Li

AA: Commercial Director Acetyl Chain
EL: Sales Director S.E. Asia, Intermediate Chemistry
HL: Site Director, Singapore Plant
CELANESE

How will Celanese's third vinyl acetate ethylene (VAE) facility in Asia, located in Singapore, complement Celanese's existing operations in the city-state?
AA: From a production standpoint, Singapore has always played a critical role in Celanese's acetyl chain business. Celanese has established Acetic Acid, VAM, Esters and now VAE production capacities on Jurong Island, and is continually looking to further strengthen its presence in Singapore. Within Asia, the city-state serves as a strategic hub from which we can grow in the region, prompting us to add an additional production plant on Jurong Island. In the past, Celanese has supplied the region from our Nanjing plant, but due to long lead time, it is logistically not optimal. Singapore has established free trade agreements with numerous countries, lending an additional advantage and incentive for us to bring production here. We are proud to be the first chemical company to build a VAE emulsions plant in Singapore. The new plant is integrated with our upstream infrastructure, which helped foster quick completion.

How is the evolving labor market composition affecting Singapore's local chemical companies and MNCs? What additional challenges are chemical manufacturers like Celanese in Singapore facing today?
HL: Singapore is associated with a high cost of doing business. Utility prices, for example, such as those for steam and electricity, are relatively higher here than they are in other jurisdictions. However, over the course of the past year, we have seen costs decreasing on the back of low oil prices. To mediate the effects of high costs, Singapore is working towards implementing co-gasification, which can help reduce the costs of electricity. If co-gasification is implemented, coal can be utilized to reduce costs.
Another challenge we face is the tightening of the labor market. A shortage of labor remains a concern across all levels of the organization, often making it challenging for many companies to find sufficient talent to support growth and development. Celanese employs contractors that have reported difficulties in sourcing talent for projects. Also, it takes us a long time, sometimes more than six months, to hire select senior technical expertise. We are hopeful that the local government will strike a balance between industrial requirements and public policy.

New capacity is coming on stream in the United States, China and India. How do you think Singapore will fare in the face of increased competition from growing chemical and petrochemical production hubs? How will Celanese strategy evolve in this context?
EL: Celanese has executed its strategy in accordance with these global megatrends. Our plant in Nanjing, for instance, is now tailored to meet regional demands. Given the low cost of chemical production in the United States, Celanese recently announced capacity increases there. We built our methanol plant in the United States, and at the end of last year we announced the debottlenecking of our acid and VAM facilities in the U.S., to boost capacity there by 300,000 metric tons. We are actively strengthening our low-cost production centers in order to spur global growth.

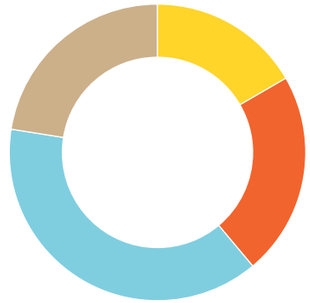
What is your medium term vision for Celanese over the course of the next three to five years?
AA: Our new VAE plant in Singapore demonstrates Celanese's commitment to growth and development in Asia. Over the course of the next three to five years, we believe that green technology and environmentally-friendly EcoVAE products will be part of a greater trend in the market. We are also confident that our business will grow in Asia outside China. Celanese's growth strategy will support our expansion and reach into emerging markets, by bringing highly successful products and solutions to the market.

Do you have a final message for our readers across the international chemical industry?
AA: Singapore is an excellent geographical location from which to serve the region. The city-state has built good infrastructure on Jurong Island, boasts stable policies, and overall serves as an ideal environment for international companies to invest in. Celanese is committed to bringing the company's best available technology to Singapore.

PRINCIPAL STATISTICS OF CHEMICALS MANUFACTURING, 2015

Source: Singapore Standard Industrial Classification (SSIC) 2015

EMPLOYMENT
Number of workers

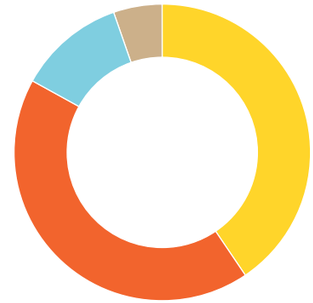


CHEMICALS TOTAL	25,304
Petroleum	4,250
Petrochemicals	5,631
Specialty Chemicals	9,760
Others	5,663

REMUNERATION
S$ million

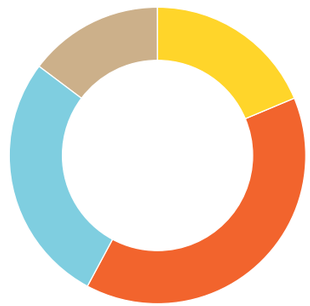
CHEMICALS TOTAL	2,632.2
Petroleum	735.9
Petrochemicals	632.2
Specialty Chemicals	853.3
Others	410.7

TOTAL OUTPUT
S$ million



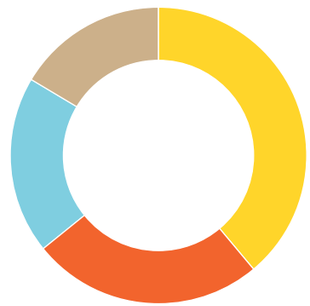
CHEMICALS TOTAL	81,043.5
Petroleum	32,911.1
Petrochemicals	34,409.1
Specialty Chemicals	9,463.2
Others	4,260.0

VALUE ADDED
S$ million



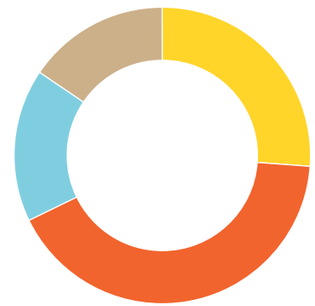
CHEMICALS TOTAL	10,408.4
Petroleum	1,948.5
Petrochemicals	4,077.6
Specialty Chemicals	2,867.3
Others	1,515.0

REMUNERATION PER WORKER
S$ thousand



CHEMICALS TOTAL	104.0
Petroleum	173.2
Petrochemicals	112.3
Specialty Chemicals	87.4
Others	72.5

VALUE ADDED PER WORKER
S$ thousand



CHEMICALS TOTAL	411.3
Petroleum	458.5
Petrochemicals	724.1
Specialty Chemicals	293.8
Others	267.5

Shigeharu Matsuzaka

Managing Director & CEO
MITSUI CHEMICALS ASIA PACIFIC

Mitsui Chemicals Group boasts a strong relationship with Singapore, having over one billion dollars in fixed asset investment in the city-state. What role does the city-state play in the company's global operations today?

Mitsui Chemicals Inc. (MCI) has established several key functions here in Singapore. The city-state plays home to Mitsui Chemicals Asia Pacific (MCAP), which is the regional headquarters for MCI in Asia Pacific, along with five other entities. Three of them are situated in Jurong Island, including Mitsui Elastomers Singapore (MELS), Mitsui Phenols Singapore (MPS) and Prime Evolue Singapore (EVLS). EVLS just recently began operations, utilizing excellent MCI's metallocene catalyst polymerization technologies aimed at expanding our packaging business in Asia. MCI also owns an affiliate company, SDC Technologies Asia Pacific (SDC AP) in Singapore, which provides coating solutions for various products. We are also leveraging Singapore's research strengths with Mitsui Chemicals Singapore R&D Centre (MS R&D), the company's only research and development facility outside of Japan.

Taking into account the move towards production of specialty chemicals, what are the key drivers for growth in which product areas?

Today in Southeast Asia, 70% of MCI's businesses depend on basic petrochemicals such as phenol, BPA or PTA, which are suffering from severe global competition in the region due to the growing supply from China. As a result we are turning to more specialty areas such as specialty polymers and healthcare materials. Specifically, MCI has identified three focus areas: mobility, healthcare, and food and packaging.

While we have several existing businesses within the healthcare area, MCAP is looking to expand its involvement in the food and packaging area as well. We are hoping to tailor our current portfolio to align with the aforementioned business areas. Furthermore, MCAP is dedicated to new product development, spearheaded by our global R&D center in Japan, which is closely linked to the MS R&D here.

Two products are driving our business expansion. The first is a polyolefin elastomer known by its brand name TAFMER. It is used to modify polypropylene and polyethylene primarily for automotive applications. TAFMER is exported from Singapore — where our plant has a production capacity of 200,000 metric tons (mt)— globally to Southeast Asia, Europe and America. Our plant in Japan is equipped with half the production capacity, supplying primarily to the domestic market.

Our second key product is the metallocene LLDPE named EVOLUE. In line with our focus on the food and packaging area, the current local plant is poised for expansion to increase its existing 300,000-mt production capacity. Our regional customer base is becoming progressively more sophisticated, creating opportunities for us to improve the performance of existing packaging solutions.

What challenges are chemical manufacturers in Singapore facing today?

The first challenge we are experiencing is the high cost associated with operating in Singapore. To mediate the effect of rising costs, it is crucial that we collaborate with all stakeholders to make our Singaporean operations more competitive. Secondly, local labor is quite costly in ASEAN countries. Singapore boasts a number of advantages including superior infrastructure and excellent human resources, and we need to leverage these factors and become more strategic in the way we operate.

What is your overall outlook for Singaporean chemicals market in the medium term?

Currently, the industry is moving away from basic petrochemicals towards the production and sale of more specialty chemicals. Market dynamics are evolving due to the increasing competition from Chinese suppliers and their excess capacity, and the reality is that the growth for the basic petrochemicals market in Southeast Asia is reaching maturity. On the other hand, we are seeing excellent growth and profitability in specialty areas such as elastomers. With that, MCI will continue to expand our food and packaging business with our new production plant in Singapore.

In line with these trends, we will stabilize basic petrochemicals production and aim to achieve consistent growth in our specialty polymers businesses. Furthermore, we can expect a jump in demand for metallocene specialty polyethylene in the Asian market, which we can satisfy with the supply from our plant in Singapore. The city-state will remain a prime business center for the world and for Mitsui Chemicals Group well into the future.

Specialties

Asia sets a new benchmark for innovation

It is no secret that specialty chemicals are the way forward for Singapore's chemicals manufacturing cluster. In fact, boosting specialty chemical production has been at the top of the country's forward-looking policymakers' agenda for years. This is because, according to the Singapore Economic Development Board (EDB), Asia's fast growing middle class population will account for 40% of global middle-class consumption by 2030, pushing demand for specialty chemicals up. To satisfy this growing demand, Singapore's specialty chemical manufacturing output has increased by 77% from 2005 to 2014 at a compounded annual growth rate (CAGR) of 5.89% (EDB data). In 2014, the sector accounted for 9.7% of the chemical cluster's total output, grossing S$ 9.2 billion.

"With regards to globalization, the rapid growth in Asia's emerging markets is offering people access to improved living standards which propels demand for high-quality products. This is where we can best meet our customers' demand for easy access to proven solutions and best-in-class technology at competitive conditions," said Peter Meinshausen, president of South East Asia, Australia & New Zealand Region at Evonik.

Furthermore, Singapore's high cost of production and increasing petrochemical competition from powerhouses such as India and China, have compelled its Jurong Island residents to pursue higher value-added manufacturing. But what exactly can the small island nation offer to the world's specialty chemical giants? Through targeted investments, Singapore's government has successfully developed an ecosystem that continues to compel global chemical companies to bring their manufacturing, R&D and business functions to the city-state. In addition to its premier manufacturing and logistics facilities, Singapore has built an innovation infrastructure comprised of top-notch facilities, institutes, and research programs that enable open innovation, collaborative research and product development. Firms like DSM, for example, are "leveraging Singapore's many research institutions and multicultural environment to conceptualize and co-create within the fields of life sciences and material sciences," explained vice president for human nutrition and health Asia Pacific at DSM, Pieter Nuboer.

Facilities such as JTC Corp's 200 hectare One-North development, an R&D hub and icon of Singapore's knowledge economy, stands as a symbol of the country's commitment to innovation.

Located in the heart of the mainland, the complex is home to four of the Agency for Science, Technology and Research (A*STAR)'s institutes, as well as a host of companies and their global research centers. "We discovered that global innovation conducted here in the consumer industry, including products developed for home and personal care segments, have many commonalities that customers seek throughout the world. Often, we think of research and innovation as being done in Europe or the US, but I believe Singapore is on par with other laboratories in the world," said VP and general manager Novecare Asia Pacific at Solvay, Valdirene Licht. Solvay opened its new Innovation Center within Biopolis in February of 2014, and has already patented technologies for the home and personal care, oil and gas and agrochemical segments. Other chemical companies such as DuPont have plans to set up similar research facilities in the city-state.

Singapore has further strengthened its scientific capabilities through public sector research organization A*STAR, and its Institute of Chemical and Engineering Sciences (ICES). ICES provides highly-trained R&D manpower and necessary infrastructure to carry out research in the chemical field. Within ICES, a specialty chemicals program has been founded to focus on developing new formulations, encapsulation and delivery technologies for various end markets. The EDB is also playing an active role and working closely with A*STAR through a joint industry sectorial planning (JISP) initiative, to identify capability gaps in scientific and technology areas that can be filled through investment. Most recently, the state's commitment to R&D was formalized through the sixth science and technology plan—the RIE2020 Plan—that pledged S$19 billion over the course of the next four years towards research, innovation and enterprise, bumping total R&D investment close to 1% of GDP.

> "The key issue is labor. SMEs are not household names that attract new graduates to their doors, making it difficult to find talent. Most of the engineers at Pride-Chem are not local Singaporeans, for example. With regards to workers, labor is a policy-related issue which is difficult to change. Accordingly, SMEs need to adapt and cross-train operators so that they can upgrade their skill sets."
>
> - Andrew Lim, Deputy CEO, Pride-Chem

If innovation resources are not enough, specialty chemical companies are likely to be convinced by the presence of key customers, including prominent fast moving consumer goods companies, to set up shop in Singapore. "While Singapore is a small market, the country has a dense ecosystem of specialty chemical companies' customers. These customers are looking beyond Singapore and innovating for the Asia Pacific market," said director of energy and chemicals at the EDB, Cindy Koh.

Wooed by the presence of customers, a pool of highly-qualified human resources, favorable IP protection laws, proximity to high-growth markets and a robust innovation ecosystem, or all of the above, specialty chemical companies are finding it hard to resist Singapore's flavorful offering.

Huntsman, Evonik, Lanxess and ExxonMobil are among the majors that have made significant investments in Singapore's specialty chemical market of late. "Prior to commencement of production, amines were imported from the United States or Europe, which took about 120 days. Today, when we ship product from Singapore to other parts of Asia, lead times are reduced to approximately 30 days, improving supply and inventory management," said Paul Hulme, until recently president of Huntsman Textile Effects. Huntsman's performance products plant on Jurong Island is currently undergoing an expansion that will double the facility's capacity by mid-2016.

Capitalizing on the growing global market for feed additives and amino acids —a large portion of which is stemming from Asian

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Peter Meinshausen

President of South East Asia, Australia, and New Zealand Region
EVONIK (SEA)

Evonik calls Singapore its "gateway to the Asia-Pacific region". With concerns over manufacturing capacity moving back to North America and Europe, or onshoring, what role will Singapore continue to play within the Evonik's greater strategy?

As part of Evonik's ambitious growth strategy, we are stepping up our presence in the emerging markets, especially in the South East Asia, Australia & New Zealand (SEAANZ) region. We have been investing in HR and assets in this region, including the realization of a landmark project that confirms our long-term commitment to Singapore and the whole of the APAC region. In November 2014, Evonik opened its largest DL-methionine production plant on Jurong Island in Singapore. With an annual capacity of 150,000 metric tons (mt), it is the largest single investment to date for Evonik outside Germany of over €500 million. In addition, in May 2015 Evonik expanded the existing oil additives plant in Singapore to nearly double its capacity, making it the largest oil additives production site within Evonik's network.

Singapore will continue to be an interesting location as a hub serving the ASEAN region, a market with more than 600 million consumers in a comparatively stable economic and political environment. In light of recent success and further opportunities associated with future regional integration, Evonik has also announced the intention to build the second DL-methionine plant in Singapore by 2019. With an additional 150,000 mt/y capacity of amino acid to be produced locally, the plant in Singapore will allow Evonik to meet strong demand for sustainable animal nutrition in Asia and beyond.

Besides health and nutrition and resource efficiency, what other global trends are driving Evonik's investments and activities in Singapore and the greater SEAANZ region?

Evonik organizes its business around three global trends: health and nutrition, resource efficiency and globalization. Within the health and nutrition segment, we work to provide solutions that enable people to stay healthy and retain a youthful look. This encompasses solutions for customers in the animal nutrition arena, the healthcare field as well as partners in the personal care industry. To address the global need for an efficient use of resources, Evonik provides solutions for mobility as well as the efficient utilization of energy. Evonik's engagement in this field includes additives for lubricants, hydrogen peroxide, precipitated and fumed silica for rubber and industrial applications and smart coatings solutions and high performance polymers. With regards to globalization, the rapid growth in Asia's emerging markets is offering people access to improved living standards, which propels demand for high-quality products in the region. This is where we can best meet our customers' demand, by placing our assets close to where they need them.

What is the scope of Evonik's R&D activities in its regional R&D hub in Singapore?

Since the establishment of the SEAANZ region, Evonik has been investing in R&D and applied technical services to provide smart custom tailored solutions to our customers, with a focus on local needs. At present Evonik has six R&D and applied technical service centers in Singapore, including the TEGO Innovation Center for coating additives, a Beauty & Care Innovation Center, and analytical and quality assurance laboratories.

Innovation and R&D are value drivers that enable a country to exploit new economic opportunities. This is important for a country's well-being and future sustainability. It also provides a competitive advantage. Innovation and R&D are increasingly being tailor-made in Asia for Asian customers. The Singapore government is well aware of this trend and earlier this year has announced an investment of S$19 billion to foster R&D in Singapore over the next five years. This clearly demonstrates the commitment to build a local best-in-class innovation landscape. The Institute of Chemical and Engineering Sciences (A*STAR) for example, is one of the national research institutes we have been closely working with to develop new products and solutions. Singapore's ability to leverage its various research institutes for cross-disciplinary research allows it to position itself as a conducive location for R&D.

Do you think that Singapore is going to continue to differentiate itself as a chemical hub in the long term?

I am confident that Singapore's positive development as a regional chemical hub will be continued. The country has strategically invested in R&D, technology, innovation and education. Singapore has taken a path forward to a sustainably balanced approach by anchoring innovation and R&D in a manufacturing environment. I view this as a precondition for the long-term success as a chemical hub in the region.

Nick Challoner

President
CRODA ASIA PACIFIC

What role do Asia and Singapore play in Croda's global operations?
Given the current global economic outlook, everyone is turning their attention towards emerging markets. Asia is an extremely diverse and dynamic region with an unrivalled fusion of cultures, technological capabilities, social classes, religions and trends. Having been in Asia for decades, at Croda we are well aware that we cannot adopt a one-size-fits-all model here to be successful, and are tailoring our activities according to each individual market. Today Asia Pacific represents more than 20% of the group's turnover.

Croda focuses on four areas: personal care, life sciences, performance technologies and industrial chemicals. As various companies are looking to diversify into areas such as healthcare and automotive, what are key the markets and drivers for Croda?
The good news is that there are opportunities in all of these areas. One of the keys to Croda's success is the company's focus on high-margin specialties, as well as the ability to work across a number of different sectors. This allows Croda to balance negative market conditions such as those currently seen in the oil and gas industry with those that are more positive, at any given time. Essentially Croda is by no means dependent on one business. For example, beauty and personal care is a market driven by considerable segmentation and fueled by a growing number of customers and consumers. This is particularly the case in emerging markets, where social standards and disposable incomes are increasing. Today Asia is the largest market for beauty care in the world, and is characterized by the fastest growth rate relative to all other geographies. The gap between the top and the bottom of the value chain in Asian countries is much broader than it is in developed economies, providing us with a number of opportunities. The market is becoming increasingly segmented in terms of customer base, and large players are not the only businesses experiencing success. In fact, there is a great number of 'regional dynamos' or fast growing local businesses that are rapid in their response and ability to accommodate niche market demands. Reaching even further down the customer pyramid there are hundreds, if not thousands, of smaller organizations poised to be the growth engines of tomorrow. The further down Croda reaches, the more successful we are.

The same trends are affecting our performance technologies and industrial chemicals businesses. As Asia's highly industrialized economies such as India, China, Korea and Japan continue to develop and specialize in different ways, they are responding to innovation and accommodating higher value niche ingredients within their formulations. This is where Croda steps in by overlaying specialty performance on top of base ingredients to add value to products and formulations.

To what extent does the firm conduct R&D in Singapore and the region?
Croda's model is quite decentralized, and our plants, people and technologies are accordingly situated close to our customers. The Asian consumers are extremely savvy and discerning, demanding performance and solutions that are fit for their needs. The market is evolving and, whilst historically most businesses have approached Asia by deploying developed western technologies, it is becoming apparent that innovation cannot be parachuted into the region and be expected to be effectively integrated into new technological solutions. Innovation in Asia has to be driven for Asia. As the fastest growing market in the world, it deserves its own attention. In light of this, our approach in the market has always been to engage in close customer collaboration and contact. Instead of one single R&D center, Croda has established research and development activities throughout the world including in Singapore, India, Japan and China.

Where do you envision Croda in the next three to five years?
Croda's strategic aims are centered around building on top and bottom line growth. We will continue to accelerate our innovation levels. We are looking to support the utilization of our innovative ingredients into as many new customer formulations as possible. Additionally, Croda is committed to investing in sustainability. This is more than just a commitment to sustainable raw material sourcing, it also includes our approach to energy management, waste treatment, safety, health and environment, new product introductions, supply chain, sourcing, relationships with employees and the community, and innovation. We will also continue to invest in proximity to and collaboration with our customers to further develop key relationships. —

> "As Asia's highly industrialized economies such as India, China, Korea and Japan continue to develop and specialize in different ways, they are responding to innovation and accommodating higher value niche ingredients within their formulations."

Pieter Nuboer

Vice President for Human Nutrition and Health, Asia Pacific
DSM

To begin, please introduce us to DSM's presence in Singapore, including any key historical milestones that have shaped its presence in the city-state.
DSM has been in Singapore for well over 30 years. Initially two independent footprints marked our presence here: material sciences and life sciences. In 2010 we brought these two businesses together as part of our One DSM agenda, which promotes collaboration among the firm's various business groups. In 2013, DSM Dyneema —one of our business groups within the material sciences cluster— opened its Asia Pacific Technical Center in Tuas. Two years later we inaugurated our landmark Mapletree Business Center office where we house five business groups. Of these groups, both DSM Engineering Plastics and the DSM Sinochem Pharmaceuticals joint venture (DSP) have their global leadership teams based here. Our regional leadership team for the Nutrition business also sits in Singapore, a location now often referred to within DSM as "our home in Asia." Today DSM employs approximately 270 people in Singapore, where we have further consolidated our brand after a number of mergers and acquisitions.

Last year DSM unveiled its Asia Pacific Nutrition Innovation Center here in Singapore. What significance does this new center bear for DSM?
The emerging middle class in Asia presents a need for customization, variety and new products. At the same time, customers are looking for ways to reduce time and cost to market. DSM's new Asia Pacific Nutrition Innovation Center was built for the purpose of conducting late stage R&D, in line with DSM's nutrition business strategy to provide global products and local solutions. The center's purpose is to understand applications that are local more often than not. Our Human Nutrition & Health business in Asia is evolving into a co-creation company as we work with customers to clearly understand their consumers as well as their brands and from there translate insights into concepts.

What trends, demands and societal challenges are driving DSM's innovation and business in Singapore?
On the nutrition side, for example, we are committed to addressing the needs of the base of the pyramid. DSM works with governmental and non-governmental institutions to come up with solutions for staple food fortification, such as rice fortification. DSM is working with local social enterprise BOP Hub to develop fortified rice for migrant workers. Additionally, we collaborate strongly on a global level with the United Nations and other organizations to bring about other positive health outcomes. These actions are especially important in light of global population growth, urbanization, ageing societies and the rising cost of healthcare. DSM is committed to improving the quality of life through nutrition. We are acting upon the need to turn the needle towards prevention in addition to curing.

How does the company promote sustainability through innovation?
DSM's purpose is captured as 'Bright science. Brighter living.' We are recognized for our commitment to sustainability, as it is at the core of our business. In fact, we frame our work in terms of three global developments that we cater to: global demographic shifts and digitization; health and wellness; and climate and energy. DSM's innovation agenda is profoundly linked to these three themes.

What Singapore-specific targets would you like to realize within the next three to five years?
In Singapore, DSM seeks to be a talent magnet. People want to work for entities that are both successful and contribute to a better world. Today we are a relatively well kept consumer secret and are actively trying to build the DSM brand. We are proudly entering a strategic collaboration with Singapore Management University (SMU), where DSM recently established a fellowship to advance knowledge, foster best practices and help shape policies through the Master of Tri-Sector Collaboration (MTSC) program. This is a good example of how we are building our brand and purpose in the local market.
The industry's impact over the last 50 to 100 years has grown dramatically. The power we yield as an industry to innovate and address challenges associated with global shifts is tremendous. But it is important to recognize that such power also comes with responsibility on the part of the industry as we cannot do this alone, we need to connect to others to solve the big issues of the world. —

> "The industry's impact over the last 50 to 100 years has grown dramatically. The power we yield as an industry to innovate and address challenges associated with global shifts is tremendous. But it is important to recognize that such power also comes with responsibility."

