# SPECIAL REPORT ON SINGAPORE

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# SINGAPORE'S CHEMICALS ECOSYSTEM

*This research has been conducted by Irina Negoita, Julian Issa, Sarah Crompton-Donnelly and Emma Johannes from Global Business Reports. For more information, contact info@gbreports.com. Cover photos courtesy of Exxon Mobil, Jebsen&Jessen and Bertschi.*

## INTRODUCTION

### Singapore's Chemicals Sector Once Again Redefining Itself

Singapore continues to redefine itself 53 years on since independence. From the city-state's humble beginnings, it emerged as one of the four Asian tigers before consolidating its position as a global logistics and business hub. With an area spanning only 721.5km2, less than half the size of London, and with no natural resources of its own, Singapore's rise was no easy feat. In fact, the country's founding father Lee Kuan Yew believed, in 1965, that a merger with Malaysia was essential to its survival. "Every time we look back on this moment when we signed this agreement which severed Singapore from Malaysia, it will be a moment of anguish," Lee uttered the day before the Malaysian parliament passed the resolution to sever ties with Singapore. Few would have disagreed with Lee's assessment then, but even fewer would have predicted Singapore's success over the next half-century.

Lee argued that an independent Singapore was a "political, economic and geographical absurdity," yet it has been these three variables that have been the bedrock of this success. Lee faced his share of political opponents, who criticized his policies, but he vanquished them by minimizing corruption and crime and allowing communities to thrive harmoniously. Adopting a free trade policy in the 1960s when few others in the region did, he paved the way for large multinational corporations (MNCs) to come. Singapore's strategic location at the southern tip of the Malay Peninsula, well positioned to take advantage of markets in the Indian and Pacific Oceans, and its natural deep-water ports made it an ideal global trading and shipping hub. By the end of 2017, there were 37,400 international companies headquartered in Singapore, including 7,000 MNCs (EDB).

Now, Singapore is leveraging dynamic trends in economic growth and shifts in geopolitical power in the Asia-Pacific

## THE ENERGY & CHEMICALS SECTOR AT A GLANCE

**10.1% GROWTH**

manufacturing sector 2017

**6.2% GROWTH**

chemicals manufacturing sector 2017

**3.6% GDP**

annual increase 2017

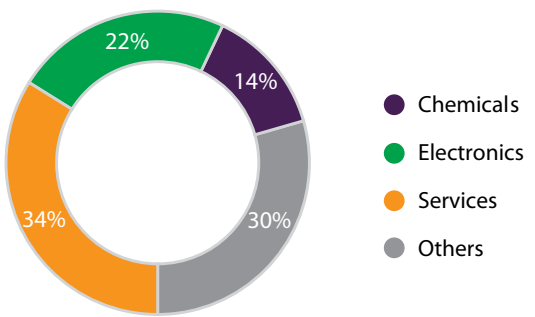
**19.1% SHARE**

chemicals share of overall manufacturing 2017

**S$19 BILLION IN R&D**

from 2016 to 2020 through the Research, Innovation and Enterprise (RIE) plan

FIXED ASSET INVESTMENTS BY INDUSTRY CLUSTER




**S$1.3 BILLION**

OF FIXED ASSET INVESTMENTS in Singapore's Chemicals Industry in 2017

Source: Singapore Economic Development Board


Introducing the largest producer of renewable diesel in the world.

NESTE
The only way is forward

## **Interview** with Damian Chan, Executive Director and Cindy Koh, Director, Energy & Chemicals, **Singapore Economic Development Board (EDB)**

**Singapore was recently ranked second as a driver of production in the World Economic Forum's 2018 Readiness for the Future of Production Report. What sets Singapore apart as the preferred destination for the chemicals value chain?**

**DC:** Singapore has a very well established foundation for its energy and chemicals industry. The industry was built on its refineries, and during the 1980s, we integrated downstream into petrochemicals. The opening of Jurong Island in 2000 put Singapore on the path towards building a highly integrated energy and chemicals complex, providing the city-state with a significant head start in the region in terms of developing a competitive and integrated chemicals ecosystem. As a result, we now have over 100 energy and chemicals companies on Jurong Island. That in itself provides Singapore with a competitive advantage over other chemical hubs in the region, which are generally dominated by individual companies. For businesses looking to operate in Singapore, the opportunity to source for feedstock and then sell their products, over the fence, is immense.

Moreover, our industry is export-oriented and driven by global demand and business cycles. As such, Singapore is highly reliant on global trade. Companies in Singapore will be able to tap into our extremely wide network of free-trade agreements representing 60% of global GDP, which includes ASEAN, China, India and the United States. We are also in the process of ratifying the Singapore-EU trade agreement. Finally, given that investments in the industry are capital-intensive, predictability, in terms of politics and government policy, is essential and something we are able to provide.

**CK:** In addition, as Singapore moves towards higher value-added derivatives, intellectual property (IP) protection with respect to innovation and manufacturing processes will be very important. For many companies, formulation and process technologies are trade secrets, so they appreciate Singapore's respect for IP protection.

**The carbon tax has been a major topic amongst Singapore's manufacturers. What do you hope the 2019 carbon tax will achieve?**

**DC:** Under the Paris Agreement, our commitment is to reduce emission intensity by 36% from 2005 levels and to stabilize its emissions with the aim of peaking around 2030. In developing this commitment, we have factored in the continued growth of emissions-intensive industries, like energy and chemicals, so that the industry has a continued growth runway in Singapore.

The carbon tax will be levied on large emitters that emit 25,000 tons and above of greenhouse gas annually. It will be priced at a flat rate of S$5 per ton for a transition period of five years from 2019 to 2023. The first payment will be made in 2020, based on emissions in 2019. While the current longer-term intent is to raise the carbon tax to S$10 and then S$15 per ton of emission by 2030. After the initial five years, changes to the carbon tax will take into account international climate change developments, the progress of Singapore's emissions mitigation efforts, and economic competitiveness. The revenues collected will be used to support companies' energy efficiency and carbon reduction projects.