Paul Hulme

President of Huntsman Textile Effects*
HUNTSMAN SINGAPORE

*From August 2016, Paul is succeeded by Rohit Aggarwal as President of Huntsman Textile Effects.

How has Huntsman evolved in the Singaporean market?
Huntsman first established itself in Singapore in 1995 with its polyurethane division. We have since grown into a corporation with five global divisions, four of which have a presence in Singapore: Advanced Materials, Polyurethanes, Performance Products and Textile Effects. Today Huntsman employs approximately 250 people in Singapore, which is also home to the global headquarters for our Textile Effects division.
In 2005, Huntsman set up a manufacturing facility for the firm's Performance Products division on Jurong Island, which is currently undergoing an expansion that will double the facility's capacity by mid-2016. Prior to commencement of production, amines were imported from the United States or Europe, which took about 120 days. Today when we ship product from Singapore to other parts of Asia, lead times are reduced to approximately 30 days, improving supply and inventory management. The city-state plays a key role in Huntsman's regional and global operations.

What prompted Huntsman to establish its global headquarters for textile effects in Singapore?
The textile industry is today very global. Over the last few years however, it has undergone a migration from Western Europe and the United States to Asia, primarily due to the availability of cheaper labor. At the time Huntsman acquired its textile effects business it was clear that Asia was the strong engine for growth. Hence it was critical for us to establish ourselves in the region for the purpose of competition, customers and global brands that are all located here.

Asia's fast growing middle class population will account for approximately 40% of global middle class consumption by 2030. What are some specific key trends that are driving Huntsman's textile business in the region?
Today, retail plays a critical role in the textile market, as leading brands drive sourcing and dictate developing trends. Consequently, Huntsman has a strong marketing team that works closely with leading brands and retailers to identify market trends. From an industry perspective, turnarounds are now much shorter than they were in the past and leading brands are deciding from where to source products. Huntsman manages a global business, due to the fact that we need to track movement and support brands across the world.
Compliance with regulations and standards also drives market trends. While it may take years to build a brand, a name can easily be tarnished very quickly. It is thus very important for brands to control their supply chain and comply with legislations. Brands, retailers and mills need to collaborate in order to establish standards for approved materials and substances, and Huntsman has acted as a catalyst between brands and mills to help define standards.

Can you elaborate on a few of Huntsman's innovations that embody sustainability?
Huntsman's AVITERA, which took approximately four years to develop, is a revolutionary poly-reactive dye and the first new reactive dye that has been brought to the industry within the last 20 years. The textile industry is the second largest industry in terms of water consumption, which is a huge issue. Through innovation and new technology, Huntsman's AVITERA SE range significantly reduces water and electricity consumption, as well as carbon dioxide emissions, during the dyeing process.
Huntsman is also engaged in an R&D program in Singapore dedicated to water management. We are collaborating with Nanyang Environment & Water Research Institute (NEWRI) to develop water treatment innovations with the goal of facilitating easier and cheaper treatment of effluent discharge. The world is undergoing a water crisis and Singapore is investing significantly to address this critical issue. People are beginning to acknowledge such issues and realize that practices need to change to become more sustainable. At Huntsman, we recognize the importance of contributing to the industry through innovation.

Do you have a final message for our international readership?
Huntsman is a global solution provider, and we see ourselves as leading innovators in the industry. We place great emphasis on business ethics. Today's industry requires people to view their business model in terms of economic and environmental sustainability, and our customers –the mills, brands and retailers are not looking for suppliers or vendors, but rather for a partner who they can work with to meet industry standards. Through collaboration with both industry governments and NGO's, Huntsman is at the forefront of sustainable innovation.

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markets— Evonik invested in 150,000 metric tons (mt) of DL methionine production capacity in 2014. Less than one year later, in May of 2015, the firm unveiled its expanded oil additives plant, nearly doubling capacity and producing 40% of Evonik's global product portfolio. The chemical company also announced plans to double capacity of its new methionine plant by 2019.
Another German chemical manufacturer, Lanxess, recently made one of its largest investments worldwide in Singapore. The firm opened its second plant in the country in August 2015, a $318-million neodymium butadiene rubber plant with an annual production capacity of 140,000 mt. Lanxess' new production facility strengthens Singapore's growing position as a hub for synthetic rubber production in the region. Other chemical heavyweights such as Sumitomo Chemical and Asahi Kasei have also put dollars towards synthetic rubber production in Singapore, further complementing the city-state's position as the world's largest rubber trading hub.
ExxonMobil, a pillar of Singapore's growth as a nation and member of the club for over 120 years, also continues to make large investments in the country. The integrated giant is currently in the process of adding increased specialty production to its complex, including hydrocarbon resins and halobutyl rubber plants that are scheduled to go on line next year. Of these facilities, ExxonMobil's new halobutyl rubber plant will be the largest of its kind in the world. "Demand for commodity products is growing at a slower rate than GDP growth, while growth in demand for select specialty chemical and lubricant products is occurring at a faster rate than GDP growth. Hence, over time we want to upgrade our molecules and add capacity to be able to convert commodity fuels into products such as lubricants, chemicals and specialty chemicals," explained ExxonMobil Singapore's chairman and managing director, Gan Seow Kee.
Firms such as DSM and Croda Singapore are also heading portions of their Asia Pacific operations from Singapore, keen to capitalize on the country's attractive innovation resources. They are working to be as close to their customers as possible in order to better cater to the evolving Asian consumer. As the fastest growing region in the world, new demands are stemming

from the region, calling for the creation of differentiated products and tailored applications. According to the EDB, growth of Asian economies has resulted in an increased market demand for energy, refined products, chemicals and consumer goods. This exponential growth is driving trends in the personal care, packaging, automotive and infrastructure sub-market segments.

"The market is evolving and, whilst historically most businesses have approached Asia by deploying developed western technologies, it is becoming increasingly apparent that innovation cannot be parachuted into the region and be expected to be effectively utilized and integrated into new technological solutions. Innovation in Asia has to be driven for Asia because, as the fastest growing market in the world, it deserves its own attention," emphasized Croda's president of Asia Pacific, Nick Challoner. Croda recently opened its expanded alkoxylation facility in December of 2015 on Jurong Island, more than doubling the firm's capacity from 12,000 mt to 30,000 mt and marking the beginning of a series of investments the company has planned for Singapore.

Asia's growing significance as a dynamic and differentiated market implies that Singapore will not only continue to serve as a regional hub for manufacturing, but increasingly as a global center for R&D and innovation. Today all eyes are on Asia and the evolving Asian consumer, particularly as the rest of the world economy experiences sluggish growth. In the context of the day, Singaporeans are working tirelessly to leverage their unique offering in the region and seize such opportunities in the specialty chemical space. And, as the nation's petrochemical competitive advantage erodes in the face of increasing capacities in lower cost production centers such as China, the Middle East and the United States, Singapore must push this agenda forward to prevent its manufacturing base from shrinking any further. The little red dot will have to continue to increase its R&D spending, provide attractive financial incentives and enhance its top-notch infrastructure to increase its specialty chemical manufacturing output, and hopefully keep shining brightly.

> "Afton's latest investment is our additive manufacturing facility, with plans for an expansion that will see the facility manufacture key components used in Afton Chemical Corporation's engine oil additives. This allows for the facility to be scalable and in line with the market's growing demands."
>
> - Sean Spencer, VP and Managing Director, Afton Asia Pacific

Valdirene Licht

Vice-President & General Manager
Novecare Asia Pacific
SOLVAY

> "As part of Solvay's global strategy, the new large-scale alkoxylation plant in Singapore is aimed at expanding the growth of its specialty surfactants in the region. The S$50 million 'on-pipe' investment will help meet that demand, complementing existing India and China facilities."

What key milestones have shaped your presence in Singapore?

Solvay established itself here more than 30 years ago. The new Solvay brings together two previous companies, legacy Solvay and legacy Rhodia, which Solvay acquired in 2011. With initial staff strength of five, our Singapore workforce is more than 200 today. Solvay has continued to increase its representation in Singapore and has six key regional business units: Novecare, Acetow, Aroma Performance, Specialty Polymers, Special Chem, Soda Ash & Derivatives. At Solvay, we develop high value-added, innovative, sustainable and competitive solutions, tailored to meet the demand of its customers for markets such as agrochemicals, aroma performance, coatings, home and personal care, industrial applications, oil and gas, specialty polymers and others.

As part of our expansion in the region, Solvay Novecare inaugurated a new plant on Jurong Island in May 2015, situated within a conveniently interconnected network of customers and raw material suppliers. We recognized Singapore as a safe place to invest, and a good hub from which to develop business in Southeast Asia, Australia and New Zealand. Hence, Solvay decided to place its Novecare plant here to capture the growth of Vietnam, Indonesia, Thailand and other neighboring emerging markets. The country is also favorable due to its IP protection laws, safety, efficiency and strong government support, which factored heavily into our decision.

Our first flagship Research and Innovation Centre, located in Biopolis, was inaugurated in February 2014 where it will lead global projects in the fields of home and personal care, coatings and oil and gas, including having a dedicated team to work on enhanced oil recovery (EOR) solutions. In addition, the lab will be a regional hub in the development of sustainable solutions for the agrochemical business. In the same year, an Aroma food lab was also established to serve as a food application lab to assist customers in optimizing the use of vanilla flavorings in their current products as well as those still under development. Since 2014 our Novecare laboratory has evolved rapidly, and undergone expansion just one year after establishment.

Could you tell us more about the new alkoxylation facility?

As part of Solvay's global strategy, the new large-scale alkoxylation plant in Singapore is aimed at expanding the growth of its specialty surfactants in the region. The S$50 million "on-pipe" investment will help meet that demand, complementing existing India and China facilities and joining Solvay Novecare's eight other alkoxylation plants in Europe and North America. Located in the world-class integrated petrochemical hub of Jurong Island, the plant receives a key raw material, ethylene oxide via a dedicated pipeline, and fatty oleochemicals from nearby countries, providing a safe and sustainable source of supply for the near and long term.

The unit produces specialty alkoxylate surfactants which deliver targeted cleansing, dispersing, defoaming and emulsifying performance attributes in formulations for the agrochemicals, coatings, home and personal care, industrial and oil and gas markets in Asia, especially for those in key South East Asia countries such as Indonesia, Thailand and Malaysia.

The key principles that drive our business today are reinforcing our presence in fast growing countries and proposing innovative solutions to our customers in our key strategic market segments in the region. The addition of this new asset in Singapore continues the execution of this strategy.

In the R&D space, what specific innovations were discovered in Asia, and now have global applicability?

Solvay currently has different technologies being patented in the fields of home and personal care, oil and gas, and agrochemicals. One example is a solution that has been developed to coat fertilizers and prevent the loss of urea. When fertilizers enter the soil, some urea gets lost resulting in a reduction of productivity and an increase of CO2 equivalent emissions. While this discovery was initially targeted towards the United States and Brazil, it is now being sold in Asia as it boosts productivity and has positive impacts on the environment.

We discovered that global innovation conducted here in the consumer industry, including products developed for home and personal care segments, have many commonalities that customers seek throughout the world. Solvay pioneered research in the home care segment, and made discoveries that could be applicable to other industry markets. Often, we think of research and innovation as being done in Europe or the US, but I believe Singapore is getting at par with other laboratories in the world. Singapore boasts good IP protection, which can lead to the decision to set up a plant to produce your technologies.

Liew Kok Oon

Marketing & Sales Director Southeast Asia
AKZONOBEL SURFACE CHEMISTRY

Can you provide our readers with a brief overview of AkzoNobel's history and facilities in Singapore?
AkzoNobel has three business areas –Decorative Paints, Performance Coatings and Specialty Chemicals, under which we have the Surface Chemistry business unit. The company's chemical operations in Singapore began in November 1974 as a branch office of Akzo Chemie Overseas. In 1999, Surface Chemistry invested €20 million to build our first chemical plant on Jurong Island, which became fully operational in 2003. Today, the multi-purpose facility on Jurong Island is home to an annual production of 18,000 metric tons (mt) of surfactants and products used in softeners, agro, road-paving and cleaning, among various applications. A technical lab was also established in Singapore. It offers efficient and valuable technical support to the customers in South East China, as a satellite facility to our Asia Technical Centre in SongJiang, Shanghai.

What role does Singapore play in AkzoNobel's greater global strategy?
Singapore has served as AkzoNobel's regional hub for chemical operations for a number of years. The island nation is a gateway to many markets including Malaysia, Indonesia, Thailand, Taiwan and Australia. Singapore has also played a key role in talent management and leadership development, as we train employees that are later relocated to different parts of AkzoNobel worldwide. We also work on innovation projects here and provide hands-on technical service to our customers.

What are some key trends driving AkzoNobel's business?
AkzoNobel's Surface Chemistry products have many functionalities that are inspired by emerging trends and evolving demands in the region. For example, the need for increased meat production in Asia has led us to develop pelletizing aids for increasing feed production yield. In the area of construction, AkzoNobel manufactures surfactants that are used in road paving. One particular innovation used in warm-mix asphalt improves working conditions, paving performance and environmental impact. By reducing fuel consumption at the hot-mix plant, our warm-mix reduces the carbon footprint of asphalt paving, and the lower paving temperatures virtually eliminate emissions and odors.
In our Surfactants platform, examples of successful recent innovations include improved agricultural adjuvants that enhance the effectiveness of crop protection, delivering customer value by reducing the amounts required and offering improved eco-profiles.

What is the role of innovation in AkzoNobel's strategy?
Going forward, innovation and sustainability will continue to drive AkzoNobel's business. We leverage chemical breakthroughs to develop products that will add value to industries and enhance sustainability. Throughout the supply chain, we engage in a largely green process from obtaining raw materials, to production, and all the way through to delivery.
The new Shanghai Technology Center in SongJiang is equipped with a full array of state-of-the-art material analysis and performance testing facilities that play a vital role in supporting product development and providing technical support to Asia markets and customers. With the further extension of our synthesis capability to ethoxylation and polymerization, we are able to support product innovation and the development of next generation formulations for chemical industrials, which is highly embedded with sustainability.

How are you creating more synergies within the region?
In China, the Boxing acquisition provides strategic presence and ensures the possibility of continuous investment in Asia. Our investment made in Ningbo, China, is the extension of our technology platform to ethoxylation and further serves different industries. Its commissioning this May and commercialization in October demonstrates AkzoNobel's strong commitment to the local market.

Do you have a final message for our readers about the chemical industry in Singapore?
Singapore is a great place to operate, given that it is very well connected in the region. The country is home to people from a variety of different cultures, speaking a number of languages. The common use of the English language here makes it easy for diverse nationalities to live and work together. Importantly for AkzoNobel, Singapore is also rich with talented people. Today, AkzoNobel has a presence in over 80 countries giving us the rich diversity of ideas that we need to continue to be innovative in the future.

Francois Bleger

Regional President
South East Asia & Pacific
CLARIANT SINGAPORE

What has been Clariant's evolution in the Singaporean market?
Clariant has been operating in Singapore for about 20 years, and Singapore is regional headquarters for South East Asia and Pacific (SEA&P). This region represents Clariant organizations in eight countries: Australia, Indonesia, Malaysia, New Zealand, The Philippines, Singapore, Thailand and Vietnam. We have 15 production sites, as well as several application development centers across the region with approximately 1,400 employees.
Clariant's production site in Singapore is specialized in manufacturing various masterbatches and providing solutions to the plastic industry. Clariant has one of the most versatile plants in Asia, and we boast sophisticated competencies in terms of processing plastics. We also manufacture medical specialties and engineering plastics. In Singapore, we also have a Colorworks center that provides design services and support to our customers.

Could you tell us about your Consumer Care Competence center in Singapore?
One of our most important business activities is consumer care, which contributes about 25% to our global sales, and it is a business that is growing significantly in this region. To respond to this trend, Clariant established its Consumer Care Competence Center in June 2015, as a way to provide innovative solutions to our customers. Additionally, today there is a need to conduct local R&D in South East Asia and the Pacific region, as the Asian consumer has distinct demands from those in other countries of the world.

How has the Clariant International Graduate Program (CIGP) been received by the industry?
The aim of CIGP is to attract top talent from various educational institutions to the chemicals industry. We employ a stringent selection process after which candidates will work on rotation within Clariant for two years. Candidates will experience different roles in countries around the world. CIGP is active in Germany, China, Indonesia and Singapore.

What are your goals for the medium term?
Singapore is very important for Clariant in terms of the company's headquarters and application development functions. We aim to strengthen both of these functions, as well as our local manufacturing capabilities. Given Southeast Asia's abundance of natural resources and growing consumer base, Clariant is also looking for further opportunities. There is an excellent synergy between industry drivers and Clariant's product portfolio, fuelling our ambitious growth plan for the future.

Thomas Holenia

President
HENKEL SINGAPORE

Please provide a brief overview of Henkel's evolution in Singapore.
Henkel was established in Singapore in 1983, and today has around 110 employees in the country. We are a leading solution provider in the adhesive technologies industry. Our second business unit specializes in fast-moving consumer goods for the beauty care industry, with a focus on hair coloring, hair care and hair styling solutions for consumers. Additionally, we have established a global supply chain hub in Singapore, which started operations in November 2015. This has been a key milestone for Henkel, which follows the successful set-up of the company's global supply chain headquarters in Amsterdam.

Can you identify trends that are driving business in the region?
The growth of the middle class is a key driver in Asia-Pacific, which accounted for 17% of Henkel's sales in 2015. End consumers are increasingly sophisticated and want more innovative yet sustainable solutions. For example, an urban lifestyle and the quest for greater convenience have led to accelerating growth of the food and flexible packaging industry. With regards to adhesive technologies, we provide innovative and sustainable adhesive solutions that contribute to a faster manufacturing process in the automotive industry, and make vehicles lighter, both of which ultimately contribute to improved vehicle efficiency and decreased energy consumption. In beauty care, consumers are increasingly demanding sophisticated and customized products. For example, our SYOSS product range is designed specifically for the Asian hair type.

Can you elaborate on Henkel's third business unit that has a presence in Asia Pacific?
Our third business unit, Laundry & Home Care, is the cornerstone of Henkel's success story, as the company's first product was a laundry detergent. In addition to its successful presence in Korea, we are one of the largest players in the laundry detergents category in Australia and New Zealand, which again underlines the importance of Asia-Pacific to our company.

Do you have a final message for our international readership?
Singapore makes it extremely easy for businesses to operate smoothly and is also a hub for expertise and qualified talent. Henkel is emphasizing diversity and inclusion as a key element of our corporate culture and we aim to be an employer of choice in Singapore.

Future-enabled Chemical Processes through Innovation

Keith Carpenter,
Executive Director,
Institute of Chemical and Engineering Sciences (ICES)

I vividly remember giving a talk to our company process development leaders in the late 80s or early 90s, on how we should improve our approach to process development and move towards the "development lab of the future".

The participants were a mixture of chemical engineers, synthetic organic chemists and physical organic chemists from our Agrochemicals, Pharmaceuticals and Specialty Chemicals businesses. I was asked, if I could make one major single change to our labs, what would it be. My reply, not totally in jest, was to get rid of all of the round bottomed flasks, or better still donate them to our competitors. So that they could remain in the dark ages, and we could move on to "properly designed" equipment which, coupled with good experimental design, would make our process development much more effective.

The point was that our ability to produce the knowledge we needed to create the most effective processes and the best equipment design was compromised by the lab equipment when complex organic chemistry was involved. Our processes went from large tonnage continuous plants with relatively simple chemistry, through to high-value, low-tonnage, multi-stage complex chemistry in batch; and occasionally hybrid batch-continuous mode, so our engineers generally were able to cover the full spectrum. However it was quite different for our development chemists back then. In the higher-value low-tonnage businesses, especially Pharmaceuticals, we generally lacked the physical chemistry expertise and the in-situ analytical and data-handling techniques that are commonplace today. Instead, process technology was very much driven by chemistry know-how and experience.

The issues we faced then and the approaches we took are relatively commonplace in the most innovative companies today. The reference texts Atherton (1), Cox (2), Sharratt (3), Paul (4) and others, with the *DynoChem* package and associated thinking from Scale-up Systems, capture a lot of the relevant techniques. The approach to process development championed by Britest (6) brought a structured systematic approach to process development. Today, the use of continuous flow process stages in a traditional batch environment may be seen as advanced, but not totally unusual. Pfizer and GSK (8) have both implemented this technology in Singapore. A visit to the most advanced labs will also be quite a different experience now. The current norm includes flow-processing alongside well characterised model reactors with in-situ and at-line sensors generating analytical data continuously, in real time. The integration of enzyme catalyzed reactions and fermentation processes would not be unusual, either.

As I look out of my window in Jurong Island, where I am surrounded by some of the most modern and efficient chemical plants in the world; and to Tuas where the pharmaceutical companies also have some of the most advanced manufacturing technology, it is clear that another major change in process R&D is underway. This new wave is driven by the vision of the future of manufacturing, the plant of the future and with it, the development lab of the future. Key drivers for change are more sophisticated consumers who demand more personalized products, growing demand especially due to the rising affluence in China, the increasing importance of sustainability, and connectivity driven by The Industrial Internet of Things.

According to 2015 statistics, manufacturing directly contributed 20% of Singapore's GDP (7). Of this, chemicals and pharmaceuticals together contributed 30% (7). It is therefore of national importance that we not only retain competitiveness, but seize the opportunity to grow.

Two things are different this time around; the pace of change and the disruption of "traditional" business models.

The pace of change is undeniable, even in industries as well-established as chemicals and pharmaceuticals. Companies continue to re-invent themselves, to reshape their strategy and refocus. The Dow-DuPont merger and the complete re-shaping of the business portfolios; the take-over of Syngenta by ChemChina; the Evonik purchase of the performance materials unit of Air Products are recent examples, and there are many more. Changes in the external environment also have had a major impact. The most obvious example being the massive changes in oil price, and the availability of gas changing the outlook for many chemicals producers; all within the last couple of years.

Common themes are feedstock security, a drive to create higher value, and access to growing markets. The drive to create higher value can be seen in many companies, and a simple look at Singapore manufacturing shows why (7). In 2015 the ratio of Value Added to Output ranged from 6% in Petroleum, to 12% in Petrochemicals, 30% in Specialties, and up to almost 60% in Pharmaceuticals. Although only a crude measure, it is clear that greater output consumes greater resources, and for a resource limited country like Singapore, creating greater value for the country for every unit of resource consumed is a major priority and an opportunity.

The disruption of traditional business models is happening across many industry sectors, driven by connectivity, social media, greater responsiveness and consumer demand. For instance, the concept of personalized medicine has been around for some time and is approaching reality in some cases. It is not difficult to imagine a similar situation where a consumer could use a simple app or portable device to characterize their hair or skin, then go onto the internet, and order a shampoo or a face cream, specifically formulated for them. Chemical and pharmaceutical companies are trying to understand what this new world will mean. Clearly, health and safety issues will prevent complete decentralization of active ingredient manufacturing. Although it is likely that smaller, locally contained, highly-automated and data-enabled manufacture will become more widespread. Formulation can be distributed more readily, even to the point of use in some cases, as exemplified for many years by the paint industry. In complex formulated products, this will require much more in-depth understanding of the relationship between the product application properties, its structure and how the structure can be controlled during processing, so that the product can automatically be made- to-order.

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The disruption of traditional business models is happening across many industry sectors. It is not difficult to imagine a situation where a consumer could use a simple app or portable device to characterize their hair or skin, then go onto the internet, and order a shampoo or a face cream, specifically formulated for them.
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For the active ingredient and additive manufacturers, this requires a much closer working relationship with the "brand" owners and their customers. An interesting example of this is the campaign run by Croda, to educate consumers on the importance of UV protection, to support its *Solaveil* technology.

For decades, sustainability has been a major driver for the industry and at the forefront of people's minds. Establishing a sustainable industry which is economically viable, provides good returns but does not do irreparable harm to our environment is a challenge that we all face. In many ways, this is not a new issue, but it is becoming more urgent and as technology develops, more options become viable. The major advances in biological sciences for example, mean that bio-based processes and bio-based renewable feedstock are becoming viable. Bio-based polymers are now more commonplace than ever before; like *Durabio*, the biopolycarbonate resin from Mitsubishi Chemicals that is based on plant-derived isosorbide. Many R&D groups around the world have developed processes where lignocellulosic agricultural waste can be turned into a wide range of products. As crude oil price rises again these technologies will provide more sustainable options for future manufacturing. However, we have yet to find a solution to capture and use greenhouse gases, principally CO2 in an efficient and cost effective way.

R&D will continue to be critical for innovation-driven economies, and productivity-driven growth. At the Agency for Science, Technology and Research (A*STAR), we are integrating across the ecosystem to drive initiatives and investments into strategic areas that can build on Singapore's strengths to create competitive advantage. We work with industry along the value chain in consortia, bringing together manufacturers with their suppliers and technology companies. An example is our Innovative Processing for Specialties and Pharmaceutical Processes (iPSP), to develop manufacturing technologies in high value chemical based processes; or our Corenet consortium developing encapsulation technology with consumer product companies. There are many examples of joint developments with industry to produce more efficient, lower cost and more sustainable processes through a combination of bio-processing, catalysis, chemistry and engineering.

Looking ahead, following the theory of natural selection, the species that thrive are those that can adapt and evolve, and so it is with our manufacturing industry. By embracing these new developments, we are presented with the opportunity to grow. There are many interesting challenges ahead, but also a world of new opportunities. —

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Global Business Reports

JURONG ISLAND

Map of the Energy & Chemicals Ecosystem in Singapore

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LOGISTICS

"The logistics world continues to evolve with increasingly globalized chemical flows. Most customers perceive the summation of their various plants as one production unit, and feed the market from different plants. There is an added complexity in the entire supply chain, which creates more opportunities for us to add value to logistics solutions."

- Koen Cardon,
CEO,
Katoen Natie Singapore

Image courtesy of Suttons Group

Logistics

Movers and shakers: Singapore's logistics firms gear up for expansion

Looking down from the 57th floor of Singapore's famous Marina Bay Sands Hotel, the island's dark waters are speckled with the glimmering lights of hundreds of ships. According to the Maritime and Port Authority of Singapore (MPA), at any given point there are about 1,000 vessels floating in Singapore's port. Approximately 30 million containers and 500 million tons of cargo are handled every year by Singapore's terminals. The city-state has long been known for its strategic positioning in the middle of the Malacca Straits, connecting Asia with the West and hence it is only natural that Singapore has become known as a global logistics hub. "Singapore is well positioned as a key logistics hub, and will play a seminal role in moving material across Asia Pacific," said country manager at Dow Chemical Pacific (Singapore), Suiniaty Basirun.

Logistics and infrastructure are key functions when it comes to the chemical industry, and hence represent a critical component of Singapore's Jurong Island Version 2.0 (JIv2.0) initiative. As raw materials and finished products are shuffled across the world through complex supply chains, these shipments often contain hazardous goods, begging compliance to strict regulations. Chemical logistics is not for the faint hearted, especially in today's volatile market. Faced by economic pressures, manufacturers and chemical heavyweights are streamlining operations, cutting costs and placing greater emphasis on diversification and R&D to remain competitive. More and more producers are choosing to focus on their core capabilities and leave the rest to the experts. "Chemical companies' core knowledge is production, marketing and R&D. Logistics is not part of this core and hence there are a great deal of inefficiencies in the way logistics is done in Asia. Our customers are becoming aware of that fact," said managing director of Bertschi Singapore, Lieven Vander Elstraeten.

While chemical logistics have long been outsourced in Europe and the United States due to discrepancies in costs, this has not been the case in Asia where salaries are largely consistent across the two industries. Nevertheless, Asian firms have started to follow suit, especially in Singapore where manpower is scarce. Facing a number of recruitment difficulties due to a labor shortage, producers are eager to outsource labor-intensive functions, such as logistics. This trend has opened a fresh gap for logistics firms to fill. In response to a burgeoning demand for chemical logistics services, international and local third-party logistics providers (3PLs) alike are stepping up. Singaporean firm Yang Kee Logistics, for example, has recently embarked on an expansion of its chemical logistics capabilities. "We have been offering transportation services to our customers on Jurong Island for over a decade. Along the course of the company's evolution, we gauged a demand for more value-added services. This prompted us to expand our offering to include warehousing, freight management and project logistics, which subsequently led to the development of our chemical warehouse in 2014 that today stands as a chemical logistics hub," said chief executive officer of Yang Kee Logistics, Jos Raaymakers.

Other logistics firms that have also been in the space for decades are beefing up their suite of technology offerings to stay ahead. Family owned BDP International, celebrating its 50th anniversary later this year, attributes success to its high technology offering. "Our flagship BDP Smart is a highly configurable strategic tool that allows shippers to visualize their logistics process and provides reports according to users' requirements. The BDP Smart Chemical dashboard is tailored specifically to the practices of the international chemical industry, with extra focus on sensitive shipments of hazardous cargo for instant visibility. Interactive maps provide users with a global view of the top 10

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> Unfortunately synergies from aligned ships and storage are not as significant as one might imagine. We offer incentives to customers to store and ship with Stolt-Nielsen, but oftentimes that does not make sense for a customer given the nature of terminal pipeline connectivity. Jurong Island, which boasts excellent pipeline connectivity between pipelines and terminals, is an exception.
>
> - Frederik Guttormsen, General Manager Asia Pacific, Stolt Tankers

Tan Soo Koong

Managing Director
VOPAK TERMINALS SINGAPORE PTE LTD

Could you summarize Vopak's history and current operations in Singapore?
As a company Vopak boasts a history of over 400 years. In 1983, with support from the Singapore government and our joint venture partner, the Port of Singapore Authority (PSA), we established our first independent oil storage terminal to serve local oil trading businesses. Known as Sebarok, the terminal had a capacity of 500,000 cubic meters, but over the years its capacity increased to 1.26 million cubic meters. Vopak's business model has also evolved from pure storage and transhipment to include bulk handling, blending and bunkering.
In line with the local government's vision to become a regional chemical hub, Vopak established its first industrial terminal, Sakra, in 1994, serving the storage needs and pipeline connectivity for a number of chemical manufacturing plants in the vicinity. Today Sakra has a capacity of 288,000 cubic meters dedicated purely to chemical and baseoil storage. The second distribution terminal (commissioned in 1974), Penjuru, previously known as the GATX terminal, was added to our portfolio in 2001. This is our only terminal located in mainland Singapore. It has built up its capability in trucking and breaking bulk, focusing primarily on distribution to serve the wide myriad of traders and distributors in Singapore. The various spate of expansions under Vopak's leadership since 2001 saw the capacity growing from 150,000 cubic meters to 283,850 cubic meters today.
In 2006, we established our Banyan terminal, a unique combination of oil, chemical and gases storage. It utilizes an integrated business model spanning bulk breaking, industrial and distribution. Banyan has grown significantly and today has a storage capacity of more than 1.45 million cubic meters. In 2010, Vopak added butadiene storage capacity to the Banyan terminal, making it the first independent storage facility for butadiene in the region. In 2014, ammonia storage was also added as to serve our customers on Jurong Island. Most recently, the Banyan terminal also grew to house the first independent LPG storage facility in the region, greatly enhancing the competitiveness of the chemical industries in Singapore.
In 2014, JTC tendered the operatorship of the Jurong Rock Caverns, Singapore's first underground petroleum and petrochemical storage facility. Vopak won the tender and operates the facility under Banyan Caverns Storage Services Pte Ltd (BCSS), a consortium where we own 45%.

What does the LPG terminal signify for Vopak's presence in Singapore and the region?
The LPG facility began with an 80,000 cubic meter tank specially designed for full containment, and with state of the art safety and environmental considerations. It is a closed off system and has zero emissions during operation. The tank's temperature and pressure are maintained by a set of BOG compressors with 100% redundancy. The tank is operated at -42 degrees Celsius and can receive LPG from a VLGC (Very Large Gas Carrier). Vopak also utilizes a pipeline system, through which an LPG pipeline grid connects to the crackers on Jurong Island. While ship or tank trucks can transport gas, pipeline transportation is the safest and most cost efficient way of transporting gas, helping customers optimize their supply chains. Future capacity increases were incorporated in the initial design of the facility in preparation for expansions.

Given the current economic downturn, how is Vopak Terminals Singapore working to optimize performance?
The low price of crude oil is attracting manufacturers in Asia, of which the true beneficiaries are Asian refiners. In terms of oil, Vopak is continuing to do well, as the Chinese market continues to grow at 6 to 7%. Their refineries are ramping up, and the powerhouse is still exporting a significant amount of products into the region. Vopak's oil facility in Singapore continues to be used for trading, break bulking and bunkering. Singapore is the biggest bunkering center in the world, hitting a bunkering record in March 2016; I do not expect bunkering activities to slow down; in fact the country will also be exploring the possibility of LNG bunkering.

What is Vopak's medium term outlook for the chemical sector in Singapore?
Looking at 2016 and beyond, forecasted future developments such as population growth, a growing middle class, increasing imbalances between production and consumption areas, will result in the need for more flows between these areas, hence needing more terminal infrastructure at strategic locations. Vopak is proud to be part of an integral role in shaping Singapore to become a major oil and chemical trading hub in Asia and the largest bunkering centre in the world, moving about 20 million mt of oil and 3 million mt of chemical related products through these four terminals in Singapore.

Koen Cardon

CEO
KATOEN NATIE SINGAPORE

Please provide an overview of Katoen Natie's presence in the region.
Despite the economic downturn, we have seen growth of 20% to 30% in the region in recent years. With oil and gas prices low, downstream businesses and petrochemical companies are still successful in this market due to cheap feedstock. There is a slowdown of investment in new capacity, but market demand continues to grow.
Four years ago, the industry focus was on capacity expansion and building new plants, but currently the greatest demand is for special services to increase plant profitability. The logistics world continues to evolve with increasingly globalized chemical flows. Most customers perceive the summation of their various plants as one production unit, and feed the market from different plants. There is an added complexity in the entire supply chain, which creates more opportunities for Katoen Natie to add value to logistics solutions.

What services does Katoen Natie offer to clients on Jurong Island?
Our logistical services can be divided into three main components: conventional logistics, added value services, and supply chain management. Conventional logistics entails warehousing, loading into containers, and transport. Added value services comprise services such as the repacking of products, optical sorting, sieving of products, and upgrading through blending and mixing. The supply chain management component revolves around data management and feasibility. Katoen Natie has significant ICD infrastructures and data management investments, whereby a product can be followed from the production facility to the end destination while implementing smarter solutions. Within our organization, data drives productivity increases and quality service.

What are some of Katoen Natie's goals in the region for the next three to five years?
Katoen Natie has a large operation in Thailand that continues to grow, and promising new operations in Vietnam. We expect our Singapore operations to continue growing in terms of value added services. Our key focus is the top ten producers of petrochemicals and specialty chemicals, and we are prepared to grow with our customers.
Also, farm to fork in Asia is drastically low and 60% is lost in the supply chain. To improve farm to fork statistics, one needs packaging, cold storage, clean water, better transport etc., all of which is driven by chemicals. Our customers are seeing substantial demand for increased volumes of chemicals. A demand for more chemicals means an increased demand for our services.

Richard Strollo

Managing Director, South Asia
BDP INTERNATIONAL

How has the firm's business evolved in recent times?
With the advent of shale gas, we expected to see less dependency among our customers on investments in Asia, and increased direct investment in the U.S. Today, given the current oil price, many shale operators have gone by the wayside, and it is unclear how long the others can continue operating. While there have been a number of changes in trade flows, they have not been to the degree we anticipated. Trends such as near shoring are progressively taking hold. More importantly, as we sit here today there seems to be an economic malaise hanging over the global industry and its supply chains.

How are these shifting dynamics affecting BDP International's customers and the company overall?
We have seen a decline in business activity, particularly among companies that are utilizing heavy equipment for deep-sea extraction. Fortunately, BDP International has a large number of downstream customers globally, insulating us to a certain extent. Within the Asia Pacific region, BDP International has continued to experience tremendous growth well into the double digits last year, particularly in Indonesia and Malaysia. Overall, our customers in the chemical industry enjoy gains from lower oil prices, especially if they have planned effectively for the long term, and are quick to adapt in the face of short to mid-term volatility.

What are BDP International's main technological developments?
Our flagship BDP Smart is a highly configurable strategic tool that allows shippers to visualize their logistics process and provides performance measurement reports according to users' requirements via a single-source web portal. Furthermore, customers in the Chemical and Life Sciences verticals enjoy fields that are unique to the industry. The BDP Smart Chemical dashboard is tailored specifically to the practices of the international chemical industry, with extra focus on sensitive shipments of hazardous cargo for instant visibility. Interactive maps provide users with a global view of the top 10 trade lanes along with any alerts that may require immediate attention. Also, within our suite of technology offerings is BDP Smart Tower, which improves visibility and optimizes utilization of our customers' tanks, a key asset in the chemical industry.

Where do you envision BDP International in the next three to five years?
Continued growth is crucial for us, together with expansion into new markets such as Myanmar, Cambodia, and the Philippines. Of the locations where we are already present, we will look to further expand our business in Indonesia and Australia.

trade lanes along with any alerts that may require immediate attention," said BDP International's South Asia managing director Richard Strollo.

In a technology-driven arena, it will be crucial for logistics companies to continue innovating in order to differentiate themselves and garner trust within the industry. Trust is especially important in the chemicals space and requires time, experience and expertise to build. Leading international intermodal chemical transporter Bertschi has managed to do this over the course of the last 60 years in Europe. Recently, however, Bertschi decided to bring its Swiss swagger to Singapore, investing $45 million in the new Bertschi Jurong Island Chemical Cluster (JICC), a chemical logistics service hub. The family-owned European company quickly wooed Singaporean clients with its new terminal, achieving astounding commercial success within just five months of operation. Bertschi offers its customers a one-stop lean supply chain solution, providing storage for dangerous goods, ISOtanks, a semi-automated warehouse and sizeable drumming and ISOtank heating capacities.

Another European player, Vopak, unveiled the region's first independent LPG import and storage facility on Jurong Island in early 2016. Further strengthening the island's logistical offering, the new facility grants the island's crackers greater flexibility to use LPG instead of solely naphtha. The 400 year-old logistics firm has constructed a complete infrastructure to optimize supply. "Vopak also utilizes a pipeline system, through which an LPG pipeline grid connects to the crackers on Jurong Island. While ship or tank trucks can transport gas, pipeline transportation is the safest and most cost efficient way of transporting gas, helping customers optimize their supply chains. Future capacity increases were incorporated in the initial design of the facility in preparation for expansions," explained managing director of Vopak Terminals Singapore, Tan Soo Koong.

Alongside its private enterprises, Singapore has gotten its logistical juices flowing with its new JTC Chemicals Hub at Tuas South, and the Jurong Rock Caverns underground storage facility. Off of Jurong Island, the former is the country's first multi-tenanted and high-rise specialized development designed for chemical companies. The construction is a plug-and-play facility geared towards companies that conduct small batch manufacturing, blending and distribution activities, including chemicals classified as Dangerous Goods (DG). The facility's value proposition is that it helps companies save on capital and operating costs. International ECPM contractor AECOM is currently in the process of fitting out potential investors' facilities within the hub. The latter, Jurong Rock Caverns, is Asia's first commercial underground storage facility for crude and condensates. The first phase of the caverns has been completed, with the hopes of saving space above ground for higher value-added activities.

Together, Singapore and its logistics companies are working to optimize chemical manufacturers' operations and bring about cost savings, with the goal to build leaner supply chains. All ears are perked for evolving customer demands: "The logistics world continues to evolve with increasingly globalized chemical flows. Most customers perceive the summation of their various plants as one production unit, and feed the market from different plants. There is an added complexity in the entire supply chain, which creates more opportunities to add value to logistics solutions," said CEO of Katoen Natie, Koen Cardon.

Companies are just beginning to scratch the surface in Singapore, excited by the prospect of Jurong's heavyweights outsourcing a greater portion of their businesses. While logistics players' critical function is at times overlooked, these movers and shakers form the backbone of all chemical operations. And as Singapore continues to search for new ways to remain competitive, optimizing supply chains will further enhance the country's industrial landscape, making it attractive to all stakeholders. "An efficient and well-managed logistics setup is key to ensuring the safe and smooth movement of goods and services across the industry and to our customers. For us, the success of Singapore and Jurong Island is not just in its strategic positioning but also in its accessibility and connectivity," said chairman & managing director of ExxonMobil Asia Pacific, Gan Seow Kee. —

> "Our total chemical storage footprint is close to 200,000 square feet, with a storage capacity of approximately 50 million liters, about 20% of which is for hazardous chemicals. We also offer ISO tank trucking and storage, and are looking to integrate drumming and blending in the future. We are currently expanding our warehouse to enlarge the company's total footprint by 10%."
>
> 
>
> - Jos Raaymakers, CEO, Yang Kee Logistics

Lieven Vander Elstraeten

Managing Director International Business Projects – Asia
BERTSCHI SINGAPORE

Bertschi is celebrating its 60th anniversary. How has the company changed over its history?
Bertschi is a family-owned company headquartered in Switzerland, founded in 1956 and run today by president and CEO Hans-Jorg Bertschi. Bertschi has always focused on chemical logistics. While we initially used trucks, the company later became the leading intermodal chemical logistics player in Europe. Bertschi has 2,300 employees and generates an annual turnover of $700 million. While at present, 95% of our operations are in Europe, we have been looking outwards for expansion since 2012. Currently we have offices in Houston, Shanghai, Singapore and Dubai.

How important is your $45-million facility on Jurong Island for the company?
Singapore is a very important hub within Southeast Asia, with PSA having several calls a day to all destinations in the region. Because of this, it makes sense to have distribution in Singapore, which Bertschi is able to operate with our own assets and a suite of in-house logistics services. Our investment is largely targeted towards the Singaporean industry, with the goal of supplying our services to the local Jurong Island specialty chemicals community. Further to this, Singapore is a densely populated country, and Bertschi is able to offer storage of dangerous goods on Jurong Island away from residential areas in a state-of-the-art facility. We did not want to end up with infrastructure that is not usable in the next ten or fifteen years and instead invested for the long term. Bertschi positions itself as a multinational chemical logistics company serving multinational customers on Jurong Island at the highest safety and quality standards. So far, we have been successful in Singapore and are already preparing a second phase expansion of our facility.

What services is Bertschi offering its customers on Jurong Island?
We offer our customers a one-stop lean supply chain solution. Bertschi's infrastructure allows for the storage of dangerous goods ISOtanks. Moreover, the facility boasts a state-of-the-art semi-automated warehouse for the storage of dangerous goods class 3, 4, 6, 8 and 9, including corrosive, flammables and toxic materials. We also offer a sizeable drumming and ISOtank heating capacity, filling chemicals off from ISOtanks into drums for redistribution to the region. Bertschi has a fleet of dangerous goods trucks to support our range of services and offers industrial processing activities such as blending, flaking and pelletization.
The facility is fully equipped with firewalls in the container yard as well as remote controlled foam guns in case of fires. We also invested in the construction of sizeable underground chemical retention basins that will collect chemicals in the case of a chemical leak to prevent vapor release and pool fires. Bertschi's facility in Singapore today stands as a model of how local regulators would like to implement building standards in the future.

Chemical logistics begs another level of safety and processes, and trust. How willing are your clients in Asia to outsource their functions?
In Europe and the U.S. outsourcing of chemical logistics is not even a point of discussion, but rather something companies choose to do because of cost reasons. In Asia, this cost discrepancy exists only to a lesser extent, especially here in Singapore where the cost of labor is high. While there is not a large difference in cost, Bertschi sees the opportunity to help companies run their operations more efficiently. Chemical companies' core knowledge is production, marketing and R&D. Logistics is not part of this core. We often conduct free consultancy to help customers find a leaner supply chain solution. For example, we can invest on our customers behalf in offsite or onsite logistics, packaging and processing infrastructure and in return customers are charged on a variable basis, turning *capex* into *opex*. In Singapore, particularly, all stakeholders are facing a shortage of labor, and this is another incentive for manufacturers to outsource labor-intensive non-core functions, such as logistics.

Where would you like to see Bertschi in Singapore in the next three to five years?
As a company, Bertschi has drafted a master plan for 2020. Firstly, in the next four years we would like to be a leading ISOtank operator in the region. Today we stand within the top five in the world, continuing to add thousands of ISOtanks each year to our fleet. We would also like to construct a similar terminal to the one we just unveiled in Singapore in China as well as in a second Southeast Asian location. With regards to Singapore, by the year 2020 we would like to be a recognized chemical logistics company, working with Jurong Island's producers both in an offsite and onsite capacity.

Chye Poh Chua

CEO
SHIPSFOCUS INTELLIGENCE*

* Previously known as EP Consulting

Can you please walk us through the creation of ShipsFocus Intelligence?
As a shipbroker we gauged a need to differentiate and pinpoint market needs in a space that is crowded with new players, but has enormous collective potential. The marketplace is becoming increasingly transparent, but an overload of information can often be stressful. In response to this, we founded the research and analysis department (R&A) at Eastport Maritime in 2000. Building on the insights derived within the R&A, EP Consulting was founded in 2010. While R&A produced market intelligence, reports, and a database solely for internal customers, EP Consulting (now ShipsFocus Intelligence) monetizes our expertise and relies on proprietary databases to turn information into insights, and insights into value creation for customers.
In 2013 we brought in research tools and methodologies from the financial industry to run models and came up with unique products unavailable previously. This spring we were proud to spinoff EP Consulting from Eastport. Today we are no longer limited to a single source of data and in-house brokers, and instead collaborate with market participants to generate wider and more comprehensive data.

Can you please provide more detail about ShipsFocus Intelligence services?
We provide both regular and specifically developed market freight, TC rate, ships price periodicals, ranging from daily to annually 5-year outlook to brokers, shipowners and investors. We are the only firm providing consistent chemical shipping-specific benchmarks that are posted on Bloomberg. A flagship product is our Asian Chemical Shipping Daily Strategy Report. We also provide strategic advisory to major chemical companies on chartering strategy and methodology. Bunkers have become an important cost factor for shipping companies, and while the price has come down substantially, we have managed to maintain highly accurate forecasts with a narrow standard deviation.
ShipsFocus Intelligence is one of three core pillars in the ShipsFocus group which offers strategic advisory and intermediary consultancy in the shipping value chain. Our aim is to be a go-to shipping data powerhouse in the chemical segment.

What is the current nature of competition in the chemical shipping industry?
Generally, it is an over-capacity situation in this segment. From a supply perspective, traditional owner-operators are contending with pool manager-operators that have emerged strongly after the last financial crisis. A few of these pool manager-operators are transforming into substantial owner-operators with what they think as cheap assets. This is probably creating irreversible changes that will impact the traditional shipping industry greatly over time. The growth in Chinese shipbuilding, ship-owning and operating companies are also giving their counter-parts from Japan, Korea and elsewhere a run for their money. From the cargo perspective Asia was a net of importer of chemicals for several decades, however the region evolved into a net exporter of chemicals. While Europe is relatively more advanced in terms of usage, Asia's growth rate is more rapid. Shorter regional routes have grown to replace some of the inter-continental trade volumes over the last 30 years. Consequently, many major trading houses, shipping companies, shipbroking houses and other related services moved eastward especially in the 1990s and 2000s.

Are challenges faced by the chemical shipping industry in the region universal?
Both universal challenges and those unique to the region are prevalent. Firstly, if shipping is already the most regulated industry, chemical shipping manages to be even more restricted due to the dangerous nature of the product being transported. Additionally, given the low cost of data processing today, receivers want to reduce their inventory as much as possible and are requiring ships to arrive within very narrow time frame, putting pressure on shippers globally. Both these challenges are universal. In terms of local challenges, Asia is a growth market, crowded with many small new companies. It can be challenging to deal with these players compared to their more mature counterparts in North America and Europe.

What would you like the newly established ShipsFocus to achieve within the next three to five years?
ShipsFocus specializes on chemical shipping. We are committed to solving industry problems with innovative solutions, namely benchmarking in a changing landscape, and leveraging technological advances to improve processing and promote productivity gains. Given the precarious nature of chemicals, shipping and its freight metrics are incredibly dynamic. We are developing a platform model for aggregated shipping which will result in reduced congestion; improved supply chain visibility; business and operational efficiency; increased access and better engagement with customers, and lower carbon footprint.
Shipping is a traditional industry occupied by many family and privately owned companies. We need to leverage that savoir faire with technology and KPIs to reduce inefficiencies. As an international maritime center, Singapore has developed the science of chemical shipping; now the time has come for us to practice it as artisans.

Chemical (Specialized) Tanker Shipping

Then, now and future

Sudheer Vijapurapu,
Managing Director,
New Asia Shipbrokers

Overview

The total world seaborne specialized tanker trade as of today stands at close to 270 Million tons (Mt). This includes the shipments of various organic and inorganic chemicals, biofuels, vegetable oil and base oils shipped on a worldwide basis. The first 15 years of the current millennium have been the most significant period this sector has ever witnessed with over 150 Mt of trade added. While many factors contributed to the unparalleled expansion of this trade, China was undoubtedly the biggest driver of growth.

The specialized tanker industry is one of the most complex shipping sectors due to its very opaque nature. There are no defined ship sizes, parcel sizes and routes, and it has many players in the form of ship-owners, commodity traders, producers and receivers. In addition to this, there are a plethora of products that can be carried by the vessels. Currently about 4000 tankers of various sizes ranging from 1,000 to 55,000 MTS DWT are trading worldwide.