The Singapore Government estimates that about S$1 billion will be collected from the carbon tax over the initial five years. However, the carbon tax is not a revenue generating exercise. The Singapore Government is prepared to make available more than what is collected to support worthwhile energy efficiency and carbon emissions reduction projects in the industry. Many of the oil majors have announced their commitment

(APAC) region. Exponential population growth has caused consumption in China, India and the Association of Southeast Asian Nations (ASEAN) to surge, propelling increased demand for a range of chemicals. Singapore's strategic location, well-defined regulatory landscape, and advantageous business conditions make it perfectly situated to capitalize on regional growth. Its manufacturing sector has seen demand rise most noticeably for high value-added derivatives including lubricants, dyes, synthetic rubbers and coatings in recent years. It is increasingly being seen as the ideal regional headquarters for MNCs, a global destination for research and development (R&D), and the Asia-Pacific's logistics and manufacturing hub.

"Although Singapore is a small market in terms of chemicals consumption, it is a good regional hub where we can easily serve the surrounding countries," said Henri Nejade, president and CEO Asia, Brenntag.

Jurong Island lies at the center of Singapore's refining, petrochemical, and specialty chemicals activity. Its integrated design and robust logistical capabilities have made it home to most of the major chemicals manufacturers. The chemicals sector has seen sustained, year-on-year growth of 10%, as of May 2018, nearly mirroring the 9.8% growth in the manufacturing sector. The industry has not been without its share of challenges, however: "The evolving regulatory landscape, organizational restructuring to a leaner workforce and demands for higher productivity are still prevailing challenges faced by the industry," said Terence Koh, executive director of the Singapore Chemical Industry Council (SCIC).

Recently ranked second as a driver of production in the World Economic Forum's 2018 Readiness for the Future of Production report, Singapore's government has underlined productivity as one of its priorities. Central to this mission, the Singapore Economic Development Board (EDB) is implementing Industry 4.0 technologies. Driven by the Energy and Chemicals Industry Transformation Map (ITM), the initiative aims for a manufacturing value added (MVA) of S$12.7

billion and 1,400 new jobs by 2025. The ITM's two-pronged strategy focuses on transforming Singapore's existing base of chemicals manufacturing through the adoption of innovative solutions and, in doing so, expanding into new markets.

Success in technological advancement and digitalization will be underpinned by the industry's readiness to adopt dramatic changes, given its conservative nature with certain manufacturers who have yet to embrace Industry 3.0-level technology. As Industry 4.0 gathers momentum, companies are grappling with trying to understand its concepts and the value it could bring. Consequently, the EDB has partnered with TÜV SÜD Asia Pacific to develop the Singapore Smart Industry Readiness Index, which serves as a diagnostic tool that companies across all industries and sizes can use to better understand Industry 4.0 concepts, evaluate the state of their facilities, and build a transformation roadmap.

Sustainability is another priority for the government, with 2018 being named as Singapore's Year of Climate Action. The government is seeking to raise the level of national consciousness about climate change and encourage efforts towards ensuring a more sustainable Singapore. This has been coordinated with the passing of legislation on a carbon tax, which will come into effect in 2019, and will be initially set at S$5/t of CO2.

Singapore has shown its ability in the past to adapt to market volatility by creating optionality and optimization. Moving forward, digitalization and technological advancement will be the pivots on which it seeks to transform itself into a more sustainable and ultimately more productive market. ■

***"Singapore's Smart Nation initiative sets the right framework for the early adoption of innovative technologies. We always position ourselves in regions where these new technologies are deployed to develop our services as close to partners and customers as possible. Our decision has been vindicated over the last three years. Additionally, the liberal labor laws in Singapore fasten the hiring process. "***

**Andreas Hauser,**
Director Digital Service, TÜV SÜD Asia Pacific

to sustainability.. We foresee that carbon pricing will become more pervasive moving forward and our early efforts will position Singapore well for the future, especially when carbon capture or sequestration technologies becomes more widely available.

**Industry 4.0 technologies have become a key focus for Jurong Island with automated systems, driverless trucks, and big data a few of the new technologies being implemented. How important will it be for the industry to embrace these technologies and how will they stand to benefit?**
**DC:** We are heartened by the early adoption of these technologies by manufacturers. Additionally, there are a number of solutions providers that are opening digitalization hubs and centers of excellence in Singapore, including Accenture, Emerson, Yokogawa, Siemens and GE. Digital transformation ranks highly on the Singapore Government agenda because such technologies have a wide range of application. For instance, besides investing in cogeneration plants, digitalization could be a low-hanging fruit for companies wanting to improve energy management to reduce carbon emissions. Digitalization could also improve competitiveness by enhancing productivity in the areas of inspection and maintenance.
In addition, the Singapore Government, alongside TÜV SÜD, launched the Singapore Smart Industry Readiness Index ('Index') - a diagnostic tool that companies can use to evaluate their Industry 4.0 readiness and develop a transformation roadmap.

**The Energy and Chemicals Transformation Map (ITM) is aiming for a manufacturing value added of S$12.7 billion as well as 1,400 new jobs by 2025. Can you introduce our readers to the ITM and tell us what it sets out to achieve?**
**DC:** The initiative to develop roadmaps for 23 sectors originated from a recommendation by Singapore's Committee on the Future Economy. Each ITM sets out a holistic roadmap for each industry across four main pillars of focus: productivity, innovation, skills and jobs, and trade and internationalization.
The ITM leverages Singapore's tripartite approach – government, unions and industries – to work together on the future competitiveness and sustainability of those respective sectors.
The productivity segment outlines the priorities with respect to improving and upgrading the existing plants in Singapore, both in terms of digitalization and product upgrading. Key to this is the diversification from commoditized to higher value added and specialty-grade products.
The other part includes system-level solutions to help improve competitiveness. This involves providing increased opportunities for companies to carry out feedstock diversification, as well as investing in logistics. For example, Petrochemical Corporation of Singapore's new naphtha storage tanks have enabled them to respond quicker to the changing needs of the market as they have flexibility to blend different grades of naphtha. Vopak's new LPG terminal also provides crackers with an alternative feedstock beyond naphtha.
The jobs and skills segment is mainly tied to Singapore's SkillsFuture initiative, which is a national movement that promotes lifelong learning and skills mastery. Alongside the ITM, we launched the SkillsFramework for Energy & Chemicals. It maps out, and makes available to the public, information related to career paths in the industry and the skillset required for each path. Subsequently the government will ensure that there are relevant courses available for individuals that want to upgrade themselves.