Economies of scale apply to most of the world's shipping trade, but not to specialized tanker shipping, where the most economical size for a specialized tanker is the million dollar question. It is not unusual to see a 3,000 MTS DWT ship along the same route as a 13,000 or a 19,000 MTS DWT ship. The most unique aspect about this industry is that it is the most predictable sector compared to the other shipping segments. With the exception of vegetable oil shipments, about 60-70% of the volumes are shipped on long term contracts of affreightment (COAs) keeping in mind the stable demand and the high product price for the various specialized products. Therefore, despite the fact that there were 10 to 15 Mt of additional petrochemical (aromatics) production capacity over the past four to five years, mostly within the Asian region, there has been hardly any effect on the specialized tanker owners' earnings, as most of these new volumes ended up on COAs instead of spot shipping.

The most profound requirement which brought a major imbalance in the industry were the IMO regulations for carriage of vegetable oils effective 1st of January 2007, which required IMO type ships to be used for carrying vegetable oil previously carried on any oil tanker. The chemical fleet, which grew at a steady pace of 5 to 6% until 2006, suddenly grew by 20%, and then stayed within the range of 10 to 15% for the next few years. Overall, the specialized tanker fleet has increased by 300%, going from 1,000 ships in 2000 to over 4,000 in 2016.

We could not say that the industry is immune to overcapacity, considering the situation we saw after the 2008 financial crisis wherein most of the owners fell into hot soup due to over ordering. The specialized tanker fleet had an increase of 50% during this time period. The freight earnings of these owners came down drastically.

Recent developments

Since the 2008 financial crisis and after the settling down of hype created by the IMO regulations, demand dropped as expected and delivery of new vessels decreased year by year until 2015, when the delivery of new vessels reached the highest levels since 2011, with y-o-y growth of 6% in the number of ships and 11% in overall deadweight capacity. The majority of ships delivered during 2015 were MR's, with sizes ranging from 45,000 to 55,000 MTS DWT. The MR owners were justified by the strong results they had in Asia in 2014, with stable CPP markets across all routes within the region and even stable returns on the palm oil market. It was however difficult to comprehend the fact that there was an increase in ships ranging 12,000 to 38,000 MTS DWT, from 1,387 to about 1,466, in the light of depressed specialized tanker markets, with low returns experienced by most of the owners in the previous years, and with no change expected in the near future due to the very nature of the industry, wherein the boom and bust cycles are a rarity compared to the other sectors.

However, the industry has become increasingly more organized -or rather optimized- especially after the massive supply of ships of different sizes between the years 2008 and 2015. There can now be an optimum size for every trade lane. For instance, 30,000 to 45,000 MTS DWT ships are the optimum for voyages spanning more than 20 days. At the same time, 13,000 to 17,000 MTS DWT are most optimal for voyages spanning over a period of 5-7 days.

Whilst the new building order activity remained at an all-time low, it was interesting to observe that during the period 2014-2015 there was an increase in the second hand sale and purchase activities, especially for ships between 6 and 15 years old, and sizes from 13,000 to even 45,000 MTS DWT. The majority of the buyers included Indians, Indonesians, Vietnamese and Chinese, who have been using their newly acquired assets to perform domestic shipments as well as shipments out of Iran. It would be remiss not to mention some of the major palm oil charterers who were also actively buying up ships in order to cater their own shipping requirements.

Otherwise, 2015 was probably the best year the industry has experienced post 2008, largely due to reduced bunker costs which prevailed throughout the year, and stable freights. However, 2016 has been a different ball game altogether for the industry, with volatile commodity prices coupled with very low vegetable oil movements within Asia. As a result, the general freight rates have certainly dropped across the board, to levels not seen for a very long time.

The future

Generally speaking, the industry's future does look stable. We do not have to really worry about over capacity in the near future as is currently the case in the other shipping sectors such as dry cargo, containers, offshore or even the petroleum tanker side. However, there will still be close to 165 IMO 2 type ships hitting the water over the next two and a half years in various sizes ranging from 1,000 to 50,000 MTS DWT. This represents an addition of about 5% to the overall existing tonnage by 2018. Compared to the past 10 years, the frequency of new building deliveries is probably the lowest with 82 vessels expected to be delivered in 2016; 57 in 2017 and the balance in 2018.

> "The specialized tanker industry has become more organized -or rather optimized- especially after the massive supply of ships of different sizes between the years 2008 and 2015. There can now be an optimum size for every trade lane. 30,000 to 45,000 MTS DWT ships are the optimum for voyages spanning more than 20 days, while 13,000 to 17,000 MTS DWT are most optimal for voyages spanning over a period of 5-7 days."

It is interesting to observe that about 60% of these 'newbies' have stainless steel tanks. It makes one wonder as to why there are so many stainless steel ships coming out when there is actually very little need for any extra tonnage, given the dismal situation of the world specialized tanker trade, and also that there are not any extra acid production capacities.

The reasons why owners went for stainless steel ships include: (i) Relatively weak yen (67% of the ships are coming out of Japanese yards); (ii) Flexible cleaning – stainless steel tanks are a lot easier to clean, compared to the coated tanks; (iii) Versatility – despite the fact that there are less acid movements to support stainless tonnage, these ships certainly serve as an option for the many products with high heating and acidity content, the shipment of which are mostly done on long-term COAs.

The prospect of specialised tanker shipping does appear to be going in the direction of 'the bigger, the better" and having an easier approach to cargo carrying on stainless steel tanks. The smaller tonnages, though getting old, still play a key role in regional trades. With over 4,000 vessels out and about in the water there should be nothing to worry about for the various traders and charterers, and with the right broker negotiating the acceptable freight, any owner will be willing to have a contract.

Fleet Growth in Numbers (1980 - e2016)

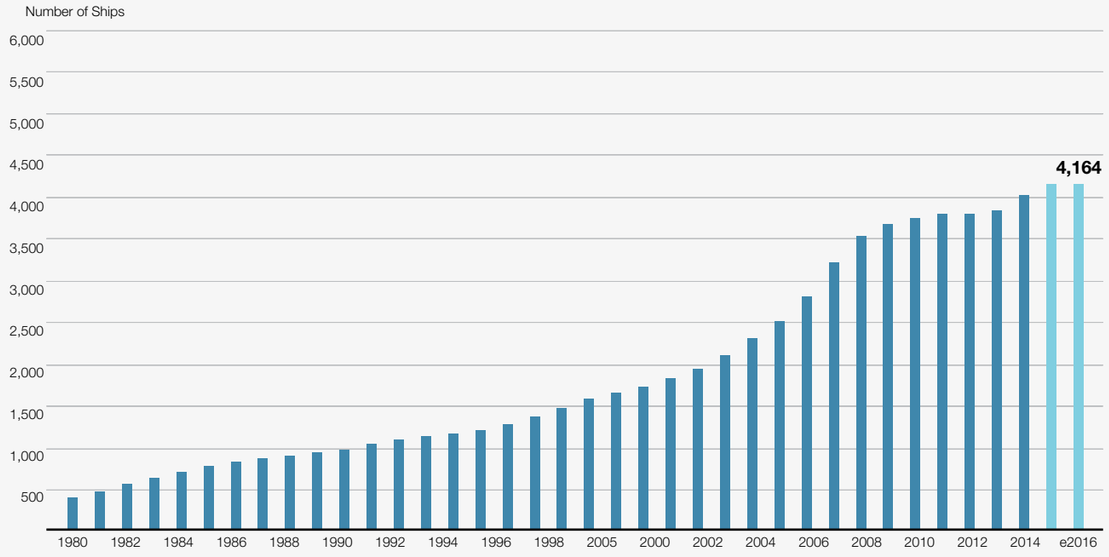

Image courtesy of Yang Kee Logistics

TRADE

"Trade has always been an important part of our existence as a nation. In a country of 5.5 million people, our total merchandise trade is valued at approximately S$900 billion, often on par with some major OECD countries. Singapore has attracted some of the world's largest companies to establish their marketing, trading, risk management, financing, and supply chain management activities in the country."

- Satvinder Singh,
Assistant CEO,
International Enterprise

Tricks of the Trade

—

Riding the intraregional wave

Singapore's unrivalled infrastructure in the region has propelled the island nation's chemical trading activities to new heights. According to the local government agency responsible for bolstering the country's international trade, International Enterprise (IE) Singapore, there are over 400 companies trading petroleum and petroleum products operating out of the country today. A mixture of sophisticated local financing, storage facilities and excellent shipping infrastructure has tempted many traders to set up shop here and distribute petrochemicals to their customers across the globe. Even during a time of high market volatility and economic uncertainty, local buyers and sellers are continuing to reap rewards amidst new trade winds. Growing regional supply bases in China and India are prompting a rise in intraregional trade, and challenging Singapore's players to time their moves well.

> Slower growth and an increase in competition due to global, regional, and Chinese manufacturing, create a challenge for every company with an aggressive growth plan in mind. The competition has speeded up product lifecycles, particularly in Southeast Asia, where some of the specialty products are now considered semi-specialty. This means that simply distributing is no longer enough to stay ahead.
>
> - Kevin W. Hack, Regional Director, Connell Brothers Company

The global commodity downturn, driven primarily by a slump in Chinese demand, has served as a major headwind for the industry. Slower consumption and investment in China have translated into sluggish demand for petrochemicals, which serve as inputs for an array of industries. This, coupled with China's own increased petrochemical production, has squeezed margins and flooded the market with supply. The Asian superpower's post financial crisis stimulus led to staggering capacity increases that are pushing the country past self-sufficiency. "The biggest trend affecting our business over the last two years has been China's evolution from buyer to supplier. While China has always served as the world's factory for consumer goods, the superpower has always been exclusively a buyer of commodities. Today however, tables have turned and products we never imagined China would supply are being exported, leading to an increasing number of small parcel shipments and logistical advantages. China is playing a different game that is affecting many manufacturers in Southeast Asia that depend on the powerhouse as a market," said director at Kempar Energy, Nikunj Parekh.

Thus, margins have been squeezed, and cheaper inputs have not offset the effects of increased supply of, and a slump in demand for, finished products. In this environment, slowing investment into industrial capacity in Singapore has been exacerbated by the fact that the island does not offer the same opportunities for scale and vertical integration as do larger markets such as China or India.

"The challenge facing Singapore's chemical industry is that new developments cannot be built on a scale compared to in China, India and America. The government is keen to continue trading commodities on Singapore's exchange, and wants companies to manage inventories locally. However companies will have to work in accordance with demand and investment", said managing director of InterChem, Gary C.Y. Yeap.

Industry sentiment, however, is far from pessimistic. While leaders acknowledge the importance of China as an industrial powerhouse in the region, there are signs that the industry is adapting rather quickly to a new phase in the business cycle characterized by more moderate levels of growth. "With regards to China I believe we are going to see a new normal. I do not expect to return to double-digit growth rates but there to be more moderate growth rates in the area of five to seven percent", explained managing director of Helm Asia, Andreas Woscheck.

Major players in the space are reacting to an increasingly competitive landscape by leveraging their strengths to distinguish themselves from the pack. Trader Integra, for example, has gone above and beyond the company's role as a trader by adding logistics to their service offering. Executive director Gina Fyffe said: "Integra has always been attentive to our customers, for example, by increasing the size of our fleet of ships and staffing to provide us with more flexibility to serve our customers in the region. Integra has integrated logistics into our service offering to consolidate a complex supply chain and reduce risk."

Other companies are strengthening their foothold in more nascent markets to access higher rates of growth. Leading global distributor for Shell MDS, EPChem International, is keen on geographical diversification. "China and Indonesia have been our traditional markets and we are looking to expand in Vietnam and Myanmar. Although these markets are not as big, they have the potential to become important in the chemical market," said the firm's chief executive officer, Seah Cheong Leng.

In the face of competition, companies are looking to identify niche markets for themselves, but moving forward, some degree of consolidation is inevitable. Global distributor Brenntag recently finalized the acquisition of ExxonMobil's largest distributor TAT Petroleum, and remains confident in pursuing more acquisitions to drive growth. "There is a demand for good distributers to serve customers and suppliers, lending huge opportunity. Furthermore, we believe that consolidation will continue in the distribution space, and Brenntag will acquire more companies in the region to support our growth strategy", said president and chief executive officer Asia Pacific at Brenntag, Henri Nejade.

While multinational corporations (MNCs) are equipped with capital and scale to expand, diversify and acquire, SMEs remain highly dependent on what is now a shrinking manufacturing base

▸ 65

Gerry C. Y. Yeap

Managing Director
INTERCHEM

Please introduce our readers to InterChem's historical presence in Singapore.
InterChem was established as a local European chemical trading company in 1986. In order to expand its presence in the global market, the firm opened an office in the United States in 1994 and another office in Asia three years later. Today, InterChem is a global business offering trading solutions to chemical companies across Europe, Asia, and the U.S. Any chemical business faces inefficiencies, ranging from a wrongful understanding of supply and demand, financing, logistics, and risk management. InterChem provides trading solutions to chemical companies and balances said inefficiencies on a global scale, often done by means of strategic alliances.

Why did InterChem establish its headquarters in Singapore?
The Asian market grew exponentially in the 2000s, prompting us to establish headquarters in the region. At the time we expected Asia to become one of our largest markets, and today the volume of products traded in Asia comprises half of InterChem's total trade volume. Along with growing demand in Asia, the region is continuing to increase its production capacities. Rather than being import dependent, Asian firms have evolved to establish their own manufacturing facilities, and we are seeing an increased demand for services and traders in the vast and diverse region. Today, our customer base is inclusive of all major chemical companies in the region including the likes of BP, Shell, CPC, LyondellBasell, Westlake Chemical, Sinopec, Petronas and ExxonMobil.

Does InterChem provide additional services such as storage, blending or processing in Asia?
InterChem offers additional services such as blending, when required. We are a small company competing against major oil trading and financial houses and thus focus on niche markets where our services are required, a strategy that has allowed us to be able to compete internationally. InterChem does not own any assets but rather has long-term commitments on tanks and storage facilities. We also assist with pre-financing and offer a guaranteed supply of raw materials and product off-take. The extra services we offer are largely dependent on market and customer demands.

How has the current price of oil and general state of the market affected your business and trade flows?
Due to high volatility, the market is evolving and will continue to change and consolidate over the next two to three years. Previously the market was focused on fossil fuels, however at present there is a wider variety of alternative feed stocks available, coupled with significant advancements in technology. Manufacturers will produce chemicals more efficiently and sustainably on a larger scale, and plants built 20 years ago will not be able to compete with new products, compelling them to adapt to new market trends. The world is comprised of a large population, and countries such as China are continuing to grow, lending a significant number of opportunities and gaps to fill in the market. Nevertheless, companies need to start looking at value instead of price.
The challenge facing Singapore's chemical industry is that new developments cannot be built on a scale compared to China, India, and America. The government is keen to continue trading commodities on Singapore's exchange, and wants companies to manage inventories locally. However companies will have to work in accordance with demand and investment. Having said this, the trade of energy will continue to increase, as consumer demand drives industrial growth.

What are InterChem's goals for the next three to five years?
While InterChem's focus has traditionally been on trading energy and petrochemical products, we have also begun a polymers department to further grow our business. Our aim for the next five years is to continue to grow our capital and expand the company by considering different product groups and services that we can provide in the market.

Do you have a final message to our readers about Singapore's trading environment?
InterChem is not a Singapore-focused company, but rather a global company. The local chemical industry's growth will depend on the way in which the government develops Jurong Island, the country's financial and trading infrastructure, storage and logistics facilities and shipping capabilities. There are many plans drafted for Singapore to successfully move forward, and InterChem will surely participate in its growth. —

> Previously the market was focused on fossil fuels, however at present there is a wider variety of alternative feed stocks and technologies available. Manufacturers will produce chemicals more efficiently and sustainably on a larger scale, and plants built 20 years ago will not be able to compete with new products, compelling them to adapt to new market trends.

Seah Cheong Leng

CEO
EPCHEM INTERNATIONAL

Please provide our readers with an update to EPChem International's operations and achievements in Singapore and the region.
EPChem International is a Singapore-based marketing and distribution company established in 1992. We specialize in special performance chemicals in the Asia Pacific region, focusing on wax and its related products. We distribute, by far, the most comprehensive range of waxes and have built a reservoir of knowledge, expertise and customer base in this specialized field.
EPChem is now the longest serving and one of the lead global distributors for Shell MDS –currently the biggest GTL wax producer in the world. We distribute their entire range of waxes and pride ourselves as the top GTL wax supplier in the Asia pacific.
EPChem is also among the most computerized companies among SMEs in Singapore. All of EPChem's operations are fully automated, allowing us to capture knowledge and information into our two in-house and fully customized systems – the Business Transaction System (BTS) and the Multimedia Information Tracking System (MITS).

What are the major applications or uses for the products within EPChem International's expansive range?
EPChem is the expert in wax and wax technology; we supply to more than 600 active customers and track more than 2,000 wax users across six continents. Having a complementary product range provides EPChem with the advantage of being a one-stop shop for various applications that we serve. We have more than 30 applications for our products and some of the key demand comes from applications which include adhesive, polymer, paving and coating, candles and wax blending, etc.
We define wax as any material that is solid at room temperature, becomes a free flowing liquid at elevated temperature and turns back again to solid at room temperature. Our waxes come from various sources, e.g. natural waxes, fossil waxes, synthetic waxes, etc.; ranging from small hydrocarbon molecules to larger complex molecules like copolymer waxes with much higher molecular weight. We also supply specialized oil.
EPChem's most important markets lie overseas and more than 95% of our business is outside Singapore. China and Indonesia have been our traditional markets and we are looking to expand in Vietnam and Myanmar.

In 2014, EPChem International received a grant from SPRING Singapore to design and implement EPChem International's first Multimedia Information Tracking System (MITS). What is the status of this project?
SPRING Singapore has been very generous in terms of its support for local SMEs. EPChem International's first project with SPRING dates back to 2000 when we identified depletion in the supply of paraffin wax caused by the changes in base oil technology. SPRING Singapore subsequently gave us a research grant under the "Innovation Development Scheme" to develop and manufacture a range of environmentally-friendly candle wax formulations.
SPRING Singapore has built a platform for us to develop various products and, in recent years, supported the automation of EPChem entirely. Their support has propelled EPChem International to become one of the few fully automated companies in Singapore.

What is your assessment of the overall business climate today, specifically for SMEs in the chemical space?
SMEs that are dependent largely on the local manufacturing base are definitely affected by external factors which they are unable to control. SMEs are affected heavily by energy prices, fluctuations in currency and the policies of other governments. The recent drop in oil and palm oil prices has had a very significant effect, causing strong upheavals in the market. Work is highly specialized and it is difficult to find and retain talent. The domestic market for chemicals is small and SMEs must venture overseas in order to thrive.

What are some goals you would like EPChem International to realize within the next three to five years?
EPChem is looking to expand our product range. New supplies have allowed us to develop new applications for our molecules. For example, our recent project is looking to develop a new molecule which has the same properties as wax but comes with added dimensions. This new molecule will allow us to solve problems currently associated with polymer applications. EPChem always strives to be one step ahead in our journey to find ways to solve specific problems within the industry. —

> The recent drop in oil and palm oil prices has had a very significant effect, causing strong upheavals in the market. Work is highly specialized and it is difficult to find and retain talent. The domestic market for chemicals is small and SMEs must venture overseas in order to thrive.

Henri Nejade

President & CEO Asia Pacific
BRENNTAG

GBR met with Brenntag back in 2012, soon after your IPO and acquisition of Zhong Yung and International Sales & Marketing (ISM)'s specialty chemicals group in Australia. What are some key milestones that have occurred since then?

After Brenntag's acquisition of ISM in 2012, the company has evolved to become one of Australia and New Zealand's top five players in terms of size. During 2013 and 2014, we worked to fully integrate our company in the region and build a comprehensive IT platform across the organizational structure. Brenntag Asia Pacific also invested heavily in human resources in preparation for the implementation of the second phase of our regional growth strategy, which has materialized successfully. Most recently, we finalized one of our biggest acquisitions to date in 2015, of TAT Petroleum —ExxonMobil's largest distributor.

In 2016, Brenntag is acquiring the remaining 49% stake of Zhong Yung. While we have already established a strong presence in China through our joint venture with Zhong Yung, our aim is to significantly increase market penetration in the country. We are currently present in the industrial chemical market in China, and will start investing significantly in the specialty chemicals market in the near future.

Each market in Southeast Asia is unique. What are some driving trends or demands that are influencing your business?

Most people refer to Asia Pacific as a region, but in my opinion each country is different and consequently so are the drivers. With regards to chemical distribution particularly, some countries are more mature, while others are in the process of developing their capabilities. There are also varying categories of service providers, matched by different levels of demand.

Brenntag Asia Pacific has divided the region into four sub-regions: North Asia, Southeast Asia, South Asia and Australia and New Zealand. The common drivers in all four regions are supplier and customer demands based on safety, compliance, and consistency of services. Brenntag's main business in the region includes food processing, followed by coatings, home care, personal care and pharmaceuticals. Consumption is increasing in this part of the world, and consequently, market demand. Beyond consumption demands, multinational companies are present in Singapore due to the fact that the city-state has constructed an ideal platform for chemical production. Manufacturers require services for their products to reach customers and Brenntag can assist in this space. Brenntag also has 20 application labs across the region and can provide technical support to customers and aid as a first screening for suppliers.

How will the ASEAN Economic Community affect Brenntag's operations and ease of doing business in the region?

Brenntag Asia Pacific is focused on local and fragmented small and medium sized customers. ASEAN will facilitate transactions between various countries in the region and an increased number of products traveling between member states. This type of exchange will be beneficial for Brenntag as we are present in all jurisdictions, and can hence interact with players as they move from one country to another. In order to manage the increasing exchange, Brenntag will continue to manage its regional hub in Singapore, the objective of which is to collect product from the US and Europe, and distribute to various regional facilities, serving local customers.

In 2013, you expressed demand for a distribution-oriented regional association to pool collective capabilities, such as the National Association of Chemical Distributors in the U.S. Has any such organization emerged since we last spoke?

Locally there has not been much progress on establishing representation for distributors. The European FECC and the North American NACD have joined together to form an International Chemical Trading Association that will likely cover part of Asia Pacific. As a global market leader, Brenntag is actively working on initiating the establishment of a local and regional trading association.

What are some of Brenntag's goals for the next three to five years?

Brenntag in Asia Pacific will continue to develop its regional hub in Singapore, while we continue along our growth trajectory in the region. There is a demand for good distributors to serve customers and suppliers, lending huge opportunity. Furthermore, we believe that consolidation will continue in the distribution space, and Brenntag will acquire more companies in the region to support our growth strategy. Our goal is to remain active in all markets and be the number one player in the region. More specifically in the medium term, we would like to focus more on specialty chemicals North Asia.

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in Singapore. They are also more adversely affected by fluctuations in commodity prices and volatile currency movements due to the cost and complexity involved in hedging and managing these risks.

"MNCs producing on Jurong Island are perhaps continuing to export to the Asian market, but local SMEs are currently not seeing much growth in these markets", says Nicholas Lim, managing director of Unilite Chemicals. Lim believes it is imperative for the government to take decisive action to strengthen local manufacturing. He claimed: "The existence of smaller manufacturers (about $100 million in annual turnover) in Singapore can help promote a more balanced ecosystem that supports local SMEs. The manufacturing base in Singapore has shrunk to almost one fifth of the country's GDP. The decline of a country's manufacturing base can eventually lead to complete erosion of such activities, and in the case of Singapore, potential reversion to solely a trade hub."

Despite structural headwinds, businesses appear to remain confident in Singapore's establishment to tackle them head on. Organizations such as SPRING Singapore, an agency under the Ministry of Trade and Industry responsible for helping Singaporean enterprises grow, have helped SMEs build credibility with entrepreneurs and business leaders. Its most recent budget provided for higher income tax rebates and increased loan assistance for struggling sectors, a move that was welcomed by the oil and petrochemicals sectors. They also support SMEs ventures beyond pure monetary incentives into the domain of increasing productivity. EPChem International, for example, has been a beneficiary

Image: Borouge

of SPRING Singapore's efforts to invest in automation systems. Seah Cheong Leong, CEO of EPChem, re-affirms the same: "SPRING Singapore has built a platform for us to develop various products and, in recent years, supported the automation of EPChem entirely. Their support has propelled EPChem International to become one of the few fully automated companies in Singapore."

Moreover, Singapore's value proposition as a trading hub remains intact given its high trade finance liquidity, dominance as a foreign exchange hub in Asia, stable regulatory and legal framework, and highly skilled workforce. In cognizance of a more challenging labor market, IE Singapore has placed emphasis on promoting and developing local talent, and launched an International Trading Program (ITP) in collaboration with Nanyang Technological University (NTU) to better prepare graduates for jobs in trading. The program is expected to go a long way in alleviating one of the industry's longstanding issues - reliance on higher-cost foreign labor.