**A*STAR is trying to increase collaboration between research institutions and the industry. How important are Singapore's research institutions in attracting new industry investment?**
**CK:** Our work in this area is closely tied to the innovation pillar of the ITM. Specialty chemicals is the growth engine of Singapore's energy and chemicals industry. For these companies, the ability to formulate the right products and deliver customized solutions is a key differentiating value proposition.
In this regard, we have shortlisted five initial focus areas that have demonstrated strong growth potential in Asia: consumer chemicals, oilfield water chemicals, lubricant additives, animal health nutrition and agrochemicals. ■

# YEAR OF CLIMATE ACTION

## Sustainability Brings a New Lens to Industry

On December 12th 2015, 175 nations adopted the Paris Climate Agreement, pledging to reduce carbon emissions through switching to cleaner fuels and financing more sustainable energy solutions. With a predicted temperature increase of between 1.7o C to 4.4o C (A1B Scenario, SE Asia) and an expected sea-level rise of one meter by 2100, Singapore will be severely affected by the effects of global warming if action is not taken. Aware of these implications, the city-state is meeting the problem head-on. Even though it ranked the eighth most sustainable city in the world in 2017 (Arcadis Sustainable Cities Index), the government knows it can do better.

Singapore therefore declared 2018 the city-state's Year of Climate Action with the intention of reaffirming its commitment to meeting its Paris targets and consolidating policy changes announced in 2017. Singapore's leadership on this issue matters even more in 2018, since it has assumed the chairmanship for ASEAN, in which capacity it is already leading discussions on climate action. "Climate change poses an existential challenge for Singapore. We must take action now, for the sake of our future generations. Although Singapore contributes only a small amount (0.11%) of carbon emissions worldwide, we will do our part as a responsible global citizen to fight climate

Masagos Zulkifli, Minister for the Environment and Water Resources, Government of Singapore

change," said Masagos Zulkifli, Minister for the Environment and Water Resources.

Sustainability, it must be noted, was only on the periphery of the industry's conscience before Paris. As much as Singapore wants to meet its international obligations, market forces are also at play. Changing consumer perceptions, new regulations, and a sprinkle of morality are additional factors propelling the quest for sustainability. This combination of factors is pushing industry and government to collaborate in specific ways at both the local and global levels.

Kenneth Lim, Site Director, Neste

Together for Sustainability (TfS) was founded for this purpose: to create dialogue on tangible sustainability improvements between both suppliers and their customers. Started by six major multinational chemical companies with significant operations in Singapore – BASF, Bayer, Evonik, Henkel, LANXESS and Solvay – TfS shares the results of sustainability assessments and audits with all its members and has a vision to improve sustainability practices across the industry's supply chains. "TfS members have been working jointly on assessing and auditing suppliers in order to create transparency and push for improvements […] We notice that sustainability is becoming more and more important. With the United Nations Sustainable Development Goals we have seen for the first time a globally accepted framework aiming at sustainability," said Dr. Gabriele Unger, general manager at TfS.

As manufacturers look for ways to be more sustainable, the concept of a circular economy that can increase energy efficiency and reduce carbon emissions is gaining currency. The chemicals industry has already seen a number of co-generation (the simultaneous production of electricity with the recovery and utilization of heat) and tri-generation (the process in which some of the heat produced in a co-generation plant to used to generate chilled water) facilities open. ExxonMobil, for instance, opened a new cogeneration plant in Singapore, while producers Chang Chun Group and Novabay have been actively decarbonizing their production processes in symbiotic fashion: Chang Chun provides high-purity carbon 'waste' to Novabay, which uses it to produce high-quality sodium bicarbonate.

Neste, which begun commercial production at its refinery in Singapore, has been forging ahead with its drive towards sustainability. The company sources 100% of its feedstock from wastes and residue oil and fats and through its NEXTBTL technology produces renewable diesel. "Neste wants to be a valued partner in the global fight against climate change, and is committed to develop solutions to help decarbonize society for the present and future generations. This is the purpose that drives us on a daily basis," said Kenneth Lim, site director at Neste.

## CARBON TAX SET FOR 2019

The impending carbon tax has been on the mind of most manufacturers as well as companies that will be directly or indirectly affected by it. Some of Jurong Island's producers have already made efforts to reduce their carbon footprint. ExxonMobil's cogeneration plant in Singapore, which opened in 2017, will have a 4% to 5% improvement in energy output, reducing carbon emissions by 265,000 tonnes per year. However, in an industry that is becoming ever more competitive, every cent counts. Industry leaders are concerned that even at the improved rate of S$5/t of CO2, the carbon tax may deter potential manufacturers from investing on Jurong Island. Terence Koh, executive director at the Singapore Chemical Industry Council (SCIC), has encouraged the carbon tax regime to be based on benchmarking, rather than a flat-tax rate. "In the long term, benchmarking systems will motivate companies towards lowering carbon emissions while ensuring the competitiveness of their business operations in Singapore," said Koh.

**S$5**
PER TONNE

Intended tax rate for CO2 emissions from 2019-2023 (Budget 2018)

**S$1 BILLION**

Expected tax revenue that will be channelled towards industry's energy efficiency projects

**1 METER**

Mean sea levels potential rise by 2100 in Singapore

**+1.7°C to 4.4°C**
CHANGE

IPCC AR4 Projections 2100 (A1B Scenario, SE Asia)

## FOR A RAINY DAY: TARGETING WATER SELF-SUFFICIENCY

The late Lee Kuan Yew made water his top priority, with a vision to capture every drop of rain that fell on the island. "Every other policy has to bend at the knees for our water survival," said Singapore's founding father. Water demand in Singapore currently stands at 430 million gallons a day, with non-domestic consumption accounting for 55% of total demand (PUB). By 2060, Singapore's total water demand could almost double. In 2015, the Water Resources Institute (WRI) ranked Singapore as one of the most water-stressed countries in the world. Moreover, the WRI argued that Singapore is set to become one of eight countries globally that will be most vulnerable to disruptions in water supply.

Singapore is therefore seeking self-sufficiency in water through a multi-pronged strategy. One of the key steps has been the construction of the NEWater plants, which recycle used water into ultra-clean, high-grade reclaimed water. Singapore currently has five NEWater plants providing 40% of the island nation's needs. It is also harnessing reverse-osmosis technology to produce desalinated water from seawater. A third desalination plant was recently completed in Tuas and construction on a fourth plant in Marina East began in earnest last year. The fourth plant is set to produce 30 million gallons of fresh drinking water per day with completion scheduled for early 2020. By 2060, the NEWater and desalination

plants are forecast to meet 85% of Singapore's water demand. Hannah Hamling, president for APAC at Golder, underlined the importance of Singapore's talented ecosystem for its success in sustainability. "One would expect Singapore to have difficulty in sustainability due to a shortage of water resources and a relatively limited land mass. The people and government of Singapore, however, have been innovative in their approach to developing a sustainable city and educating its people on their carbon footprint. Much of this success can be attributed to a drive in Singapore to create an awareness, and an ownership, within its citizenry," said Hamling.

With non-domestic water consumption set to account for 70% of overall intake by 2060, manufacturers are looking at ways to improve water-usage efficiency through their operations. Huntsman, which operates in an industry that heavily relies on water consumption, has been prioritizing water savings in its innovation pipeline. Its award-winning proprietary dye, AVITERA, will cut water usage by 50%. LANXESS' LewaPlus software suite is also directly improving water purification. These solutions are increasing recovery rates in the reverse-osmosis process of water purification to 98%, considerably higher than the traditional 75% to 85%.

In light of Industry 4.0, water and waste resource-management companies are also expanding their product offerings to streamline and optimize their customers' processes. Veolia Water Technologies, that has a wide footprint in APAC, has offered a digital platform, AQUAVISTA™, to provide plant personnel with a

Hannah Hamling, President for APAC, Golder.

Frédéric Théry, CEO Asia Pacific, Veolia Water Technologies.

Rohit Aggarwal, President of Textile Effects Division, Huntsman.

monitoring tool to efficiently control connected plants and water-treatment equipment. "The AQUAVISTA™ portal provides real-time remote monitoring of equipment data, dynamic alarm management, and information for operators, leading to real improvements in efficiency and productivity. Moreover, the AQUAVISTA™ provides benchmarking and suggestions for process optimization," said Frédéric Théry, CEO Asia Pacific, Veolia Water Technologies.

Singapore has come a long way since the polluted waterways of the 1970s. The city-state's lack of clean water would for many countries have been a crippling disadvantage. Yet Singapore turned that weakness into a strength. Now a global hydrohub, it is leveraging its capabilities, from its leading research institutions to its multiple industrial sectors, to develop innovative, sustainable solutions to optimize water use and secure the city-state's water future.

## A SEARCH FOR REGULATORY COHESIVENESS

In Singapore as well as China, a strong and cohesive regulatory framework complements the growth in demand for sustainable products. Rohit Aggarwal, president of global textile effects at Huntsman, said: "This is a perfect storm; where the consumer is becoming more aware of environmental sustainability and governments are prioritizing legislation. This represents an exciting time for the industry as focus shifts from pure cost to sustainability and creating value," said Aggarwal.

Despite this, other countries in the ASEAN and APAC more broadly, including Indonesia, Malaysia, and India, have been slower to adopt new regulations on sustainability. These markets are also some of Singapore's top export destinations. Unlike in the EU, the ASEAN does not have a regulatory setup that creates uniformity across the region. This is problematic for Singapore's chemicals producers as they are likely to face competition from local producers that may be using cheaper, less environmentally friendly products. "What is happening in China and Singapore is very different from both Southeast Asia and India. In those regions, the change to volatile organic compounds (VOCs) and low odor is not driven by regulation or the government but by marketing forces," said Belur Krishnamurthy Sethuram, managing director, India, Japan and SEA-ANZ, Celanese.

Singapore has been a force of change in the past and is taking the lead in specific areas. Singapore's green building strategy, for instance, aims at making sure that 80% of all buildings meet green credentials by 2030. Jeremy Rowe, managing director of decorative paints, Southeast and South Asia and Middle East, AkzoNobel, highlighted that this initiative is a great example of how Singapore is able to instigate a regional shift. "Singapore is a leader in the region when it comes to developing regulations through its system of governance, measurement and incentives. This is why Singapore sets ambitious targets on green buildings, for example. What is positive is that many countries in the region use Singapore as a reference point for building regulations, which increases regional standards," said Rowe.

Singapore, alongside China, is setting an example for the region. India and Vietnam are already showing further commitment to strengthening their regulatory framework and, with Singapore holding the ASEAN chairmanship this year, there is an increased possibility that the association aligns further on sustainability. ■

# MANUFACTURING

## Singapore's Chemical Producers: Feeding Asia's Appetite

One would be forgiven for missing the little red dot on a world map, but Singapore has proven over recent decades that size does not matter. Its position as a top 10 exporter of chemicals, according to the World Trade Statistical Review 2017, is alone testament to this truth. This feat is even more impressive when considering India, which exported US$36 billion of chemicals in 2016 - US$9 billion less than Singapore – is 4,716 times the size of Singapore.

The 32 square-km Jurong Island, an amalgamation of seven offshore isles, has been at the heart of Singapore's emergence as a chemicals powerhouse. With the global chemicals market expecting a compounded annual growth rate (CAGR) of 3.9% from 2015 to 2030 according to Ernst and Young, the island's role is set to grow even more powerful.

In fact, Singapore's manufacturing sector has experienced a resurgence in 2017, with the sector expanding by 10.1%. This measured against 3.7% growth in 2016, according to Singapore's Ministry of Trade and Industry. Although chemicals output is expected to increase by 5% in Q1 2018 compared to Q4 2017, the general business outlook for the first half of 2018 is less auspicious: growth is expected to decline by 9% compared to the second half of 2017, as noted by the Singapore Economic Development Board (EDB). This decline, however, is driven largely by a reduction in petrochemicals production due to scheduled plant maintenance, suggesting it will only be a temporary downturn. Further downstream, specialty chemicals manufacturers anticipate greater output in the near term due to increased export orders from the region, as ASEAN economies are expected to perform strongly in 2018 thanks to growth in domestic demand.