Global macroeconomic forces will undoubtedly continue to dictate margins and profitability in the sector, but despite short-term challenges, Singapore is poised to continue attracting capital and investment, albeit at a slower pace. Its ability to sustain its dominance as a regional trading hub will be largely contingent upon the development of Jurong Island, the country's financial and trading infrastructure, storage and logistics facilities. According to IE Singapore, Asia is expected to account for approximately 60% of the average annual growth in global trade until the year 2020, and there is no better location than Singapore from which to capture this growth. —

> "Singapore is a strategic location for the production of value added products as well as for R&D. Through establishing said infrastructure, the country has fostered an excellent environment to support the distribution market. For example, Singapore is home to all the top flavor houses in the region that have been servicing Southeast Asia, as well as large international pharmaceutical companies."
>
> - Lim Siew Tin,
> Managing Director,
> Jebsen & Jessen Ingredients

SINGAPORE, A GLOBAL TRADING HUB

SINGAPORE TRADE: AN OVERVIEW

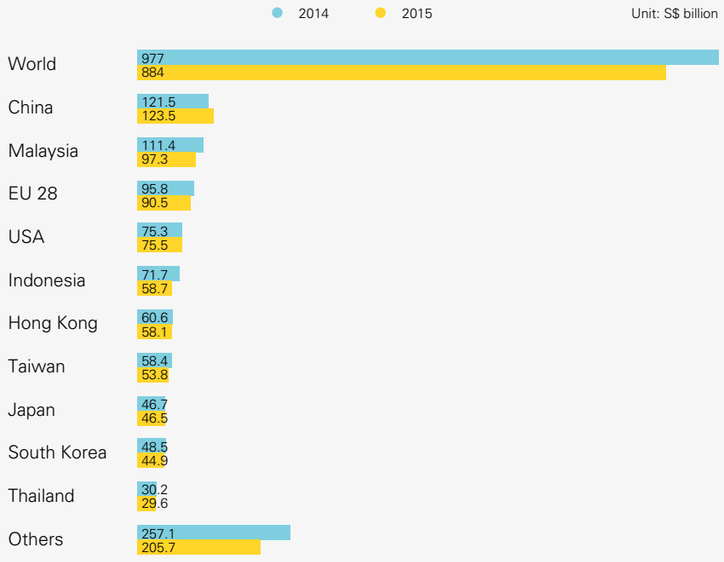
Source: Singapore Department of Statistics

Unit: S$ billion (2015 data)

TOTAL TRADE AT CURRENT PRICES	884.1
Total exports at current prices	476.3
Domestic exports	233.4
Re-exports	242.9
Total imports at current prices	407.8

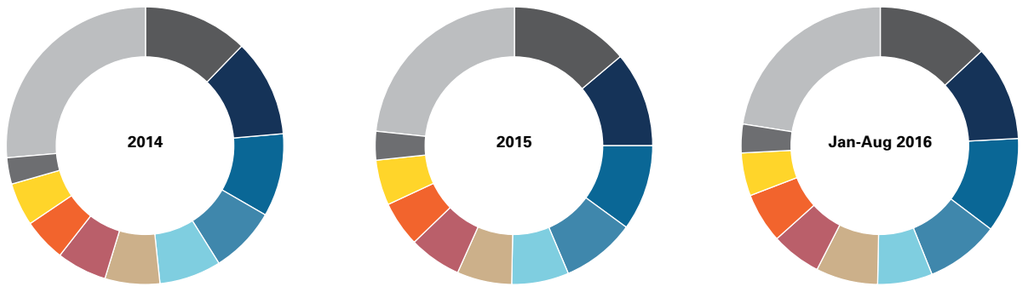
SINGAPORE'S TOP TRADING PARTNERS

Source: International Enterprise Singapore



TOP MARKETS' SHARE OF TOTAL TRADE

Source: International Enterprise Singapore



	% 2014	% 2015	% Jan-Aug 2016		% 2014	% 2015	% Jan-Aug 2016
World	100	100	100	Hong Kong	6.2	6.6	7.1
China	12.4	14	13.2	Taiwan	6	6.1	6
Malaysia	11.4	11	11	Japan	4.8	5.3	5.7
EU 28	9.8	10.2	11.2	South Korea	5	5.1	5.2
USA	7.7	8.5	8.6	Thailand	3.1	3.3	3.3
Indonesia	7.3	6.6	6.4	Others	26.3	23.3	22.3

Nicholas Lim

Managing Director
UNILITE CHEMICALS

> The manufacturing base in Singapore has shrunk to almost one fifth of the country's GDP. The decline of a country's manufacturing base can eventually lead to complete erosion of such activities, and in the case of Singapore, potential reversion to solely a trade hub.

Unilite is a nearly 40-year old family business and an important SME in the local chemical ecosystem. How has the company progressed over the last three years?

Three years ago demand for chemical raw materials was high and the manufacturing climate was healthy. At the time, we were in the process of expanding our business in Malaysia, which is currently doing well despite political uncertainty in the country. With regards to Singapore, over the last three years a downturn in the oil and gas and marine sectors has had a negative impact on a number of supporting manufacturing industries. Today conditions in Singapore are generally not as favorable as they were three years ago.

Can you provide us with a breakdown of the services that you offer to the chemical industry?

In Singapore, a local chemical distributor cannot focus on only one industry. Unilite is continuing to serve different markets, with water treatment being our main focus area. While we had plans to increase our toll manufacturing business for the oil and gas industry and start a small manufacturing unit outside of our current premises, we have put this operation on hold. Unilite continues to serve the coating and electroplating industries, however all industries in Singapore are declining. In the past, Unilite's main business in Singapore consisted largely of exports to Southeast Asia, the Indian sub-continent, Japan and the Middle East. There were many trading opportunities in the global marketplace, but today it is difficult to remain cost-competitive in export markets. While there are no custom duties and taxes in Singapore to deter companies like us from exporting, there are a significant amount of indirect taxes and costs.

As a semi-specialty company, we continue to import products mainly from developed countries such as Japan, U.S.A., and Europe to sell in Singapore and greater Southeast Asia. In my opinion, the U.S. is more of an import base than an export base from which Unilite is importing raw materials for producers in Singapore. Unilite's exports to high growth markets have also decreased as countries such as Malaysia and Indonesia are strengthening their own industrial manufacturing bases. Multinational corporations (MNCs) producing on Jurong Island are perhaps continuing to export to the Asian market, but local SMEs are currently not seeing much growth in these markets.

What difficulties are associated with addressing SME-related challenges?

Over the last 10 years, the Singaporean government has focused on attracting high value multinational manufacturers to the country. Hopefully in the next five years the government will try to fill the gap by also turning their attention to SMEs and encouraging these companies to start manufacturing. The existence of smaller manufacturers (about $100 million in annual turnover) in Singapore can help promote a more balanced ecosystem that supports local SMEs. The manufacturing base in Singapore has shrunk to almost one fifth of the country's GDP. The decline of a country's manufacturing base can eventually lead to complete erosion of such activities, and in the case of Singapore, potential reversion to solely a trade hub.

Singapore's industrial base is comprised of a local, a regional and an international economy, running concurrently. Today however, there is a lack of synergy between the three. The local economy consists of workers earning incomes on the lower end of the spectrum, while the regional market consists of local SMEs supplying to multinational producers. There is a significant gap between the local and regional economies, and yet another large schism between the regional and international economies. The latter includes large multinational producers with very high incomes. The international economy is doing well, but in my opinion, the EDB has overlooked the regional economy during the course of the last few years.

What are some of Unilite's biggest achievements throughout the decades and what are some advantages of being positioned in Singapore?

In terms of information, Singapore as a country has the ability to react quickly. The country still has a bright future ahead, and once the market recovers we will be back on track. Within the next five to 10 years however, a reevaluation of the EDB strategy will be required. While continuing to encourage MNCs to manufacture in Singapore, their priority should also be to promote synergy with smaller SMEs and hence support the local industries. What continues to differentiate Unilite in this market is our positioning as a bridge between Singapore's international and regional economies.

Andreas Woschek

Managing Director
HELM ASIA

> Decreasing oil prices are a challenging factor for any distributor or marketing company. But, having been in this market for many decades, we understand these are short-term developments. In these types of economic periods, we are further strengthening our marketing activities.

Could you please introduce our readers to the history of Helm's presence in Asia?
Helm opened its first office in Asia in 1967 in Tokyo, Japan. Since then, as a European company in Asia we have been very early movers, opening an office in India in 1974 and Hong Kong in 1983. This was followed by the growth of our presence in China, beginning in the 1990s up until the present, where we have four sales offices plus the head office in Shanghai. Besides China, Helm has today subsidiaries in Tokyo, Seoul and Mumbai, led by our regional headquarters here in Singapore.

Why was Singapore selected as a new hub for business?
Helm operates within four business areas: chemicals, fertilizers, crop protection, and pharmaceuticals. In the past we steered our business predominantly from Helm's head office in Hamburg. We conducted business with Asia but not within Asia, which was not ideal. We knew we had to strengthen the presence in the region, especially for our chemical and fertilizer businesses, to achieve further growth. Thus, our current target is to increase our commodity businesses in Asia, and particularly Southeast Asia. Hence the reasoning behind opening an office in Singapore was partly to set up regional headquarters within a typical chemical hub, which Singapore surely is, and secondly to have an office overseeing business within key Southeast Asian markets such as Indonesia, Malaysia, Thailand, Vietnam and Singapore.
Helm's business model is not to be a distribution company with a broad product portfolio, but instead to concentrate on selected core products. We strive to be market leaders within our portfolio, bringing us to our slogan "Did we ask Helm?" Our most important chemical products in the region are Acetyls and Methanol. Helm will continue to expand its Asian organization by establishing further offices and pursuing strategic investment opportunities in select countries.

What is Helm's competitive advantage in an increasingly crowded market?
Firstly, Helm serves globally. We are equally successful in all major regions including Europe, the Americas and Asia. Because of our extensive reach we can offer any producer marketing services across the world. We also exercise a unique single sourcing strategy and offer balancing opportunities to our partners, which is quite unusual for distribution or marketing companies. For example, Helm buys our suppliers' surplus volumes, but if required, we can cover the excess demand as well. Being a family-owned company, Helm thinks and acts long-term and puts particular emphasis on close relationships with its partners.

How is Helm reacting to the current economic environment, plagued by lower oil prices and volumes as well as slowing growth in China?
Decreasing oil prices and subsequently lower petrochemical prices are a challenging factor for any distributor or marketing company. But, having been in this market for many decades, at Helm we understand these are short-term developments, and that the markets will change again. In these types of economic periods, we are further strengthening our marketing activities. With regards to China, I believe we are going to see a new normal. I do not expect to return to double-digit growth rates but there to be more moderate growth rates in the area of five to seven percent.

What would you like to achieve as Helm Asia in the next three to five years?
It is our intention to be closer to our Southeast Asian customers in the industries where we are mainly active. Secondly, we will pay a great deal of attention to regional product management, as responsible agents for the sourcing of products for our Asian colleagues' local distribution activities.

Do you believe Singapore will remain at the helm of the chemical industry in Asia?
Singapore is going to face a number of challenges from neighboring countries and has to reinvent its functions. Nevertheless, I am quite sure it will master these challenges because the government is very concerned about the future. Singaporeans do not rest on their achievements and are constantly looking ahead. The country's astounding development over the last fifty years has proven that its policymakers had indeed crafted a good master plan. The Economic Development Board (EDB) is attentive towards the industries and companies coming to Singapore that can contribute to the further development of the country. —

Gina C. Fyffe

Executive Director
INTEGRA

> We have to continue to be careful and creative. Within this type of environment there are increased risks and diminished rewards, as margins are squeezed. We need to dig deep into our expertise, stay smart and try to get smarter.

In a market crowded with traders, how does Integra manage to set itself apart from its competitors?
There are traders and traders, and Singapore's market is indeed a very crowded space. How we differentiate ourselves at Integra is by being honest and true to the values that we have embodied since our founding. These include service, community, and strong creative performance, so that our customers are pleased with the job that we have done and are happy to give us repeat business. This is a philosophy we have lived by for the past 27 years, and pioneered in the industry. A trader is only as good as their next piece of business, and in the world of trading it is crucial to be creative and proactive. Over the years, Integra has increased the size of our fleet of ships and staffing to provide us with more flexibility to serve our customers in the region. Integra has integrated logistics into our service offering to consolidate a complex supply chain and reduce risk.

What is your assessment of the challenges associated with sourcing talent in Singapore?
While Singapore is headed in the right direction, the reason people pay for foreign talent is that they cannot find talent locally. Often companies require staff that understand the way Europeans, Americans, Africans and Asians do business. In a global business, staff need to understand matters from a global perspective. This is more difficult to train for and requires time and experience. However, when we look to recruit staff, we always start our search in Singapore. We try to avoid uprooting people and adding a new location to the list of things they need to learn. We try to recruit locally because, from a cultural perspective, an employee needs to understand the local market context. Cognizant of this need, Singapore is promoting programs, especially within schools and universities, to train people to function in international markets.

At present Asia represents a significant portion (35%) of Integra's trading volume. How do you think this will evolve over the next three to five years, especially given the upcoming wave of petrochemical plant openings in the U.S.?
We are very excited about the U.S., where we also do a significant part of our business. It is going through a number of radical changes such as the first crude oil exports in 40 years. The interesting thing, however, is that we see a growing synergy between the U.S. and Asia. This raises the question: will the 35% be intra-regional or will there be more deep-sea movements going forward? Because of 'short-termism' we expect to see last minute movements within Asia itself. But because crackers in Asia are heavy, while crackers in the U.S. are light, a disconnect may emerge. It is likely that product will leave Asia in increasing amounts for the U.S. until the latter rebalances itself. The U.S. is looking at refineries as well, since the risk is that heavier streams will not be as available. The question going forward is, will they concentrate on what is domestically available, and import the rest? Or will the U.S. look at ways to produce more of the heavy ends to balance their needs? It will be interesting to see how these dynamics shape up.

Given the dynamic state of the industry, where would you like to see Integra in the next three to five years from now?
We have to continue to be careful and creative. Within this type of environment there are increased risks and diminished rewards, as margins are squeezed. We need to dig deep into our expertise, stay smart and try to get smarter. The skills we have developed are going to continue to be valuable, but we have to learn new skills as well in order to stay relevant. Volumes may be low and more companies are hunting for business, which means we have to do what we have always done: be nimble, creative and proactive. We need to listen very closely to our customer base and what they want, because we are a service provider. Traders do not make markets; traders balance supply and demand. There is a high attrition rate among traders and today survival is the name of the game. —

Image: Accenture IoT Center of Excellence

SPECIAL FEATURE

INDUSTRIAL INTERNET OF THINGS

"We are seeing the perfect storm: proliferation of sensors, increase of smart phone adoption, favorable economics of technology, and emerging millennial workforce are all encouraging signs to increase adoption of IoT. Most importantly, clients who have gotten off the blocks have started to see tangible benefits."

- Senthil Ramani
Managing Director, Digital Business Lead and Director,
IoT Center of Excellence - Resource Industries
Accenture Consulting

Digitizing the Chemical Ecosystem

A special feature on IoT

Smart Singapore

Singapore's commitment to increasing productivity through innovation and mechanization has propelled the city-state forward on an Internet of Things (IoT) crusade. Through targeted investments in various technology centers of excellence, the local government is helping drive industrial innovation forward. However, industrial application of IoT scratches only the surface of the state's total technology agenda. The resource-scarce nation is seeking to leverage its formative strength, talent, to transform itself and add value to the global marketplace by building the world's first Smart Nation. Smart Nation aims to leverage IoT technology to improve the quality of life of its citizens, infrastructure and industrial sector, in a bid for Singapore to remain one of the most economically competitive and livable cities in the world.

The industrial sector factors heavily into Singapore's Smart Nation equation, with the manufacturing sector representing close to 20 per cent of the country's GDP. When applied in an industrial context, IoT has the potential to increase productivity, safety and competitiveness of both the enterprise and the economy. By helping solution providers overcome the most difficult "first-adopter" stage for new IIoT technologies, Singapore's economy stands to gain a first-mover advantage and establish itself as the IIoT technology and business hub of Asia.

Internet of Things (IoT) Explained

This latest technology buzz phrase is taking not just Singapore, but the world, by storm. But what exactly does IoT mean, and how pertinent is the concept to the world of chemicals? For starters, IoT can be loosely defined as a network of physical objects that are linked to one another through the Internet. More concretely, it refers to physical objects, equipment or machinery that are fitted with various types of data-collecting sensors.

14.2 TRILLION USD

What the IoT could add to the world economy between now and 2022

To complete the IoT puzzle, cloud-based applications analyze the data that is collected by sensors, eventually enabling machines to communicate with other machines, applications or users. The application of IoT is not limited to any particular industry, device or user, but rather can be employed in virtually every sphere of life. As an example, new smart metering systems in homes digitally provide energy suppliers and end users with consumption data. Smart meters automatically send meter readings to suppliers, and show users how much energy they are consuming in near real time. Provision of this data results in more accurate energy bills and increased energy awareness among consumers, ultimately leading to cost savings and more sustainable living practices. Now just begin to imagine what IoT can achieve at scale, and within a large chemical facility.

Turnaround your Plant and Balance Sheet

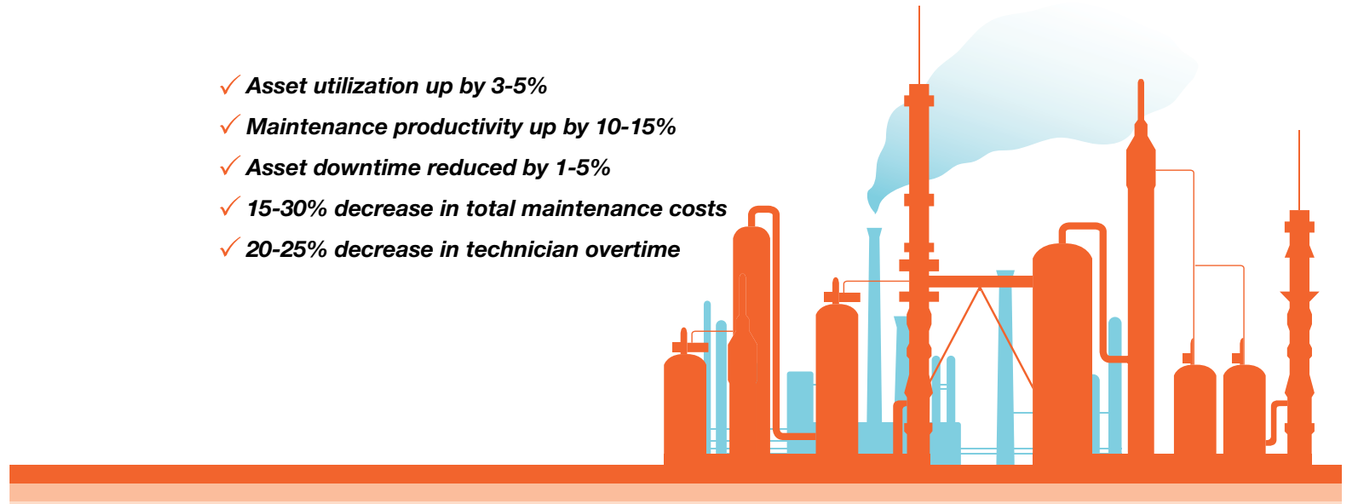
While IoT debuted decades ago, the concept has begun making strides in the industrial space only recently. You might ask, why is this the case? The answer is simple —data. The amount of data generated within a process plant or mine site has been discovered to be astounding. According to Accenture, 144 terabytes of data are generated in a mine site in the span of just one hour, which up until recently, was not being leveraged. To make music out of the copious amounts of data, Emerson for example, helps "industrial plants gain huge benefits from data analytics, by integrating and analyzing large amount of data using smart field devices on plant equipment," explained vice president of solutions and lifecycle services, Vidya Ramnath.

These benefits trickle down to the bottom line. A company with EBITDA of $2 billion can save $100 million by implementing digital plant initiatives. By going digital, end users are quickly discovering that industrial IoT (IIoT), or IoT applied within the context of industry, boosts operations on two fundamental fronts: reliability and energy efficiency. In today's marketplace, increasing and ensuring both factors are imperative for any firm to remain competitive. By engaging IIoT and installing sensors on 148 of chemical manufacturer Denka's steam traps, for example, the firm was able to save 7% on the cost of steam. "In a highly complex and volatile business environment, companies are finding ways to perform, optimize processes and operate more efficiently to sustain growth," said head of Yokogawa's new co-innovation center and general manager of the firm's Singapore Development Center, Joseph Lee Ching Hua. ▸ 78

BENEFITS OF ADOPTING IoT

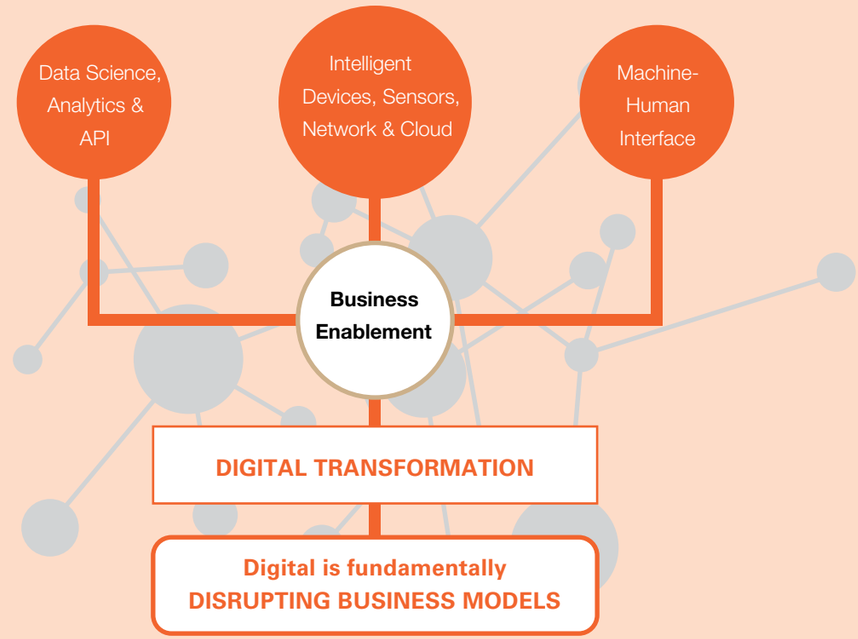
Source: Accenture

- ✓ *Asset utilization up by 3-5%*
- ✓ *Maintenance productivity up by 10-15%*
- ✓ *Asset downtime reduced by 1-5%*
- ✓ *15-30% decrease in total maintenance costs*
- ✓ *20-25% decrease in technician overtime*



SUMMARY

Source: Accenture



Vidya Ramnath

Vice President,
Global Solutions & Services
EMERSON PROCESS MANAGEMENT

What significant milestones has Emerson achieved since we last met with you in 2013?
There have been several exciting developments, most notably our work around Pervasive Sensing, Big Data, Industrial Internet of Things (IIoT) and 3D printing (Additive Manufacturing). In 2014, Emerson opened its first global Pervasive Sensing Centre of Excellence in Singapore. Through this Centre, we are providing IIoT-enabled remote monitoring services to help manufacturing plants improve their energy efficiency, reliability, productivity and safety. The Centre creates IIoT solutions by remotely performing data collection, data analytics, and consulting for plants in the region. This initiative also supports the Singapore government's Smart Energy initiative.
Analytical measurement remains a core part of our portfolio, fortified in 2014 with the establishment of the Singapore Analytical Manufacturing and Integration Centre (SAMIC). This Centre produces and distributes analytical and combustion sensors; engineers and designs complete analyser-based solutions; develops and produces customer-specific systems and products; and supports our customers on Jurong Island in the chemical and life science sectors.
Finally, in May 2016 Emerson entered into a Research Collaboration Agreement with Nanyang Technological University (NTU Singapore) under which we will create a new Centre for research and development of methods for using 3D printing for the fabrication of severe-service industrial control valves. 3D printing is a revolutionary technology that makes it possible to design and manufacture control valves much more quickly, economically, and with better mechanical properties.

How is Emerson working with data analytics and big data technology to help petrochemical facilities improve their efficiencies?
As the leading digital automation provider, Emerson has been helping industrial plants gain huge benefits from data analytics, by integrating and analysing large amount of data using smart field devices on plant equipment. With the maturation of internet, and through its Pervasive Sensing technology, Emerson has powered IIoT and extended its smart solutions and services to a host of new applications.
One of our successful IIoT projects for the chemical industry in Singapore is the remote monitoring services for steam trap in the Styrenic Resins plant operated by Denka Singapore. Emerson's Wireless Acoustic transmitters were installed on 148 of Denka's critical steam traps. Steam traps are remotely monitored and analysed by Emerson experts to instantly spot energy losses. This results in large energy savings and reduced carbon dioxide emissions. Denka Chemicals in Singapore saved 7 percent on the cost of steam.

How is Pervasive Sensing changing behaviour in the petrochemical industry?
Pervasive Sensing is the foundational part of Emerson's IIoT strategy. The IIoT affects many areas of plant operation. It has applications in reliability, maintenance, energy efficiency, productivity, health, safety, and the environment, by leveraging on cloud technology.
Pervasive Sensing revolves around the placing of sensors on equipment that were never instrumented before due to the high cost of analog wiring. Today, inexpensive wireless sensors can be installed quickly and easily, and communicate to data analysis and asset management systems.