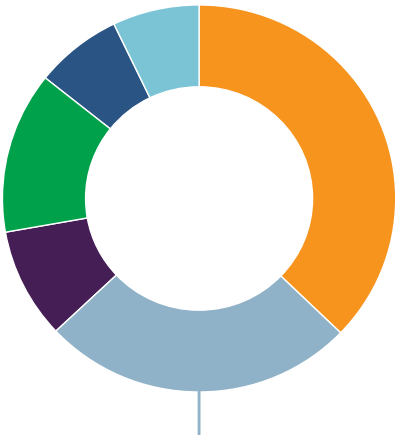
## SPECIALTY CHEMICALS

Singapore's forward-oriented leadership knows all too well that the city-state will not be able to compete with its neighbors as a low-cost destination for manufacturers. To enhance the island's competitiveness, it must nurture a business environment that is especially conducive to the production and export of specialty chemicals. Asia Pacific's (APAC) specialty chemical market is set to continue growing in the coming years, from US$259.6 billion in 2017 to US$361 billion in 2023, representing a CAGR of 5.7% according to P&S Market Research. With this increase in demand from a number of end-user markets in APAC, most notably in agrochemicals, lubricants and oilfield chemicals, water-treatment chemicals, and specialty coatings, companies can leverage the opportunities for research excellence and technological advancements that make Singapore so enticing to multinationals (MNCs). "As Singapore moves towards higher value-added derivatives, intellectual property (IP) protection with respect to innovation and manufacturing processes will be very important. For many companies, formulation and process technologies are trade secrets, so they appreciate Singapore's respect for IP protection," argued Cindy Koh, director of energy & chemicals at EDB.

With this outlook in mind, Singapore is cementing its status as a global hub for R&D with its highly skilled talent pool and top research institutions. Through its Research, Innovation and Enterprise (RIE) 2020 plan, it is pumping S$19 billion alone into R&D that can drive eco-

Peter Meinshausen, President for APAC South, Evonik.

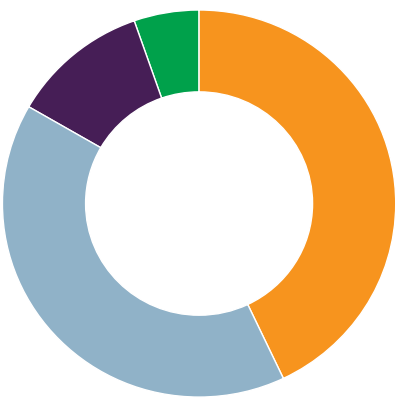
## Manufacturing Output (2017)



Total Output : S$82.7B

| | |
|---|---|
| Electronics | 37.1% |
| Chemicals | 25.8% |
| Biomedical Manufacturing | 9.2% |
| Precision Engineering | 13.7% |
| Transport Engineering | 7% |
| General Manufacturying Industry | 7.2% |

## The Singapore Chemical Cluster is made up of the following segments



| | |
|---|---|
| Petroleum | 43% |
| Petrochemicals | 40% |
| Specialty Chemicals | 11% |
| Others | 6% |

## Interview with Terence Koh, Executive Director, Singapore Chemical Industry Council (SCIC)

**What initiatives are the SCIC currently working on?**
Industry productivity and sustainability continue to be key focus areas. SCIC is exploring ways to help industry address and support industry sustainability needs in areas of energy efficiency, conservation of water resources, waste management and the reduction of environmental emissions. For example, we are working closely with the UK Energy Institute on industry capability-building efforts to upgrade companies' knowledge on energy efficiency and lower carbon emissions. This is in parallel to the implementation of the carbon policy. The Productivity Council comprises the Singapore Economic Development Board (EDB), Association of Process Industry (ASPRI) and SCIC, and has recently embarked on the trial certification process, aiming to improve the productivity levels of the process industry.
Singapore launched the Energy & Chemicals Industry Transformation Map (E&C ITM) in October 2017, focusing on innovations through Industry 4.0. There has been ongoing collaboration with the EDB on enhancing greater awareness amongst industry players including the small and medium enterprises (SMEs) to leverage on innovation and ensure that the industry is ready for the Industry 4.0 evolution.

**Can you tell us more about Singapore's first national standard for liquefied natural gas (LNG) bunkering that was launched by the SDO@SCIC together with MPA and SRPING Singapore?**
To maintain Singapore's position as a premier bunkering hub, it is important to remain competitive and to keep abreast of new growth and developments regionally and internationally. To achieve this, the shipping industry is constantly looking at solutions to meet more stringent regulatory requirements. Singapore has also taken measures to provide cleaner and alternative sources of fuel such as LNG. In April 2017, the SDO@SCIC together with MPA and SPRING Singapore jointly launched the first Singapore Technical Reference (TR) 56 for LNG Bunkering. The Technical Reference (TR) 56 for LNG Bunkering was developed to help the maritime industry in Singapore pave the way towards a low-sulfur requirement in bunker fuel following the announcement by the International Maritime Organization (IMO) to cap the sulfur content of marine fuel at 0.5% from 2020.

**What regulatory changes have been implemented to address safety in the industry?**
With the enactment of the workplace safety and health (major hazard installations) regulations in September 2016, SCIC has been building capacity and safety case knowledge to prepare companies to implement safety case regime regulation. To date, more than 300 practitioners from 70 companies have been trained. We have also launched the safety case e-forum that allows the major hazard installations community to exchange information.
Moving forward, as we continue to instill a safe work environment, SCIC has been working closely with the Ministry of Manpower and Workplace Safety & Health Council to reinforce the "Vision Zero" movement, starting with Jurong Island. Since the incorporation of the seventh code on security into Singapore's Responsible Care program last year, a set of self-evaluation guidelines on security practices has been developed. These fit-for-purpose guidelines aim to encourage companies to achieve continuous improvements in security performances through a risk-based approach.

**What are the main challenges facing the chemicals industry in Singapore?**
Evolving regulatory landscape, organizational restructuring to leaner workforce and demands for higher productivity are still the prevailing challenges faced by the industry. As we gear up for Industry 4.0 in process, technology and organization, industry players will need to relook how they can align their business operations with cyber platforms via vertical integration. Apart from that, integration horizontally across the entire value chain is equally important. ■

nomic growth through creating value, adopting technology, and translating research into concrete business solutions. Moreover, the Energy and Chemicals Industry Transformation Map (ITM) is targeting the construction and/or expansion of 20 new application-development centers by 2025, with US$55 million added in business expenditure on R&D (Ministry of Trade and Industry).

In the past year, a number of Jurong Island's manufacturers have invested in research facilities and partnerships. Mitsui Chemicals, for instance, has been working closely with the Agency of Science, Technology and Research (A*STAR) to develop advanced materials as well as chemical and biotechnological processes that enhance sustainability and productivity. Linde Gas has also recently launched an S$30-million initiative to develop an Asia Pacific Digitalization Hub – the first such center outside of Germany. Another is Evonik, that recently opened its Asia Research Hub, a rare feat for a company that traditionally concentrated its R&D in Germany. "Now, for the first time, we have a major concerted initiative to bring significant R&D capability to Asia, complementing our R&D in Germany. We have decided to do this in Singapore because it has over the years managed to establish a very interesting, highly developed, state-of-the-art ecosystem for R&D. We see an interesting overlap in the areas that we are working in: additive manufacturing, functional surfaces and tissue engineering," said Peter Meinshausen, president for APAC South at Evonik.



***"There are other major trends. First, the continued will to increase sustainability and resource efficiency – a paradigm shift in consumer demands. Second, the notion of a 'circular economy' is gaining attraction. And third, industries are digitalizing. Together, these form the ingredients of a revolution of the chemicals industry. This transformation has already begun. Welcome to 'Chemistry 4.0'"***

**Peter Nagler,**
Executive Director, Institute of Chemical and Engineering Sciences (ICES), Agency for Science, Technology and Research

DSM continues to invest in its Asia Pacific Nutrition Center. Pieter Nuboer, vice president for animal nutrition and health and president for nutritional products at DSM Asia Pacific, has seen the industry become more insight-driven: "The Center has brought us closer to both customers and their consumers. At the center we offer externally facilitated exploration and typically a new idea comes out of our workshops, such as an ingredient or label claim. We host multinationals and large regionals in workshops to go deeper into the industry's needs – a recent example would be our fourth Sustainable Evidence-based Actions for Change (SEAChange) summit that was recently held in Singapore," said Nuboer.

Despite Singapore's clear advantages in terms of academic and research excellence, some companies are deciding to split the baby: basing their production facilities elsewhere in the ASEAN, while only retaining their research and innovation facilities in Singapore. For example, Corbion's APAC headquarters is in Singapore, where it also has an application and innovation center, but its regional production facility is in Thailand. In another case, AkzoNobel conducts its R&D in Singapore and retains some manufacturing capabilities here, but most of its production facilities are positioned elsewhere the region, including across the Strait in Johor, Malaysia.

Nonetheless, Singapore's motivated ecosystem, which is now embracing biotechnology, digitalization, and analytics, continues to attract specialty chemical producers to set up their regional HQs and innovation hubs alongside their manufacturing facilities. Driven by the aforementioned incentives and all-important political predictability – something that Malaysia has reminded is never a given in any jurisdiction, as will be discussed below – Singapore remains the top destination for MNCs aiming to meet APAC's increasing demands for chemicals. Doan Nguyen Hansen, head of McKinsey's chemicals and agriculture practice, highlighted that when companies carry out a total cost equation assessment, Singapore is still highly attractive. "They are willing to balance higher operating costs and rigorous environmental standards against a more highly skilled talent pool as well as the ease of doing business. Over the past five to 10 years, several MNCs located their Asian HQs in Shanghai. However, some companies are also now moving their Asian HQs to Singapore due to the ability to recruit global talent, the high quality of life, and the easy business environment," said Hansen.

*"Dow has been leading the development of innovative and sustainable products, and obtained 754 patents in 2016. Some key examples include the ECOGROUNDTM technology – one of 10 winners at the 2017 R&D 100 award. It is a waterborne acrylic binder for making rubberized running tracks, playgrounds and walkways that significantly mitigate exposure to materials with volatile organic compounds (VOC)."*

**Paul Fong,** Singapore and Malaysia Country Manager, DOW Chemical

## PAINTS AND COATINGS

The last decade has also seen steady regional growth in the paints and coatings industry, with Asia now accounting for 50% to 55% of global production. Paints and coatings remains one of the most heavily regulated subsectors of chemicals, while at the same time with one of the largest growth potentials, particularly in the adoption of low-solvent and solventless technologies. Singapore's manufacturers are particularly benefiting from the increasing regional demand for these sustainable and innovative solutions. Celanese completed its vinyl acetate-ethylene (VAE) emulsion production facility in 2016 and is supplying to Southeast Asia, India, Japan, and South Korea. "The new production facility will give Celanese a strong platform to grow the business across the region. [...] We have seen the increased adoption of the VAE emulsion across the region due to its good environmental profile with low volatile organic compounds (VOCs), low odor, as well as requiring little to no coalescence," said Belur Krishnamurthy Sethuram, managing director, India, Japan and SEA-ANZ at Celanese.

Dow Chemical has also been prioritizing the adoption of new innovative, sustainable products, as demonstrated by the 754 patents it obtained in 2016. Following the DowDupont merger, the company's Materials Science Division will focus on three market-leading segments: performance materials and coatings, industrial intermediates and infrastructure, and packaging and specialty plastics. In addition, Singapore portends as a regional HQ for a number of Dow's other divisions, as well as a regional R&D center.

Arkema Singapore, which serves as the regional headquarters for Southeast Asia, has just moved to a new office in December 2017. The company has recently announced a doubling of expansion to its chemical plant in Malaysia as well as a 6% to 9% increase for its Kynar range of fluoropolymers due to increasing demand. "The demand is linked to the growth in wealth. Fluoropolymers are being used in the mega trends identified by Arkema specifically in water filtration as the membrane, in PV solar panels and in storage of energy in lithium batteries," said Danny Foong, general manager for Arkema.

Danny Foong, General Manager, Arkema.

Frank Goovaerts, Regional VP Sales APAC & Managing Director APAC, Corbion.