What are the impediments to automation?
The chemical industry must be concerned with safety at all times, and is understandably cautious and conservative about anything that changes the way things are done. When we launched wireless sensors in 2008 customers were concerned about potential problems with reliability and data loss. Today, after hundreds or thousands of successful projects, we are seeing widespread adoption of wireless and pervasive sensing.

What can we look forward to from Emerson and the industry in the years to come?
With growing concerns over the environment, there are increasing regulations surrounding energy, steam, electricity, and air consumption. As energy regulations evolve and expand, so will interest in energy savings generated by Pervasive Sensing strategy. Opportunities and growth will continue to present themselves in the chemical industry and downstream, so the future looks promising.
At Emerson we are passionate about delivering our solutions to our customers in Singapore and across the globe. The Pervasive Sensing Centre of Excellence lies at the core of our field and plant sensor network innovation, and we plan to continue developing products and software capabilities that partner powerful, predictive analytics with the customers' entire enterprises. Backed by the strong infrastructure here, and in partnership with local customers and the government, we continue to develop advanced solutions in Singapore and bring them to the world. There is no better incubator of innovation in the world than Singapore.

Joseph Lee Ching Hua

Head of Co-Innovation Center &
General Manager of Singapore
Development Center
YOKOGAWA ENGINEERING ASIA

Could you please provide our readers with a brief overview of your services and recent milestones?
Yokogawa is comprised of three businesses: sensors or instrumentation, control systems and information systems. In a highly complex and volatile business environment, companies are finding ways to perform, optimize processes and operate more efficiently to sustain growth. In the face of such challenges, the Singaporean government is introducing the Smart Nation transformation and encouraging partnership among technology players such as Yokogawa, and end users to adopt the Internet of Things (IoT). With the support of the local government, Yokogawa is co-innovating with our customers to develop new solutions rapidly, which forms the basis for Yokogawa's new Co-innovation Centre, the first of its kind in Singapore.

What impact will data analytics have on plant operations and petrochemical decision makers?
At the heart of IoT lies a need for solutions to meet existing challenges. At Yokogawa we aim to first understand current challenges and discover how information or data can inform solutions and create value. For example, today's smart sensors on a pressure transmitter will measure typical pressure sensor information and provide diagnostic information. This information is valuable for analytics and can help predict the failure of certain equipment and sensors, generating intelligence to improve operations.

How is Yokogawa packaging its solutions for petrochemical and chemical companies in Singapore?
A solution typically finds its roots among subject matter experts. If a customer faces challenges with safety or equipment reliability, for example, asset management experts and alarm management specialists will first work to understand the alarm and failure types their equipment are experiencing. We then engage in a co-innovation process with customers to customize a solution.

Can you provide a case study example that exemplifies Yokogawa's offering?
Customers in the power sector experience challenges with both equipment and human reliability, namely human error associated with younger operators. This challenge is also prevalent in Japan, from where we applied our existing technology to a new client in Singapore. In this case Yokogawa successfully automated critical SOPs (Standard Operating Procedures) for the client, improving consistency, productivity and reliability by reducing cycle time and manpower, and allowing existing manpower to be redeployed. In Singapore, the Energy Market Authority (EMA) supported such innovative project.

What is your outlook for the adoption of IOT by the chemical industry in Singapore?
IoT is a hot topic, but few operators have truly adopted IoT within their plants, because the exact value remains unknown. Another key area under development with regards to IoT is cyber security. Industry players are taking a 'wait and see' approach towards putting information on an open system. We have to be able to demonstrate both added value and security to increase adoption rates.
The end user has to be incentivized to invest in new technologies. While the IoT platform, data scientists and technology are all present, the overall acceptance level is low due to the capital and safety intensive nature of the industry. Key players are waiting for others to adopt IoT, to observe results. While the Singaporean government is supporting innovation in this space through the JI 2.0 initiative, in order for IoT to take off there needs to be a push from both customers and technology providers. This is why co-innovation with the customer is crucial to success.

Working off of a strong foundation, do you think Singapore will become a global center for IoT innovation?
A firm push from the government, coupled with demand from the industry for increased reliability and productivity during an economic slowdown, will help Singapore continue to be an innovation pioneer. However, it will take years of partnerships, data analytics and study to evolve. For example, twenty years ago one had to call a broker to place trades on the stock market. Today, all stock trading is done through the Internet by robots trading based on analysis of years of past data. If one applies this example to the amount of rich data in plants coming from sensors, automation is theoretically possible. Perhaps ten or twenty years later a plant will run entirely by itself. Many scenarios are achievable with the right set of data.

◂ 74

Another large chemical manufacturer, Afton, recently unveiled a new plant on Jurong Island that stands as a testament to the benefits of digitization. "Afton's plant on Jurong Island has a very high level of automation and utilizes advanced distributed control systems to manage plant process and utilities systems, ensuring ongoing safety, productivity and sustainability. Notably, it is our first facility in the world to have an installed remote machine-human interface, which reduces manual communication and human error, thereby improving productivity," said vice president and managing director of Afton Asia Pacific, Sean Spencer.

How exactly can a chemical plant leverage IIoT to achieve these savings? According to Accenture, four fundamental pieces of the IIoT puzzle need to fit together in order to effect change: sensors, data science, a human-machine interface and action. Traditionally, a contractor comes on site to inspect the health of plant equipment, including the likes of pumps, heat exchangers, blowers, cooling tower cells and non-process compressors. Manual inspection and data collection is typically conducted a few times over the course of the year to ensure smooth plant operation. However, there are a number of caveats associated with this conventional process. The first is related to labor, as large teams are deployed to perform inspections, collect data and identify necessary improvements. Contractors often have to measure the health of dangerous equipment, adding a layer of risk to an already costly and time-intensive process. Further to this, many issues are often not detected on time or at all, leading to damage that interrupts plant operation and production, and loss of capital.

The first and key ingredient in the IoT recipe, a sensor, automates measurements and performs them much more frequently. Affixed to assets, sensors can measure variables such as pressure, temperature, corrosion and humidity, and transmit relevant data over a secure network to analytics software. This is where the second ingredient, data science, comes into play, generating reports that reveal the condition of a given asset. Thirdly, an interface between machine and human provides the operator with the information needed to act and make an informed, cost-saving decision. Analytics can often specify the amount of financial loss associated with the deteriorated state of an asset, yielding a clear impetus for the

Image: Process control systems such as SIMATIC PCS 7 are already being used by different chemical producers. Photo courtesy of Siemens

fourth ingredient to kick in: action. Hence, leveraging IIoT can result in less time spent on collecting data manually, and more time acting on results, leading to improved productivity, increased efficiency and cost savings.

Rent, Lease, or Buy?

Reading this you might quickly be wooed by the wonders of IIoT. But how can such technology be implemented in a facility without overhauling the entire plant? Do the purported savings justify the cost? There are various approaches to plant modernization and the realization of a total digital ecosystem in which sensors, networking and software fit together. In fact, an IIoT infrastructure can be installed and parceled within a plant in virtually countless number of ways. Traditionally, plant owners have invested in purchasing sensors, networks and software, and conducting reporting autonomously. However, IoT allows for remote monitoring, and new business models that encourage greater partnership and enable less capital-intensive commitments. For example, digital automation provider Emerson installs sensors, networks and software in exchange for zero upfront investment. Instead, the firm offers what can be described as an IIoT subscription, charging a monthly fee for resulting data analytics.

"Pumps, steam traps, and other equipment monitored on-premise, centrally from the corporate engineering center, and remotely from Emerson's center of excellence, have enabled our customers to yield huge benefits at the operational level. These real-world implementations are helping industrial facilities to frame their priorities for IIoT investments," said Ramnath.

With capex considerations also in mind, systems integrator Accenture is offering clients the opportunity to rent or lease equipment, and begin pilots to test the waters before considering building an entire network. "There is also a trend towards permanently leasing and renting, and adopting the use of shared services," said managing director, digital business lead and director of Accenture's IoT Center of Excellence, Senthil Ramani. The company is committed to building "custom IoT journeys" for their industrial clients in the region through their newly established IoT Center of Excellence in Singapore.

Electrical engineering and software firm Yokogawa is working alongside its customers in its new Co-Innovation Center, to ensure efficient utilization of data and diagnostics generated by their smart sensors. But, regardless of the chosen provider, by leveraging data science, digital transformation has the potential to maximize the utilization of existing assets, often with little to no capital expenditure.

Employing a New Generation

IIoT is inextricably tied to the workforce of the future. By 2025, millennials, or digital natives, will comprise 75% of the global workforce. This implies that in order to attract and retain talent to traditional manufacturing industries such as chemicals or mining, business models will have to evolve and incorporate new technologies. Incoming workers are quick learners and gear towards efficiency, and are not inclined to read hundreds of pages of instruction manuals to assimilate operational knowledge. "Wisdom needs to be digitized, without which smartness cannot meet wisdom, and younger operators run the risk of working in a plant without sufficient knowledge. Going digital can help solve this issue and accelerate the pace of adoption for the incoming generation," said Accenture's Ramani. As more and more wisdom is digitized, the results are multifold. Fewer workers are needed inside a plant, which increases productivity and safety. As more processes are progressively automated, workers can engage in higher value added tasks that are both safe and more technical.

Leading the Digital Revolution

Singapore is evolving into an IIoT global center of excellence, with technology players such as Emerson, Accenture and Yokogawa pioneering new developments in the sector. With the support of Singapore's government, these players have established a Pervasive Sensing Center of Excellence, An IoT Center of Excellence and Co-Innovation Center, respectively. Government agencies are also incentivizing the uptake of plant modernization, digitization and automation, and supporting the development of an innovative industrial ecosystem. These policies are not only in line with goals to improve productivity, but factor in to a greater vision of total transformation.

"Singapore was, and continues to be, a net exporter of chemicals. But more importantly, I believe the city-state is on its way to transforming itself and becoming a net exporter of innovation in the chemical industry, with IoT leading the agenda," said Ramani.

Image: Wireless acoustic transmitters installed on steam traps. Courtesy of Emerson.

CASE STUDY

Denka Lowers Steam Costs thanks to IoT

Source: Emerson

Challenge

Denka, a manufacturer of polystyrene resins in Singapore, purchases steam from a utility provider used in the process. The plant has hundreds of steam traps. After years of operation, steam traps may fail due to cold or blow-through which results in wasting steam, water hammer, erosion, corrosion, and lower heat transfer efficiency.

Due to expensive manpower, location safety, and high capital expenditure, it is challenging for Denka to survey their steam traps frequently. Hence, they engage contractors to inspect them yearly, and forgo the steam loss between inspections.

Solution

Emerson installed *Rosemount 708* Wireless Acoustic Transmitters on 148 of Denka's critical steam traps. The transmitters monitor noise and temperature of the steam traps and transfer the data through a 3G mobile network to a *Microsoft AZURE* cloud virtual server. The analytics software, *SteamLogic*, then automatically analyzes the data and generates alerts.

Emerson experts review this information and provide actionable reports to Denka. Then Denka's maintenance staff repairs or replaces the failed steam traps according to the reports using new standard operating procedures (SOPs) and therefore achieves substantial savings, thanks to this digital transformation. Periodic surveys by workers and annual inspections by contractors are no longer required.

With this business model, Denka only pays monthly subscription fees for the necessary services. There is no upfront capital expenditure.

Results

- 7% steam savings with automatic and continuous remote monitoring service.
- Traps in bypass reduced to less than 4%.
- On system startup, 15% blow-through and 8% cold units identified.

Senthil Ramani

Managing Director, Digital Business Lead and Director,
IoT Center of Excellence - Resource Industries
ACCENTURE CONSULTING

What is the scope of your Internet of Things (IoT) Center of Excellence for Resources in Singapore?
Accenture launched its IoT Center for Excellence for Resources in September 2015 to help clients navigate, understand and embrace IoT, leapfrog capabilities by leveraging IoT, and disrupt existing business models. Accenture works closely with the World Economic Forum, who released a report earlier this year that contains three significant statistics. Firstly, 90% of business leaders say it is important to act now on business models regarding digital change, a significant change in percentage since we saw in 2015; 72% of CEOs are struggling to find the right digital talent; and 81% of these leaders said industry boundaries are blurring. Digital is a vehicle for transformation, and CEOs are the stewards leading the charge. Industries are no longer regarding themselves as silos; hence a chemical industry is not just a provider of chemicals but also solutions. Accenture's new IoT center seeks to foster new business models, prime the industry for an incoming digital workforce, and enhance plant safety, productivity and efficiency.
Through the new IoT center, Accenture has had the pleasure to host over 150 clients. We utilize a case-led approach in which we show practical end-to-end industrial deployments, at scale. We bring the best of Accenture from all our global centers of excellence to Singapore. From the center, Accenture has handled over 300,000 sensors and flown drones to engage in image processing to enhance safety and productivity over an area eight times the size of Singapore.
IoT serves industrial customers the same way e-commerce does technology companies. Years ago, technology and media companies began leveraging e-commerce in order to become digitally relevant. Today, the answer for industrial customers is to adopt IoT.

What are some trends encouraging the adoption of IoT among chemical companies?
We are seeing the perfect storm: proliferation of sensors, increase of smart phone adoption, favorable economics of technology, and emerging millennial workforce who are savvy with the use of technology are all encouraging signs to increase adoption of IoT. Most importantly, clients who have gotten off the blocks have started to see tangible benefits. As an example, one of our clients has saved 15-30% in maintenance costs over this past year alone.

What are some reservations industrialists have with regards to implementing new technologies such as IoT?
While there is a notion that asset-intensive industries cannot digitize, there is a step change effect on value, which they have come to realize. According to Accenture's research on digital plants, a company with EBITDA of $2 billion can save $100 million by running digital plant initiatives.
Fundamentally, there are three degrees of separation for full-scale digital and IoT adoption: building a solid business case and capital expenditure (*capex*), talent, and security.
From a *capex* perspective, in some cases existing infrastructure can be used and leveraged. For example, one of Accenture's largest clients has existing video feeds in place that we are using to help them address safety issues such as exposure to chemicals and toxic gases. The other key notion is that clients can test the waters by leasing and renting, after which, if a productive outcome is observed, they can transition to more permanent infrastructure. With regards to security, the posture needs to change from defensive to proactive.

What impact will IoT have on the workforce?
We are confronted by two challenges. The first is the rise of a digital workforce that is willing to take on new challenges. These workers need to be integrated into the force in a way that they have not been in the past. Secondly, we do not come from an industry that naturally attracts talent. Further to this, the concept of knowledge exchange needs to be revised. Those who are retiring are departing with operational wisdom that they developed over decades. This wisdom needs to be digitized, otherwise younger operators run the risk of working in a plant without sufficient knowledge. Going digital can help solve this issue and accelerate the pace of adoption for the incoming generation. Accenture focuses on building digital solutions to solve exactly these challenges, such as digital standard operating procedures, permits, fatigue monitoring, health status, augmented reality and virtual reality solutions.

Raimund Klein

Executive Vice President
SIEMENS ASEAN

Siemens has been involved with Singapore for more than a century. What have been the main milestones during this history?
Siemens is one of the world's leading energy and chemical solution providers, supplying a comprehensive portfolio of solutions to the chemical industry, ranging from automation and process drive technology to digitalization. Since our establishment here in Singapore, we have grown with the country along their development into a global energy and chemicals hub. The chemical industry has long played a seminal role among Singapore's key industrial segments—electronics, marine and oil and gas—comprising approximately 30% of Singapore's total manufacturing output, and prompting Siemens' involvement in the sector decades ago.
Today, Siemens is focused on providing high-quality, reliable and flexible automation and drive solutions to chemical businesses in Asia Pacific. As an example, our Digital Factory Division offers a comprehensive portfolio of seamlessly integrated hardware, software and technology-based services to support companies in enhancing the flexibility and efficiency of their manufacturing processes and reducing the time-to-market of their products. Siemens is actively transitioning from a pure product and systems business strategy to a solutions-based value proposition. We continue to differentiate ourselves with our extensive portfolio of sensors, communication and monitoring equipment.

Can you provide us with a case study example of a project you have completed in the chemicals space here?
In 2011, Siemens Singapore was awarded a contract by Lanxess, the world's largest manufacturer of specialty synthetic rubber, to equip their production facility on Jurong Island with integrated electrical distribution and automation solutions based on our SIMATIC PCS 7 process control system. More recently, in 2015, Siemens successfully installed the SIMATIC PCS 7 Alarm Management Solution for German specialty chemicals manufacturer Evonik Industries at their expanded oil additives plant on Jurong Island. This would ensure efficient plant operation, which is especially important to cater to the growth in production capacity.

How are Siemens' technologies contributing to overall energy and cost optimization?
Chemical production processes are costly and consume large amounts of energy. To resolve this challenge, Siemens engages in performance contracting, spending months within a given plant to identify the clients' major energy consumption areas. We then build tailored energy saving models, and simulate the amount of energy that would be saved by using our technology, along with estimate associated costs.

In today's uncertain economic climate, most players are looking to diversify their offering. What are some new market requirements that you have identified?
There is a widespread demand to boost productivity in Singapore and beyond, which is accompanied by a growing need for digitalization. Due to cost pressures, the first action operators often take is to reduce headcount. However, this is not always the optimal solution and may result in quality issues. Hence, we are observing a shift towards digitalization of processes and data-driven manufacturing, which requires solid and reliable process control systems. To satisfy these market demands, in the latest release version 10.2 of our CAE software solution, Comos for the process industry, we incorporate innovative features. Through this new technology, Siemens is driving its digitalization strategy forward and increasing the speed and efficiency of project competition.

What are some goals you have set for Siemens Singapore to achieve within the next three to five years?
Today's chemical industry is becoming increasingly more competitive, as more companies expand their product lines to differentiate themselves from industry leaders. To be successful, one requires application know-how within the process industry, R&D efforts to develop deliverables, and market power to sell. This year, our Process Industries and Drives Division has grown by 20%, as a result of offering quality, cost-effective and highly efficient products to drive growth in the chemical industry. We would like to continue along this growth trajectory, and partner with chemical companies to reduce their carbon footprint through energy efficiency process solutions for a sustainable work environment.

Do you have a final message for our international readers?
Staying competitive in the current economic climate will require businesses to deliver products or processes at a faster rate and with greater flexibility. It is imperative for business leaders to optimize their production processes through automation, in order to cut costs, improve productivity levels and ensure environmental sustainability in the long run.

Image courtesy of AkzoNobe

KEY SERVICES

"While 2016 is a challenging year for Asia Pacific and Singapore, with a downturn in the offshore oil and gas markets, progress continues for the chemical plants, and there are attractive projects on the horizon. We will be diversifing to become less dependent on oil and gas and green field projects, focusing more on maintenance contracts."

- Robin Koenis,
Managing Director,
Mammoet Asia Pacific

Builders and Movers Diversify to Conquer

Engineering and construction companies adapt to new market conditions

Image courtesy of Mitsui

China's 6.7% growth rate is hardly a new topic of conversation, some refer to this as the superpower's "new normal". What is often referred to as China's chill, or the giant's slower growth, has spurred a ripple effect across the region and the world. The state's industrial overcapacity, coupled with lower demand, has stalled many players' success, including those serving the chemical and petrochemical industries. Falling external demand has resulted in fewer green field projects in Singapore and beyond, pushing more players across the world in new directions. According to the Ministry of Trade's (MTI) Economic Survey of Singapore 2015, external demand grew at a slower rate of 2.5%, compared to 4.3% in 2014. As an air of global economic uncertainty continued to weigh on investor confidence, total private gross fixed capital formation in the country also declined by 2.2% in 2015, extending the 5.2% contraction in 2014.

In an era characterized by falling demand, fewer new builds, increasing investment costs and heightened competition, chemical majors are curbing capital expenditure and focusing on operational excellence. New economics have profoundly impacted members of Singapore's engineering, procurement and construction management (EPCM) and services ecosystem who are diversifying their offerings to remain competitive, and fighting hard to improve productivity and stay in the game.

"It is true that some Association of Process Industry (ASPRI) members might have experienced a decline in their business as a result of the current economic situation. As oil prices are lower, a large number of plants have put their projects on hold and work volumes have declined significantly, resulting in a very competitive market," said general manager of ASPRI, Chantal Quek.

To combat these external challenges, industrialists are looking outside the scope of their traditional business models and pursuing opportunities in other geographies. Global EPCM firms such as WorleyParsons, for example, are catering to new demands by being nimble and adding services to their existing suite. In July of 2015, the Australian engineering firm launched its Advisian business line in Singapore, which targets asset intensive businesses operating within the hydrocarbons, minerals and metals, chemicals, power and infrastructure sectors with niche technical and management consulting services. Advisian enables WorleyParsons to guide its customers through their entire project life cycles, by addressing their permitting, quantitative risk assessment (QRA) and environmental risk assessment needs, and helping them maximize production, reduce operating costs and generate maximum profit.

> "We perceive demand for construction services both in Singapore and the greater region. Within the city-state specifically there is a strong focus on productivity. Accordingly, we are leveraging our global AECOM expertise to look at smarter ways to construct, whether through modularization, or other new construction techniques that are becoming more prevalent here due to manpower constraints."
>
> - Timothy Petch, Executive Director - Construction Services SE Asia, AECOM

Providing an enhanced integrated offering is popular, as players seek to fill gaps and reduce risk for their customers. In June of 2016, another global player, AECOM, brought its famed construction services line to Southeast Asia to offer customers a complete service and a different delivery model. The construction services line enhances AECOM's existing environmental and design offering, and allows the firm to provide their customers with a fully integrated delivery. Instead of engaging multiple players, clients in Southeast Asia can now turn to a single entity, resulting in less risk and cost savings.

"More clients are requesting a one-stop solution provider, as they do not want just one piece of advice, and instead prefer an integrated service offering instead. Our thinking behind piecing everything together is that traditionally there have been many cracks between contracts, for example between design and build, whereas in an integrated offering, there is nowhere to hide," explained senior vice president and managing director of AECOM's Asia Pacific Environment business line, Bengt von Schwerin.

A single delivery model allows companies to generate savings internally as project managers can administer fewer develop-

ments. It also allows clients the flexibility to remove layers of overheads within the supply chain and manage risk more actively.

Today, newer ways of packaging are not limited to services, but also extend to the physical parceling parts of the plant. Firms such as McConnell Dowell are utilizing smart construction techniques to reduce costs for clients and boost productivity, a key focus area for the local government. As an example, modularization allows companies to leverage lower cost centers by building parcels in other countries, to reduce costs and circumvent manpower shortages in the city-state. "As part of the engineering solutions we offer, McConnell Dowell also utilizes modularization as frequently as possible. Modularization takes place off-site or in fabrication facilities outside of Singapore, reducing man-hours in Singapore and improving both productivity and efficiency. For example, we have recently shipped large modules to Australia from one of our facilities in Batam," said managing director at McConnell Dowell, Murray Dundas.

But with only two major projects in progress on Jurong Island at present, other firms are turning their attention towards maintenance provision. Dutch heavy lifting company Mammoet is now offering its maintenance expertise to the chemical industry in Southeast Asia, as the firm increases assistance with plant shutdowns and turnarounds. Mammoet is investing in smaller cranes to serve a more diverse selection of clients. "There is currently a need to refocus our business and diversify away from oil and gas and expand upon our competitive advantage. We have diversified our crane range, for instance, to address evolving customer demands," said managing director of Mammoet Asia Pacific, Robin Koenis.

However, as companies look to delay maintenance projects and shut down cycles, demand for maintenance services has also contracted by roughly 30% since 2015, putting downward pressure on service rates. Competition is fierce and the lack of work volume is compounded by Singapore's tight labor market. Firm efforts on the part of the government to reduce Singapore's dependency on foreign workers have left many contractors without a sufficient workforce. "With limited capabilities, resources, land and manpower, smaller firms find it difficult to increase facility utilization and service efficiency," said CEO of Huationg Holdings, Jimmy Chua.

Instead of permitting companies to rely on cheap labor, policymakers have put forth incentives to encourage innovation and productivity. Notwithstanding a strong drive from the top to increase productivity growth —which until last year has been flat or negative— companies across the process, construction and management sector continue to struggle without sufficient human resources. Heightened competition for work packages, coupled with a lack of manpower are forcing companies to think differently.

Fortunately, the resilient city-state and its stakeholders are taking steps to ride out the economic downturn. Firstly, with regards to labor, specialized foreign worker accommodation facilities are being built

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SINGAPORE COSTS

Source: Ministry of Trade and Industry

Unit Labor Cost Index of Overall Economy (Year-on-Year Growth)

+3.3% (2014) +2.8% (2015)

Unit Business Cost of Manufacturing (Year-on-Year Growth)

-2.1% (2014) +1.4% (2015)

Unit Labor Cost of Manufacturing (Year-on-Year Growth)

+2.5% (2014) +6.3% (2015)

Kong Chee Min

Chief Executive Officer
CENTURION CORPORATION LIMITED

Please introduce our readers to Centurion's newest ASPRI-Westlite Papan facility. What will the new workers accommodation bring to Singapore's process industry?

ASPRI-Westlite Papan stems from the Association of Process Industry (ASPRI)'s vision and initiative to build Singapore's first dedicated workers accommodation with an integrated training center, to contribute to the sustainable growth and productivity of the Process, Construction and Maintenance (PCM) industry. In partnership with ASPRI, Centurion and its development partner, Lian Beng Group, recently completed this new generation accommodation in May 2016.

ASPRI-Westlite Papan houses 7,900 beds targeted at workers in the PCM industry. The accommodation is strategically located with easy access to Jurong Island —home to more than 100 global energy and chemical companies— allowing residents to commute conveniently to and from work. With the completion of this accommodation, Centurion's workers accommodation portfolio now stands at 61,200 beds across Singapore and Malaysia.

How would you characterize the competitive landscape of foreign worker accommodation in Singapore?

There is significant demand for high quality purpose-built foreign worker accommodation in Singapore, given the relatively large size of its foreign worker population. While there are other accommodation providers, Centurion's holistic management approach distinguishes us from our competitors. Our partnership with ASPRI came about through a tender process, which we secured based on our capabilities and track record in managing foreign workers accommodation.

In addition, Centurion provides other benefits such as welfare, entertainment, social activities, together with communal facilities designed to improve interaction among residents, as we strive to form a community within each accommodation. We pride ourselves on setting the benchmark for workers' accommodation in Singapore. We are also committed to giving back to the community, and work extensively with various community groups and non-governmental organizations (NGOs) to offer social and emotional support, counseling and assistance to our residents.

What sets the ASPRI-Westlite Papan facility apart from other existing facilities in Singapore?

Centurion's ASPRI-Westlite Papan accommodation has an integrated ASPRI training center, and more importantly, all residents will receive up to 48 hours of subsidized training annually. Workers within the process and chemical industries require regular training and upgrading of technical skills, and the center will offer functional and specialized on-site training for mandatory and skill trade courses (including programs run by the Singapore Workforce Development Agency, Ministry of Manpower, Singapore Civil Defence Force and ASPRI-Institute of Process Industry). ASPRI-Westlite Papan has also been uniquely designed to maximize land usage, and optimizes communal spaces to carry out different activities.

Furthermore, the accommodation is strategically located in close proximity to Jurong Island. With a short 12-minute bus journey to the Jurong Island Checkpoint, the time saved by travelling not only gives workers more time to rest, but also increases worker productivity. We are also working with ASPRI and relevant authorities to potentially reduce the time residents take to enter Jurong Island by offering pre-security clearance within the dormitory.

How will the current labor supply situation in Singapore affect the demand for foreign worker accommodation moving forward?

The government regulates the number of foreign workers through a quota system, ensuring a balanced demand and supply. The long-term demand for quality workers accommodation in Singapore is expected to remain healthy. Singapore's government agencies have been stepping up its enforcement actions against employers who do not house their workers properly and are closing down illegal dormitories and factory converted dormitories that do not meet safety and health regulations.

Although the softening economy and slow-down in select business sectors in Singapore may temporarily reduce the take-up rate for dormitory beds, the government's continued emphasis on housing more foreign workers in purpose-built workers accommodation to enhance their living conditions and well-being, coupled with continued investment in public infrastructure and construction projects, are positive factors for the workers' accommodation industry moving forward.

What goals does Centurion hope to achieve within the next three to five years?

As one of the largest purpose-built workers accommodation provider in Singapore and Malaysia, Centurion believes it is well positioned to maintain its leading position in the market and continue capitalizing on opportunities as they arise. The group is building its operational capability across its workers and student business segments to further improve management and efficiency. Centurion will continue to look out for opportunities to selectively expanding in existing and new markets, while evaluating asset enhancement opportunities to deliver long-term value for our shareholders.

Robin Koenis

Managing Director
MAMMOET ASIA PACIFIC

What significant milestones has Mammoet undergone over the last years?
In 2015 Mammoet entered a joint venture with mechanical construction company Sankyu, which has resulted in a mutually beneficial partnership. Traditionally, mechanical construction companies invest in expensive cranes, but with one or two projects per year, do not achieve full utilization. On the other hand, Mammoet engages in numerous projects annually, and our joint venture spreads risk for both Sankyu and ourselves.

What is Mammoet's applicability within the chemical and petrochemical industries?
Mammoet has a long history of maintenance projects in Canada, South Africa, the Netherlands and the Americas, and is now offering the same suite of services to the chemical industry in the Southeast Asian region, assisting with shutdowns and turnarounds. We have the largest fleet of cranes and trailers in Asia, and are able to support all kinds of EPC contractors. Across the region we are moving drilling rigs, conducting maintenance work for chemical and energy plants, as well as assisting with expansions and green field projects. Singapore serves as our international headquarters for Asia Pacific. We store and maintain our equipment nearby in Malaysia, where there are fewer space constraints.

EPC contractors have seen the number of green field projects decline in recent years. How is Mammoet coping with the industry downturn?
There are certainly fewer new investments, and hence we need to refocus our business. Mammoet's strategy is to diversify away from oil and gas and expand upon our competitive advantage. We are diversifying our crane range, for instance. While in the past clients would only come to Mammoet for medium sized to large equipment, today they are interested in the entire range. We are investing in smaller cranes to best serve all clients.
Mammoet has extensive experience in the maintenance field worldwide. In Canada and Holland for example, we have contracts with Shell in line with their cost improvement KPIs. We were able to implement solutions and savings, building a great deal of trust with the client. In fact, Mammoet's financial system is integrated with that of Shell's, making billings automatic. We hope to earn that same level of trust with our regional clients in Asia Pacific.

Why have you identified Singapore as a strategic location for project management and engineering?
Singapore is a solid base with a large pool of high-quality talent. Due to the country's robust chemical and energy sector, there are a large number of experienced operators and talented engineers. There is a high level of education here, and Mammoet too invests significantly in our new hires and in their training.

Training crane operators is famously capital-intensive and crucial due to the dangerous nature of the work. What is Mammoet's approach to training?
Operating cranes is extremely dangerous, and is associated with a high fatality risk and a minimum requirement of five years' experience before operation. We administer our own in-house operative trainings, which are offered to third parties as well, and have a full-time rigging and operating school in Malaysia. It is a substantial investment, with cranes costing roughly $5,000 a day, but the Mammoet's philosophy is to invest in good people and training. Our Singaporean and Malaysian staff travel to Holland to train using the largest simulator, where there is universal access to all of our equipment. Earning lifting hours is integral to raising qualified operators.

What can we look forward to from Mammoet in the region over the next five years?
While 2016 is a challenging year for Asia Pacific and Singapore, with a downturn in the offshore oil and gas markets, progress continues for the chemical plants, and there are attractive projects on the horizon. For example, Mammoet has been awarded four of five packages on the RAPID project in Malaysia.
In the medium term, we will be diversifying to become less dependent on oil and gas and green field projects, focusing on maintenance contracts and working hard to provide our clients in Singapore and Southeast Asia the same high standard of service. And, as always, we will be continue to invest in good people. —

> "Singapore is a solid base with a large pool of high-quality talent. Due to the country's robust chemical and energy sector, there are a large number of experienced operators and talented engineers. There is a high level of education here, and Mammoet too invests significantly in our new hires and in their training."

Jimmy Chua

CEO
HUATIONG HOLDINGS

Please provide an overview of the services Huationg offers in the region and identify recent milestones.
Since its humble beginnings in the 1980s, Huationg has grown into several subsidiary companies in diversified fields. We supply and rent mobile cranes, crawler cranes, and lorry cranes. Our business is lifting and shifting. Lifting is anything that travels vertically and laterally, and shifting is anything that travels horizontally. To ensure that our services do not become redundant, we must embrace the latest technology developments. Our assurance of efficiency, safety, and quality provides us with a great competitive advantage within the industry, and contribute to transparency and profitability. Over the past two years we have managed to achieve a final price drop of 20%. Huationg has also been accredited with ISO 9001, ISO 14001, and OHSAS 18001, and we recently expanded our operations into Myanmar.

How is the Huationg group using new technologies?
Our company is built upon system dependence. Over time we have incorporated enterprise resource planning (ERP), our own resource planning module (ITMS) and GPS systems, and are moving toward a more user-friendly SAP system. We are innovation seekers and we work closely with government agencies such as SPRING Singapore to find improved ways of doing things. At present we are pioneering a revolutionary Fore Protection System, which focuses on properly securing employees working on any equipment standing two meters above the ground or higher.
For crane operators we are looking at training master class operators, and have formed a workgroup under the WSHC. Skills are not learnt in the classroom, but transferred through application. We are currently in the process of writing the software for an I-record system which will be launched in July 2016.

Singapore is renowned for its infrastructure and the ease of doing business. Are there any obstacles to operating in the city-state?
There are numerous advantages to operating in Singapore. There is no price fixing, and the financing of capex is very easy, as is the movement of equipment. However, given the cyclical nature of the industry we have witnessed a 30% drop in final prices over the last two years. With that in mind, there is an increasing need to move offshore, and in our industry there is a particular need for manpower and for land.
With limited capabilities, resources, land and manpower, smaller firms find it difficult to increase facility utilization and service efficiency. We are in discussions with governmental agencies, such as ASPRI, about how to best increase the gross floor area (GFA) of allocated land. At present there is a disconnect between the spaces being allocated and their suitability to our industry niche and equipment. A machinery hub could maximize land use and increase productivity, and shared resources would allow smaller equipment owners to decrease required operating space and reduce extraneous resource duplication.

How has Huationg done outside of Singapore?
Earlier market conditions forced us to move out of our comfort zone and invest abroad. Recently, the market has improved and the need for such expansion has become limited. Opportunities come with risks and not all SMEs have the same appetite for the difficulties abroad. Despite the overall success of our investment in Myanmar, there are many limitations. For example, we bought MAN trucks from Europe, but we were unable to get the shipment out of port for eight months, which would be enough to bankrupt some companies. Localization is difficult due to the propensity for local governments to protect the local status quo and empower native companies. Indonesia, however, is an example of a country making strides in the region to improve the ease of doing business. Huationg is looking into ventures there and in Saudi Arabia.

Have you found hiring abroad difficult?
The labor talent in Myanmar is not yet as advanced as in Singapore, but it is affordable compared to Singaporean labor, starting from 10 USD a day and evolving. In this region, young people are increasingly eager to truly learn the processes behind their work. If companies are willing to spend the time and invest the money to groom local capabilities, the possibilities are limitless. One pair of properly trained hands will move ten times more precisely that twenty pair of hands that do not know where to put their strength. —

> "There is a disconnect between the spaces being allocated and their suitability to our industry niche and equipment. A machinery hub could maximize land use and increase productivity, and shared resources would reduce extraneous resource duplication."

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proximate to Jurong Island, specifically for the struggling process industry. "ASPRI-Westlite Papan stems from the Association of Process Industry (ASPRI)'s vision and initiative to build Singapore's first dedicated workers accommodation with an integrated training center to contribute to the sustainable growth and productivity of the Process, Construction and Maintenance (PCM) industry," explained group chief executive officer of accommodation provider Centurion, Kong Chee Min.

Workers housed within ASPRI-Westlite Papan will receive 48 hours of heavily subsidized training each year, as well as functional and specialized on-site training, incur reduced travel time to work on the Island, and potentially clear security within the dormitory itself. This initiative, combined with those spearheaded by the Process, Construction and Maintenance Management Committee's (PCMMC) Productivity Council, have been fired up to improve the process industry's productivity through the introduction of best practices, mechanization and benchmarking.

"Mun Siong Engineering is involved in the ASPRI-Westlite Papan project as well as the Process, Construction and Maintenance Management Committee (PCMMC) initiatives, which successfully address labor issues in Singapore. As a testament, our workers are among the first batch to move into the dormitory upon its opening in June," said executive director of Mun Siong Engineering, Quek Kian Hui.

The state is also working to mediate adverse effects of the economic slump. Cognizant of the challenges associated with a tight labor market, in the 2016 budget the government granted a reprieve from foreign worker levy hikes to the struggling process sector. The budget also addressed the need for Singapore's small and medium sized enterprises (SMEs) to scale up, and consequently included schemes to promote automation and internationalization. Notwithstanding policymakers and associations' valiant efforts to spur recovery, the reality is that until external demand picks up and rebalances supply, competition will remain squeezed. "As Southeast Asian neighbors present investors with lower cost alternatives, Singapore needs to innovate and enhance cost competitiveness with its high quality and efficiency-driven service offering," emphasized Quek.

And Singapore is doing just that. By tirelessly leveraging and enhancing its strengths, the island nation has continued to attract fixed asset investment (FAI) to its shores. According to the MTI's Economic Survey of Singapore 2015, manufacturing garnered the most FAI commitments relative to other sectors despite the challenging external environment. Within the sector, the chemicals cluster attracted the largest amount of investment—$3.6 billion, or 32% of total FAI.

"We are still seeing investment in areas where customers are able to leverage existing assets into producing differentiated products, or where customers are looking for security of intellectual property. Customers are looking to build on existing investments as opposed to building new greenfield projects," said director of hydrocarbons and chemicals Southeast Asia at WorleyParsons, Matthew Spalding.

As Singapore continues along its higher value added production journey and weathers the economic storm, EPCM contractors and service providers will have to continue to adapt, innovate, and vie for a smaller piece of the pie.

> "As part of the engineering solutions we offer, McConnell Dowell utilizes modularization as frequently as possible. Modularization takes place off-site or in fabrication facilities outside of Singapore, reducing man-hours in Singapore and improving both productivity and efficiency. For example, we have recently shipped large modules to Australia from one of our facilities in Batam."
>
> - Murray Dundas, Managing Director, McConnell Dowell South East Asia

Quek Kian Hui

Executive Director
MUN SIONG ENGINEERING

Could you walk us through your key historical milestones and achievements since the company's foundation?

Mun Siong Engineering Limited was established in 1969 with a key focus on construction around South East Asia. In the 1990s, however, we began concentrating our efforts in Singapore due to competing labor costs in the region. Initially, Mun Siong Engineering was a mechanical based company with piping and steel structure capabilities, until we acquired OHM Engineering, and strengthened our electrical and instrumentation capabilities in year 2000. Ten years later, Mun Siong Engineering had its initial public offering. A year later, the firm acquired Wing Wah Industrial Services — a machine shop that provides rotating equipment overhauling and modification services. In 2013, Mun Siong Engineering established its scaffolding capabilities and incorporated Pegasus Advanced Engineering as an overseas investment holding company to further expand the firm's capabilities. Today, we have more than 1,200 employees in seven offices across Singapore. The main component of our service offering that has evolved over the past years is our engineering capability, taking on full-fledged design engineering and EPC projects.

What compelled Mun Siong Engineering to employ this diversification strategy?

There are significant barriers in moving our core construction and maintenance services out of Singapore. However, our engineering services are still internationally competitive in terms of quality, and can be performed anywhere around the world. Thus, we have also decided to diversify into smaller scale EPC projects in Singapore to make our business more competitive. Mun Siong Engineering secured a small EPC project for a petrochemical producer in Tuas. The manufacturer contracted us to re-engineer their warehouse and production facility for which we offered a complete turnkey package for this project.

How are you coping with a lack of human capital in the city-state?

Mun Siong Engineering relies heavily on foreign labor, for which the government issues us man-year entitlements (MYEs) that allow us to bring them into Singapore. This is due to the fact that we have several maintenance contracts with petrochemical majors throughout Singapore. Training the foreign work force is of a prime concern for us, and Mun Siong Engineering is committed to conduct two types of in-house training for our employees – the government-mandated training, as well as internal hard and soft skills training, which includes the client-specific training. Mun Siong Engineering participated in the initiatives for ASPRI-Westlite Papan integrated dormitory, and the Process, Construction and Maintenance Management Committee (PCMMC), which successfully helped to improve the productivity of our employees, and indirectly assisted us to cope with the increasing stringent labour restrictions in Singapore. The PCMMC's Productivity Council has started to introduce industry benchmarking. We have already adopted some strategies associated with the productivity objective, such as the self-propelled bundle-puller, which has improved productivity and reduced labor requirements.

Given that shutdowns and turnarounds are being delayed, what differentiates Mun Siong Engineering in a tough and competitive market?

Even when shutdowns and other major works are being delayed, routine maintenance will always be required. Previously, most of our competitors were only interested in major projects, but today, competition has heightened. We hope that our existing contracts and projects can pull us through this difficult period, while we diversify our business and expand our clientele concurrently.

Do you believe there are sufficient government policies in place to assist companies during this climate?

The government is doing what it can to support SMEs and the industry at large, including provision of grants. Given today's economy, however, no amount is sufficient. While Singapore has a significant standing in the oil and gas industry, the city-state is unable to significantly influence the outlook for the oil industry. Thus, we will have to wait for the market to recover – which I expect the cycle to start turning in 2020.

Do you have a final message for our international readers?

Although most Singaporeans view having a career in the banking or consulting sectors as the more attractive choices, I believe having an engineering career, especially for the petrochemical market, can be attractive for talents who seek challenges too. While we currently struggle to attract locals to this industry, the local government has noted the bias career choice, and has plans to rebrand engineering as an appealing career alternative. I am hopeful that Mun Siong can do its part to showcase engineering in the petroleum and petrochemical market for what it is; an opportunity for a highly analytical, challenging and rewarding career.

Shaun Pang Tong Heng

General Manager
AD-METH MECH-FIELD

In 2013, the demand for downstream maintenance plants was on the rise. What has changed since then?
In 2013 there were a number of major ongoing projects on Jurong Island, a large number of which have already been completed. While there are a few upcoming projects in the pipeline, they might not be realized due to the current price of oil. Plants such as Teijin, for example, have been shut down. Ad-Meth remains focused on providing maintenance services to the industry. Unfortunately demand for maintenance is also falling, we expect a 30% decrease this year.

What is Ad-Meth's primary focus as a maintenance provider?
Ad-Meth's maintenance services are mainly focused on heat exchangers. Our services included hydrojet cleaning and refurbishing services for heat exchangers and other equipment. We service refineries and chemical plants including Shell Eastern Chemicals, Shell Seraya Chemicals, Lanxess, Chevron, DuPont, Celanese, Singapore Refining Company and Singapore Power Group.

Does the availability of manpower continue to pose a problem for companies like Ad-Meth?
Finding skilled manpower and technical expertise is currently the main issue for Ad-Meth, as not many Singaporeans are entering the chemical industry. Another issue is that, while equipment is becoming progressively more automated, there is insufficient capital to invest in new and more efficient equipment. The cost of operating in the industry is high and maintenance service rates are continuously being pushed downwards.

What is Ad-Meth's competitive advantage in the market?
Ad-Meth's key advantage is our responsiveness. We have proven that we can complete projects safely and cost effectively using the best technologies available on the market. We value commitment to our end-users and we want to work on a long-term basis with our clients.

How easy is it for small to medium companies to obtain financing in Singapore?
The government is highly supportive when it comes to financing for equipment, and provides options at low interest rates. In terms of business loans, the current hot topic is the bank's exposure to the oil and gas industry. Today there is sufficient financing available for downstream projects, while upstream projects are suffering.

What is your outlook for Singapore's chemical sector and for Ad-Meth?
I expect that the demand for Ad-Meth's services will grow over the long term. We are positioning ourselves to ensure that we are lean, cost effective and able to provide the best services when new projects and demand for related services resurges. If the government wants to further develop Singapore's industry, local authorities will have to make sure that the country retains cost competitiveness.
Singapore's government is open to bringing more multinational corporations (MNCs) into the country to spur economic growth. The country is politically stable and open for business to the entire world. In the long term, demand will start to increase, making now a good time to invest in the country as costs of raw materials continue to fall. Especially given policymakers' goals to increase production of specialty chemicals, there continue to be substantial opportunities in the market.

A Glass Half Full

Singapore pioneers water and environment solutions

Water scarcity is a critical challenge facing our world today. In fact, in January 2015, the World Economic Forum announced the water crisis as the #1 global risk based on impact to society. The rapid disappearance of our world's essential non-renewable resource is compelling leaders, policy makers, innovators and industrialists to find ways to reduce, reuse and recycle water. Among them, Singapore has taken it upon itself to become a global leader in the field of water technology, recognized as a "Global Hydrohub," and home to approximately 180 water companies and 26 private research centers.
Endowed with few natural resources, the city-state uses four major sources of water, known as the National Taps. One of these is imported water from Malaysia, based on an agreement that will last through 2061. Singapore is planning ahead for water security, not only to meet the anticipated increase in demand with growth, but also towards drought resilience from climate change and other challenges. These challenges, like others facing the island, have inspired Singaporeans to develop new technologies to bring about water security and efficiency, at both the municipal and industrial levels, and eventually achieve water self-sufficiency.
"Maximizing use of water is especially important today as availability and quality of water are limiting factors for industrial and community growth. Hence, there is a demand for technological innovation to transform the way we treat, distribute and reuse water. This is especially key in Singapore, where there is limited water avail-

ability and high dependence on other countries such as Malaysia for supply," explained general manager of GE Power & Water, Daniel Lim.

Over the course of the last few decades, Singapore has secured its water supply from four water sources, or Four National Taps: local catchment, imported water, reclaimed water (known as NEWater) and desalinated water. In the process, the country has fostered the growth of a robust environment and water industry, which contributed S$1.7 billion to GDP in 2015. According to the Singapore Economic Development Board (EDB), since 2006, a total of S$470 million in public funds were put towards innovation and capability development in the space. Publicly funded research centers of excellence —Nanyang Environment & Water Research Institute (NEWRI) and NUS Environmental Research Institute (NERI)— have been founded to drive water research at Nanyang Technology University (NTU) and National University of Singapore (NUS), respectively. NUS and NTU are ranked as the world's first and second universities for water research. Most recently, in June of 2016, Singapore founded Asia Pacific's first center to develop and commercialize innovative separation and filtration technologies in partnership with the industry. The new Separation Technologies Applied Research and Translation (START) Center seeks to address both industrial and municipal demands for clean water. Minister for the Environment and Water Resources Masagos Zulkifli told the press that "there is a large gap between lab research and product commercialization" which START seeks to fill.

Multinational and homegrown Singaporean companies alike are working to leverage the city-state's mature water R&D ecosystem to locally develop and export water and waste treatment technology. For heavy industrial consumers of water such as chemical and petrochemical manufacturers, these technologies and solutions have the potential to considerably alter the bottom line. "Our customers are constantly looking for solutions to reduce water consumption, reuse and recycle whenever possible," said general manager of Nalco Champion's energy services downstream business line for Asia Pacific, Kian Tick Ong. Ecolab's energy services division, Nalco Champion, is one of a number of companies that are working alongside Singapore's chemical industry to address the water challenge. "We have developed new water chemistries that allow for a broader operating envelope, higher cycles with reliability, and hence, water conservation. We also ramped up our efforts in Integrated Water Management to enable recycle and reuse of cooling water blowdown," explained Ong.

At present, industrial consumers' demand for water solutions is only growing as a result of Singapore's record-low reservoir levels, which are putting pressure on costs. Multinational giant GE Power & Water is working to help chemical manufacturers and other large consumers combat this issue. "One of the unique business models that GE offers is termed Build Own Operate or BOO, where industry need not invest

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Daniel Lim & Hoshang Subawalla

DL: General Manager
ASEAN Japan Region
HS: Regional Executive Asia Pacific,
Water & Process Technologies
GE POWER & WATER

DL

HS

What are GE Water's activities in Singapore?

DL: GE Water specializes in water treatment and process system solutions for a number of industries including the petrochemical, chemical, power, food and beverage and semi-conductor sectors, across the Asian market. We work across the entire water space, with the aim of bringing together experienced professionals and advanced technologies to solve the world's most complex challenges related to water availability, quality, productivity, the environment and energy. GE Water boasts an equipment and chemical division that develops chemistry, programming, monitoring, tools, and online digitization, to help petrochemical plants run as cleanly and smoothly as possible. Our broader goal is to promote sustainable plants and maximize every drop of water through reuse. To achieve this goal, GE Water partners with EPC companies for the building of waste treatment facilities within plants on Jurong Island.

How does GE Water add value to the local chemical sector?

There is a demand for technological innovation to transform the way we treat, distribute and reuse water. This is especially key in Singapore, where there is limited water availability and high dependence on other countries such as Malaysia for supply. While water can be purchased, the effective price and use of the resource is critical for sustainability. Programs on Jurong Island have been put in place to encourage companies to pursue recycling technologies, and include incentives from JTC Corporation and Singapore's national water agency, PUB. Today, there are several new water facilities in Singapore that utilize GE's membrane bio reactors to pass dirty water through a proprietary system in order to obtain clean water, which can then be used for non-potable applications. GE has also built capabilities to produce energy from waste plants.

Why is Singapore important to GE Water's operations in the region?

HS: GE Water & Process Technologies Asia Pacific (APAC) headquarters are located in Singapore due to the ease of doing business here, coupled with our strong ties with the EDB. We are building our core competencies in Singapore to not only serve the greater Asia Pacific region, including China. Further to this, GE Water is in the process of establishing three engineering Centers of Excellence based out of Singapore. These would be underpinned by the Analytical Services Center of Excellence, which was set up a few years ago. The planned three Centers of Excellence shall serve the Ultra-pure Water (UPW) market (microelectronics, pharmaceutical and power sectors), the exploration, production and refining industry sectors and the municipal industry segment with a unique focus on waste to value (including energy and nutrient recovery), respectively.