## LIFE SCIENCES

The middle class in ASEAN is forecast to more than double over the eight years from 2012 to 2020 to 400 million people, constituting 55% of the global middle class population (Nielsen). This will bring a new surge in demand in a host of end-user markets for personal-care products, pharmaceuticals, and food. These opportunities are driving investment to the region. Sumitomo Chemical Asia, for instance, has expanded production capacities to meet them. Motoyuki Sakai, president of the company, emphasized that the company's strategy towards population growth included increased food production through its supply of agricultural chemicals and animal-feed additives – and the preservation of the environment and energy.

Others are going all-in. AkzoNobel Paints chose Singapore to be its global HQ for marine, protective, and yachts coatings and regional HQ for decorative paints. The company has prioritized growth in the region with powder coatings emerging as a key sub-sector for growth. "Powder coatings is an interesting sector that we, as the market leaders, will look to consolidate. It is one of the fastest growing sectors due to its logistical and applicatory benefits and its zero VOC content," said Jeremy Rowe, managing director of decorative paints, South East and South Asia and Middle East for AkzoNobel Paints.



As ASEAN is one of the most diverse regions of the world – think different cuisines, cultures and languages – companies feel additional pressure to strategically understand each jurisdiction they are serving. A number of companies, including Corbion, DSM, Croda, Syngenta and Henkel, are utilizing Singapore as a center for research. They can develop new applications and technologies in Singapore and then use the jurisdiction as a launch pad to connect with their localized hubs across the region. Corbion, which is an industrial biotech innovator and a global market leader in lactic acid and lactic acid derivatives, has invested in a research laboratory in Singapore. "The laboratory acts as an application and innovation center, although basic research and developing is carried out at our global HQ in Netherlands and in the United States. We take the knowledge and experience we have from our overseas offices and apply them to the needs of our customers here in Asia," said Frank Goovaerts, regional VP sales APAC & managing director APAC.

Croda has taken this approach one step further, not only setting up laboratories in Singapore but also moving to a direct-selling model that might undercut traditional distribution channels and give the company a strategic advantage. "The performance improvements in Asia reflect the benefits of increased proximity to local and regional customers […] We want to continue to grow our customer base by reaching as many customers as we can where we can create niche applications and value for them," said Marc Teo, regional managing director, South Asia for Croda.

Digitalization is another way that producers are aiming to reach their end-user customers more directly. Syngenta, a global leader in agribusiness and agrochemicals, set up a Digital Innovation Lab in Singapore to raise smallholder productivity and improve the experience of its channel partners. "We knew that connecting with our intended customers through conventional means would be frustrating, bureaucratic and too slow for what we need to achieve. Instead, we have 'digital champions' based at a local geography level who are the heartbeat of the work that we are doing," said David Ryan, head of commercial excellence for APAC at Syngenta.

## MOBILITY

China's increasing demand for commercial vehicles as well as environmentally friendly vehicles is another area that presents new opportunities for Singapore's additive manufacturers. The four largest additives producers – Afton Chemical, Lubrizol, Infineum and Chevron Oronite – account for 80% to 85% of global business and have a major presence in the island-nation. They continue to strengthen their hand across a number of APAC's end-user markets, not only in engine-oil additives and fuel lubricants for the automotive industry but also additives for personal care and food. Afton Chemical recently expanded its Singapore operations with a second-phase expansion, set to be completed in late 2018, that aims to develop dispersant technologies to meet China's growing demand in the automotive industry. Lubrizol Southeast Asia's managing director, Paul Nai, has also seen the way in which consumers purchase products is changing, especially due to the younger generation, who make the majority of their purchases online. "The ways in which vehicles are used to transport goods is changing, with smaller van vehicles driving around the city far more than in the past, and vehicles typically transporting goods from one center to another with multiple stops along the way. Operations like this have a greater impact on the engine, so better-quality lubricants are required, and we are focusing on developing these," said Nai.

Paul Nai, Managing Director, Lubrizol Southeast Asia.

The needs of the automotive industry have also increased global demand for synthetic rubber. Tire production has seen an annual growth of 3% to 4%, with ASEAN growth at 5% to 6% and China at 7% to 8%. Although the industry suffered from volatile feedstock prices, global demand for synthetic rubber is expected to grow by 5.16% annually from 2017-2021. Consumers increasingly prefer synthetic rubber to natural rubber due to lower costs and wider varieties and applications. For example, ARLANXEO, a joint venture between Saudi Aramco and LANXESS, now has butyl rubber and neodymium butadiene rubber (NDBR) production facilities in Singapore. Given the former's access to the raw materials required for synthetic rubber, the company believes it can capitalize on growing regional demand. Lastly, the fuel additives and lubricants market is seeing particularly dynamic growth. As with the synthetic rubber industry, this growth is driven by increasing demand for passenger cars and commercial vehicles in APAC, most nota-

bly in China, which is currently producing 20 million cars a year. China's new cleaner emission regulations are adding to this demand for additives.

## TEXTILE CHEMICALS

China has dominated textiles in recent years, following a manufacturing shift to the eastern part of the country due to advantageous low-cost labor. Yet there is now a growing trend of manufacturers going back to the United States, as cost structures have narrowed, along with energy costs. Rohit Aggarwal, president of the textiles effects division at Huntsman, highlighted that productivity in APAC will be central to companies' maintaining global competitiveness. "The brands are focusing on fast retailing and the emphasis on speed, agility and inventory management will become ever more important. Cost and shorter lead times will drive the supply chain in the next few years. We can expect efficiency and enhancement in logistics and supply chain management to cope with the trends of speed and agility. Singapore will play an even greater role as a creator hub as well as a logistics base," said Aggarwal.

## PETROCHEMICALS

In the coming decade, APAC is expected to contribute two-thirds of total global demand for petrochemicals (KPMG). Braskem, the largest petrochemical company in Latin America, initially came to Singapore in 2011 to carry out market intelligence but its office quickly began focusing on trading and sales to cater to APAC. Renato Teodoro Goebel, head of APAC at Braskem, sees a slew of opportunities for investment and trading in the region. "It is culturally and economically diverse, where a convergence of very developed and developing countries meet. We are going to pay close attention to the changing dynamics of the region, and I believe Braskem's presence in Asia will grow substantially over the coming years," said Goebel.