A majority of the city-state's water reclamation plants utilize GE's ultrafiltration membrane systems. We are taking further steps to partner with plants in order to develop energy neutral wastewater treatment plants. Currently GE's technologies extract methane from municipal sludge and use it to generate power within the municipal treatment plant itself.

What have you identified as the main challenge facing manufacturers with regards to wastewater recycling and related cost management?

HS: The PUB is increasingly concerned about water supply to industrial consumers due to record-low reservoir levels. This is in turn having an impact on costs, which GE is seeking to address. We support the industry to recycle and reuse water to improve efficiency and become more cost effective. One of the unique business models that GE offers is termed Build Own Operate, or BOO, where the industry does not need to invest capital in new technologies. GE rents the equipment incorporating cutting-edge technology to industry, and operates the equipment for the customer. The customer pays GE per the volume of water treated on a monthly basis.

Where would you like to see GE Water within the next three to five years?

DL: GE Water is constantly working as a partner to customers, supporting them in their utility and wastewater needs. We are also seeking more partners that are equally passionate about the industry, and to expand our offering to our clients.

HS: Today GE Water maintains an important presence in Singapore, with a team of over 120 employees operating in the country. We continue to invest in training to retain our position as one of the top employers in the region.

Jeffrey Fung

Chief Executive Officer
NSL OILCHEM WASTE MANAGEMENT

NSL OilChem operates a number of businesses spanning across the oil and chemical value chain. Can you please walk us through the company's evolution?

NSL OilChem is a subsidiary of NSL Ltd whose history dates back to 1961. First started as the manufacturer of steel to support Singapore's nation-building efforts in infrastructural and residential development, NSL Ltd is now a leading industrial group in Asia Pacific with businesses in Precast concrete & Prefabricated Bathroom Unit, Dry Mix and Environmental Services. NSL Group has operations and joint ventures in nine countries and has been listed on the Singapore Exchange since 1964.

During the 1990s, Singapore was in need of a service provider to handle sludge and marine slop, compelling us to enter this market. NSL OilChem partnered with a French company to pioneer innovative technologies used in the recovery of marine waste, and within five years seized an estimated 50% of total market share. In 2001, as a response to customer demands for a one-stop service, we acquired a logistics firm that specialized in oil collection from shipyards. Subsequently, NSL OilChem Logistics Services was formed, and today we collect approximately 70% of land-based oily waste in Singapore.

Continuing along our acquisition spree, NSL OilChem bought an oil distribution company in 2007, which led to the establishment of NSL OilChem Trading. This strengthened our waste oil collection network. Given the volume of oil being collected, we decided to treat our residue in-house and invest in an incineration company, which later evolved into NSL OilChem Green Energy.

Over the course of nearly two decades, NSL OilChem has grown to become one of Singapore's largest industrial environmental services groups, working across the waste management, logistics, trading and green energy sectors. Together the NSL OilChem Group earns an annual turnover of approximately $100 million.

What facilities do you have in the island?

NSL OilChem has evolved into a fully integrated waste management company, with facilities both off and onshore. We are the only company in Singapore that has a waterfront facility for the purpose of receiving waste and treat it at the same site. NSL OilChem also operates an incineration facility that can process up to 20 metric tons of hazardous waste per day. Utilizing a green process, the heat from the waste is captured and converted into steam, which is in turn used within the plant to process additional waste.

In 2009 we built a local used lubricants re-refinery plant that can recover base oil from used engine oil. As a result of these recycling capabilities, NSL OilChem managed to extract better value for the recovered products as the recovered base oil could be used to blend low-grade engine oils, which has been extremely well received in the emerging markets.

What challenges are the manufacturers facing with regards to waste management in Singapore?

A lack of trained professionals and waste management engineers is the most pressing challenge companies are facing today. Training staff in the fields of safety and compliance is very important in the industry, and companies should consider improving the skills of their labor force so that they can adequately address waste management needs. Proper waste treatment plant design is another factor, as facilities must be able to evolve when new waste streams are being generated.

NSL OilChem helps customers address any kind of waste management issue. We view our customers as partners, and seek to understand their challenges and demands. Through these relationships we can offer viable, safe and efficient waste treatment solutions. The market is indeed crowded with small and medium sized enterprises (SMEs) that provide hazardous waste management services. However, moving up the value chain, there is a high demand for, yet low supply of hazardous waste managers, due to process complexity and limited specialized knowledge.

What are NSL OilChem's strategic goals for the next three to five years?

Given our current sales platform in the market, NSL OilChem is equipped to understand customer demands better than ever before. This intelligence and our strategic positioning will allow us to take the next step and replicate our business model in markets across Asia and Europe.

LWAD

Jacob Tornfeldt Sørensen & Lee Wan Aik Desmond

JTS: Head of Innovation, Marine Infrastructure and Energy
LWAD: Senior Engineer, Business Development for Industrial Utilities
DHI WATER & ENVIRONMENT

Please provide an overview of DHI's facilities and services in Singapore.

JTS: The DHI research center in Singapore consists of roughly 100 people working across the water industry in all areas: cross flooding, potential ground water, sediment dumping, reservoir ecology, marine ecology, sand sources, offshore structures, and industrial water. We work with industries to optimize water usage, policy makers to establish sustainable water behavior, and insurers to qualify expectations.

LWAD: DHI is an environment consultancy company that imparts clients and technology providers with knowledge on the best approach to water management systems. We are expanding our expertise in the area of water auditing, in response to the Singapore Public Utilities Board's (PUB) latest implementation of the water efficiency management plan. Our services cater to all industries that use significant amounts of water, of which the petrochemical industry is one. While system integrators tend to push for the sales of their products, DHI combines different technology providers to suggest custom systems to solve challenging water problems for the clients.

What does a water audit entail?

LWAD: DHI has a systematic water audit which covers the six R's: Reduce, Renew, Reuse, Recycle, Reclaim, and Return. With this, we aim at recovering water during upstream stage low costs, whereby the client will not require heavy capital investment on an entire downstream complex treatment system. We attempt to assess the true cost of water throughout the lifecycle and attempt to apply the concept of "Aqua fit for use" approach whereby water of right quality and quantity should be reused/ recycled for specific purpose.

Can you provide a case study of waste treatment with regards to the petrochemical industry?

JTS: At Singapore Refinery Corporation, we had identified five solutions of which one was implemented in April 2016: a water reclamation treatment plant to produce ultra-pure grade water, which is cleaner than NEWater and can be used directly in their boiler and at their main plant.

LWAD: Stemming from this research project, we have established projects in the bio-medical, pharmaceutical, electronics, food manufacturing, shipyard and petrochemical industries. To lead by example, DHI performed a free water audit for a specialty chemical company where we found significant, unanticipated amounts of water generated from their processes. We are currently discussing the next phase, the analysis of an appropriate treatment system, and assisting them in application of PUB subsidiary grants.

What challenges have you encountered working within the chemical and petrochemical sector?

JTS: Despite numerous incentives for sustainable wastewater treatment, companies are wary of hindering production. Relative low water pricing in Singapore, conservatism and operational processes in the chemical industry makes new idea implementation a challenge. With DHI's help, the government is creating successful examples of sustainable water systems that generate efficiency improvements and cost savings. Management is skewed toward proven technologies and voluntary cost savings, and not motivated by mandatory regulations and increased water prices. It would be ideal to help large companies through a slow transition towards more effective wastewater solutions over the next 5-10 years to lead an entire industry shift.

What will be the greatest obstacles for Singapore to achieving its goal of water self-efficiency by 2060?

LWAD: The technology to achieve this goal already exists and we need to improve on the water recovery rate offered by these technologies. This would mean more research efforts for wastewater treatment processes. Other challenges include space constraints regarding the establishment of these technologies within companies' premises and Singapore's scarce land area. Singapore, as well as Southeast Asia region must embrace the attitude of using water more conscientiously and the importance of industrial water efficiency will continue to grow as industrial (non domestic) water usage accounts for more than three times of water consumed in the domestic sector.

What are DHI's main goals for the next three to five years?

JTS: DHI has been in a reactive stage as a government consultant, and in coming years we endeavor to move up the value chain and work proactively with cities and big industries to support decision makers. We want to be involved in entire operations from planning stages through to system implementation. Flood and drought management risk is also a division in which DHI wants to be more involved.

LAWD: DHI wants to be part of a cultural shift toward rethinking the way we perceive recycled water, not just on the industrial level but for end-users as well. DHI links companies to PUB and encourage them to save water with regards to achieving Singapore's 2060 water goal.

Image courtesy of Nalco Champion

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capital particularly in new technologies. GE rents the equipment and operates it for the customer," said GE Power & Water's Asia Pacific regional executive for Water & Process Technologies, Hoshang Subawalla.

As part of a statewide drive to reduce water consumption, from January 2015, the national water agency, the Public Utilities Board (PUB), has mandated large water users to install private water meters at various water usage areas on their premises. The PUB is also requiring users to conduct an annual submission of water efficiency management plans for the following three years. In response, Danish environmental consultancy DHI Water & Environment is expanding their water auditing expertise. "DHI has a systematic water audit that covers the six R's: Reduce, Renew, Reuse, Recycle, Reclaim, and Return. With this systematic water audit process, we aim at recovering water during upstream stage, whereby the client will not require heavy capital investment on an entire downstream complex treatment system," explained senior engineer at DHI Water & Environment Singapore, Dr. Lee Wan Aik Desmond.

In addition to tackling the water variable in the sustainability equation, Singapore is also supporting the development of its broader environmental industry, comprising environmental consultancy, waste management and pollution control. Homegrown NSL OilChem for example, has grown to become one of Singapore's largest environmental services groups, and is quickly expanding its presence in the region. "We are the only company in Singapore that has a waterfront facility for the purpose of receiving waste. This facility is unique in that it is able to maximize efficiency and cost effectiveness by receiving and treating waste at the same site," said chief executive officer of NSL OilChem Waste Management, Jeffrey Fung.

Singapore is continually reinforcing its position at the helm of the global water and environment sectors, exporting technologies that equip both municipalities and industries with the tools needed to combat water scarcity and be more sustainable. But what precludes companies and plant operators from rushing to conduct audits and implement sustainable water management practices? "Despite numerous incentives for sustainable wastewater treatment, companies are wary of hindering production," explained head of innovation for marine infrastructure and energy at DHI Water & Environment Singapore, Jacob Tornfeldt Sorensen. Much like the IIoT story, "conservatism and operational processes in the chemical industry make new idea implementation a challenge," confirmed Tornfeldt. Other hindrances include manpower shortage and space constraints, both of which limit companies' abilities to implement solutions on their premises.

While sustainability is a key theme today across industries, a further mindset shift needs to occur in order to spur widespread change and adoption. With Singapore's non-domestic sector accounting for about 55% of water demand, industrialists share great responsibility in helping Singapore achieve water self-sufficiency. Not only do water and waste efficiency result in cost savings, but form part of a greater effort to sustain our society as we know it today.

Building Bridges across the Technology Readiness Valley

Taking Good Ideas to Great Products

Adil M. Dhalla,
Managing Director,
Separation Technologies Applied Research and Translation (START) Centre,
Nanyang Technological University – NTUitive Pte Ltd
Deputy Director,
Nanyang Environment and Water Research Institute (NEWRI),
Nanyang Technological University

One of the biggest challenges for commercialization of novel technologies is the gap between laboratory processes, results and testing, and the full scale final product. This gap is based on several key challenges, including scale-up of component materials and equipment, systems level thinking, and testing at pilot scale in an actual application setting. The recently launched START Centre will provide a path for separation technologies to be developed into commercial products.

Striking the Right Balance

Often, one comes across discussions on the relative importance of basic and applied technology development. Obviously, the correct answer is striking the right balance between the two –without strong basic research, there would be no platform from which to build products, and applied research provides the path to engineer basic innovations into actual solutions.

For Basic Research, the focus is on novelty; the emphasis is on learning, discovery and scientific publication. Some typical questions that are asked at this stage are: Is this new? Has this been done before? How does this advance our scientific understanding? How do we communicate this? It is critical that this piece be done right, because it is the basis of everything to follow.

For Applied Research, the focus is on developing new products and solutions, or, equally importantly, using existing technology in a particular field to provide solutions to a problem in another area. The emphasis is not only on technology, but also on protecting intellectual property, finding and developing potential markets, and often potential commercial benefit.

Typical questions asked by applied researchers in a "Business Proposal", which can then develop into a "Business Plan", are: What are some of the key problems the basic technology can solve? Are there existing solutions to this "problem"? If there are, how does our proposed solution compare to the existing technologies? The technology may be novel, but why is it "better"? Has the Intellectual Property been protected? How "scale-able" is the technology? Who will be willing/able to scale it up? How much will it cost (systems, not just materials)? Where can I test "proof of concept" in real life? Who will apply it (potential customers)? Who can commercialize it?

It is important to note that not only the thinking, but also the skill-sets needed for basic and applied research, while complementary, can be very different. Typically (though not always), skill sets for basic research, as would be expected, are more science-based, while those for applied research are more closely linked to the domain of engineering.

START Centre

The two major universities in Singapore, Nanyang Technological University (NTU) and National University of Singapore (NUS), are recognized as world leaders in the field of Water Technology, especially in the area of separations. Several innovative technologies have been developed in their laboratories, with excellent potential for future products.

However, as discussed earlier, there is a big gap between a technology developed in the laboratory, and a full-scale product. Let us take the example of a membrane based separation technology. The first challenge would be the feasibility of scaling up the fabrication of these membranes to manufacturing on an industrial scale. The next would be designing and developing modules in which these membranes would be packed. Once this has been done, one would need to design a system (including pumping, plumbing, electronic controls) depending on the application targeted (which could be municipal or industrial). Finally the "proof of the pudding" would be to test this system in real life conditions, at an actual test site.

Going directly from laboratory scale to manufacturing is a huge risk, based on the challenges above. This can be mitigated by developing the systems on a pilot scale. The START Centre has been launched to provide a path for the commercialization of materials, equipment and processes related to separations technology. The facilities being set up include pilot-scale membrane fabrication equipment, systems design and development and pilot testing under real life conditions. The START Centre is being staffed with technologists skilled in materials science, chemical engineering, electrical and mechanical engineering.

This initiative will provide academic and research institutions a much needed platform to take their innovative technologies forward to actual products, in partnership with key companies, both global and local. In addition, it will also give critical training in applications, scale-up and pilot testing, to undergraduate and post-graduate students, which will better prepare them for their careers, and also enhance their employment prospects.

Industrial Gases

Giants Rise to the Challenge

Industrial gas products are referred to as 'the oxygen of the chemicals industry'. From the food we eat to the electronics we use and the pharmaceuticals we are prescribed, the daily applications of industrial gas products are numerous and have been improving living standards for decades. It follows, then, that there is no better home for the leading industrial and specialty gas players than Singapore, a citadel of high standards. The success of Jurong Island engendered the development of a highly competitive and reliable pipeline network for industrial gas providers, and is home to industry heavyweights such as The Linde Group, Air Products and Air Liquide Singapore. President of industrial gases Southeast Asia at Air Products, Alex Tan, surveyed the market and noted: "There are two broad categories of industrial gas players in the market: tier one global majors which represent almost 90%-95% of the market share, and tier two local transfill companies. Currently, there is also a growing number of Chinese companies entering markets outside of China and competing for market share."

Despite Singapore's strong capacity expansion in the energy and chemicals space in recent years, the global commodity downturn is demanding transformation in the industrial gas sector. All of the key players echo concern over their customers' cost constraints and are rising to meet the

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> "We operate in 22 locations around Singapore, comprising four subsidiaries and joint venture companies. ALSg has invested approximately USD$1 billion in assets and much of this is dedicated to our network on Jurong Island."
>
> - David LeBlanc, Managing Director, Air Liquide Singapore (ALSg)

Alex Tan

President Industrial Gases
South-East Asia
AIR PRODUCTS

Could you give us some background information about Air Products?

Our history dates back to 1940 when the firm pioneered the onsite mode of industrial gas supply. Today, in Singapore and across the world, Air Products builds gas facilities at customers' sites and owns and operates these facilities to supply customers in various industries including steel, oil and gas and petrochemical sectors with large quantities of oxygen, nitrogen and hydrogen via a pipeline network.

Air Products has been serving the Singapore market since 1997. We have gas production facilities on both Jurong Island and Senoko serving our customers via different supply modes. Our onsite plant in Sakra was built in 1997 to supply oxygen and nitrogen to a leading chemical company and a few other pioneering customers in the formative years of Jurong Island. This onsite plant also caters to other firms on Jurong Island and the mainland through a pipeline network or via our liquid gases distribution trucks. If smaller volumes are required, customers have the option of purchasing gases in cylinders.

In addition, we also offer an innovative application –the Air Products Express (APEX) Nitrogen Pumper Service– which reduces the downtime for refineries and other petrochemical companies on Jurong Island during their planned or unplanned maintenance. Our services offer a wide range of flow rates, pressures and temperatures, and gases are delivered safely without customers having to make any additional capital investment. The applications for the APEX Nitrogen Pumper Service are wide-ranging and include hot purging/stripping, cooling of reactors or heat exchangers and pressure testing.

How would you characterize the competitive landscape in Singapore?

There are two broad categories of industrial gas players in the market: tier one global majors which represent 90% to 95% of the market share, and tier two local transfill companies. Currently, there is also a growing number of Chinese companies entering markets outside of China.

What differentiates Air Products' service offering in the marketplace?

Air Products is a world leading industrial gases company with 75 years of heritage in safety, innovation and operational excellence. We have a solid track-record in the areas of safety and reliability. One example is our extensive hydrogen pipeline network between Louisiana and Texas, which spans over 600 kilometers. Among all, our main differentiator is innovation. Today, we have more than 4,800 patents and invest USD $140 million annually in R&D. We continue to develop new applications that improve our customers' cost position and help them reduce their carbon footprint.

Air Products has been a leading global supplier to the refining and chemical processing industry for more than 65 years. Many chemical processes are enhanced through our gas technologies. Oxygen-based solutions that enable our customers to increase production without significant capital increase include oxygen enrichment technologies for capacity expansion at sulfur recovery plants, air-based oxidation plants, fluid catalytic cracking units and wastewater treatment systems.

As highlighted earlier, one of our innovative applications includes our APEX Nitrogen Pumper Service offering for refineries and petrochemical companies. By utilizing a vaporizer inside a truck, we are able to transform liquid into gas at high pressures quickly. With the use of our mobile trucks, Air Products is able to perform rapid cool-down and heating of reactors, which shortens the entire turnaround schedule for refineries.

What goals does Air Products hope to achieve within the next five years?

Air Products has been in the Singapore market for close to 20 years and we have built a strong position on Jurong Island. Our goal is to continue to support Singapore's industrialization efforts and invest in larger plants. We strive to expand our business and grow our market share through targeted investments. Another important goal is to continue to innovate and offer an increased number of innovative products and services to the market. We view Air Products as not only a supplier of industrial gases but an innovative provider of solutions to our customers which ultimately add value to them in all areas including safety, reliability, cost efficiency and reduction of carbon footprint.

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challenge with internal improvements, technological innovation and infrastructure expansion.

The Linde Group, which operates a high performance air separation unit (ASU) and one of the largest gasification plants in the Asia Pacific region producing gaseous hydrogen and carbon monoxide, is addressing the changing landscape with a new organizational outlook. "The industrial gases industry here and globally has weathered significant economic challenges, which include an oversupply in the steel industry and slump in oil prices. Some of our customers have similarly been impacted by the economic headwinds. We have identified a major opportunity in building even closer partnerships with our customers to deepen our understanding of their businesses. This enables us to help them identify the right gas solutions to reduce costs, optimize process efficiency and enhance productivity," explained the group's regional managing director for South Asia and ASEAN, Rob Hughes.

The sensitivity to customer cost constraints is most evident in the unwavering adoption of new technologies. Air Products' Tan highlighted the possibilities of productivity improvement and cost reduction through innovation: "Customers always require safety and reliability from their suppliers, but the main differentiator in the market is innovation. By introducing more oxygen to the steel production process, for example, iron ore is burned more effectively. Higher oxygen levels allow for faster heating and faster burning, and subsequently significant costs can be saved on coke and higher productivity can be achieved. Oxygen is cheaper than the raw materials and the end product is cheaper high quality steel."

Air Liquide Singapore, the largest gas provider in the region, currently owns and operates the largest network in Singapore with six separation plants, interconnected by a common pipeline. By coordinating shutdowns with customers, and offering expansive backup storage facilities, Air Liquide Singapore endeavors to limit downtime for customers and ensure a constant supply of industrial gases. David Leblanc, managing director of Singapore, Malaysia, Riau Island (SMR), for Air Liquide Singapore, remarked: "The advantage of being part of a pipeline network is that we have a number of plants that allow us a very high level of reliability. If there is an interruption to a plant, we can directly divert supply from another plant to the same customer."

What once were gas providers 25 years ago are now full-fledged technology stalwarts and solution providers. The acute attention to customer needs industry-wide has transformed the industrial gas sector in Singapore, which promises to evolve on both organizational and technological fronts. Although the region will not experience growth equal to that of the past decade, existing expertise will continue to enhance the client experience from the ground up, and expand beyond the chemical and petrochemical industry to buoy new sectors and geographies. —

Rob Hughes

Managing Director for
South Asia and ASEAN
THE LINDE GROUP

What have been the main milestones for The Linde Group recently?

The persistent economic uncertainties over recent years have impacted many markets and industries across the world. The industrial gases industry here and globally has weathered significant economic challenges with the slowdown in key pillar industries such as steel and oil and gas, which has had a trickle-down effect on other downstream industries.

With a diverse customer representation, from steel to food and beverage to healthcare, we have seen a shift in customers' demands from us for solutions and technical advice on productivity and operational efficiencies. As such, The Linde Group has evolved both globally and within Asia to be a more customer centric, solutions-focused organisation. We are building even closer partnerships with our customers and deepening our understanding of their business operations. This enables us to help them identify the right gases solutions to optimize process and cost efficiencies, and productivity, while maintaining high-quality output.

A case in point –in January, we renewed our long standing relationship with a global key customer, Celanese, to continue supply of carbon monoxide to their Singapore-based manufacturing facility plant for the production of acetic acid. The agreement underscores the strength of long-term cooperation and working with customers for win-win outcomes.

Low oil prices are compelling players across the chemical industry to diversify. Has The Linde Group adopted a diversification strategy in the Asia Pacific region?

Our gases solutions touch almost if not all parts of life – from the manufacturing of stainless steel for your teaspoon, to the fizz in your carbonated drink, to the electronic components of your mobile phone, to supply of medical oxygen in hospitals. This means we have an extremely diversified customer base across global markets. We are constantly developing and leveraging new gases solutions and gases-related technologies through our R&D centers in China, India, Germany and the US to satisfy our customers' diverse needs. New technologies that are developed for our customers in one market are introduced to customers elsewhere. For example, our oxygen injection technology used to aerate the waters in fish farming in Norway has been applied for the cleaning up of rivers in this region.

On healthcare, we are a global leader of medical gases, devices, clinical care, and support services in Europe and the United States, and we are presently looking to expand those areas of expertise in Asia. We are working towards meeting the healthcare industry's needs with regards to services, packaging, digitalisation and product management within hospitals. Subsequent to a successful foray into Hong Kong, we are now proud to supply six major hospitals in Singapore.

What are some challenges and advantages associated with operating in Singapore?

Singapore's connectivity and stable infrastructure remain an attractive location to base our regional headquarters. This is simply because of the access to talents here. Singapore is home to an excellent education system and an attractive hub for international professionals. The management team in our regional office is evenly comprised of men and women, and the office is culturally diverse with more than twenty languages spoken. A multitude of cultures brings a diversity of thought and experience gives us that competitive edge to remain weatherproof and forward-looking.

What opportunities is The Linde Group looking to seize in Asia Pacific's chemical industry?

The next ten years will not witness the same global and regional growth as that of the last decade. Asia however, remains a key growth engine for the world. Malaysia, for example, is building a key chemical cluster in the Johor state. We have recently announced a joint investment there with Petronas Gas Berhad. Thailand also serves as a critical geography for us: the government is pursuing significant infrastructure investments, a good sign to calibrate growth levels. We have a strong position in the Thai Map Ta Phut industrial cluster, which we expect to be a growth area in the medium term.

The rising living standards, coupled with the ageing population and increasing of wealth in the emerging markets here, create in-roads for us to progress with our healthcare offerings.

What does The Linde Group hope to achieve within the next three to five years?

Digitalisation will change the operations of how we do business in the gases industry, and it will be crucial to remain ahead of that curve. This region is definitely where the growth is, and we are committed to being a part of that growth. Significant investments have and will continue to be made here over the next decade, as we continue to work with our customers and diversify our offerings accordingly. —

COMPANY INDEX

Global Business Reports
COMPANY INDEX
This list is a limited selection of companies and should not be considered a comprehensive guide of the players operating in Singapore's chemical industry.
GBR holds an exclusive and extensive database for Singapore and the wider region.
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