As China and the ASEAN continue their economic ascent and rapid urbanization, major regional players and MNCs are monitoring how best to meet demand and capitalize on opportunities. Singapore has been proactively modernizing its refining and petrochemical industry through technological advancement, energy efficiency and reduced reliance on importing feedstock by increasing its liquefied natural gas (LNG) capabilities. Singapore LNG Corporation achieved

Renato Teodoro Goebel, Head of APAC, Braskem.

Masayuki Kinoshita, Managing Director and CEO, Mitsui Chemicals Asia Pacific.

provisional acceptance for its fourth storage tank in March 2018, which will add 260,000 m3 of storage capacity to bring the terminal's total storage capacity to 800,000 m3.

Despite the slowdown in the first half of 2018, Jurong Island's petrochemical producers are still well positioned for future growth. Low crude oil prices and growing demand in a number of end-user industries including plastics, packaging and transportation in APAC are the main contributing factors. Mitsui Chemicals Group has, for instance, continued to expand its footprint in Singapore by opening its Prime Evolue plant in April 2017, the only Evolue plant outside of Japan producing EvolueTM branded MLLDPE. The plant is a prime example of how companies leverage Singapore as a base to tap into the growing ASEAN middle class. "The expansion rate of packaging materials in Southeast Asia is expected to exceed 10% per year, and the Prime Evolue plant increases our presence in this growing market," said Masayuki Kinoshita, managing director and CEO, Mitsui Chemicals Asia Pacific.

ExxonMobil has had an equally busy year, completing its new grease and synthetic lubricants facilities in June 2017. The expansion of the Jurong lubricant plant increases the company's capability of meeting growing demand for grease and synthetic lubricants products in the region. Furthermore, ExxonMobil completed the acquisition of Jurong Aromatics Corporation's Jurong plant, one of the largest aromatic facilities in the world. "The plant has an annual production capacity of 1.4 million tonnes and

Gan Seow Kee, Chairman and Managing Director, ExxonMobil APAC.

presents operational and logistical synergies for ExxonMobil's integrated refining and petrochemical complex nearby. As a leading global manufacturer of aromatics, the addition of this aromatics plant to our existing operations in Singapore will help us better serve our customers in key Asian growth markets," said Gan Seow Kee, chairman and managing director of ExxonMobil APAC.

## ACROSS THE JOHOR STRAIT: MALAYSIA'S POTENTIAL

Malaysia's emergence as a Southeast Asian manufacturing hub continues to take shape alongside Singapore, despite political uncertainty. As power is changing hands for the first time in over 60 years, there is an air of excitement but trepidation about governance, as Mahathir Mohamed's new government has announced that addressing his country's growing national debt is its top priority. Mahathir also put forth a blueprint for the country's infrastructural and industrial projects in light of the debt issue, which included the postponement of the Kuala Lumpur-Singapore high-speed rail. Singaporeans will keep a close eye on these developments next door.

The single most important development in Southeast Asia's petrochemicals industry is the Pengerang Integrated Petroleum Complex (PIPC). The project is set to generate US$4.5 billion in gross national income by 2020 and help create 8,600 high-skilled jobs. Key to PIPC is the joint venture between PETRONAS and Saudi Aramco for the Refinery and Petrochemicals Integrated Development (RAPID) project, which includes a US$7-billion investment from Aramco, the largest-ever foreign direct investment in Malaysia. RAPID is expected to be completed by early 2019, and the refinery will produce gasoline and diesel to meet Euro 4 and Euro 5 fuel specifications.

The expansion of Malaysia's petrochemical capabilities is a harbinger of things to come in the region. In 2016, petroleum projects including petrochemicals in Malaysia recorded the highest investments approved, amounting to US$3.83 billion. Although they are not involved at the PIPC, both Lotte Chemicals Titan and Nylex (Malaysia) Berhad believe they will be able to continue prospering despite the magnitude of the project due to the growing end-user demands of APAC. "There will be some short-term impact when RAPID comes on-stream but we believe that the market in this region is big enough for both of us and together we can contribute to the growth and development of Malaysia," said Philip Kong, executive VP for corporate planning at Lotte Chemical Titan.

Lee Dong Woo, President and CEO, Lotte Chemical Titan.

The market is indeed big enough to accommodate PIPC as a neighbor, as 60% of global demand for petrochemicals is in Asia. Singapore's petrochemicals hub, however, will have to continue differentiating itself from its close neighbor by producing higher value-added derivatives while benefiting from the increased trading opportunities offered by PIPC. ■

# LOGISTICS

## By Land, Sea and Air: Asia-Pacific's Forward-Thinking Logistics Hub

Singapore's integrated and connected logistics system has long been the city-state's backbone in its transformation from a low-income country to one of the world's wealthiest. Despite being a small local market, the island nation has developed its infrastructure to serve every part of the international logistics chain. Its status is now mostly undisputed; Singapore has ranked as Asia's top logistics hub for 10 years and came fifth in the most recent Logistics Performance Index global rankings by the World Bank. Moreover, it is the world's second busiest port in terms of total shipping tonnage as well as home to Changi Airport, voted the top-rated international airport for six consecutive years (World Airport Awards). In 2017, Menon named Singapore the leading maritime capital in the world, ranking highest in a number of categories including shipping, ports and logistics as well as attractiveness and competitiveness.

Singapore is not resting on its laurels. Construction began in 2016 on the Tuas mega port, whose capacity of 65 million twenty-foot equivalent units (TEU) is more than the combined capacity, 50 million TEUs, of the city's existing terminals. It will be the largest container terminal in the world and the single largest fully automated terminal. This expansion dovetails with the government's industry-transformation program, which aims to cement Singapore's future as an innovative and forward-thinking logistics hub. A separate road map for logistics is set to add US$8.3 billion in value to the sector and create 2,000 jobs by 2020 (Ministry for Trade and Industry). "We are excited for the development of the new port, which will further underline Singapore's connectivity to the world and its strategic regional dominance in the field of chemicals," said Lieven Vander Elstraeten, CEO, Bertschi Singapore.

Lieven Vander Elstraeten, CEO, Bertschi Singapore.

Yang Kee Logistics, the largest homegrown logistics provider, is set to benefit from the construction of Tuas. With two facilities currently operating in Singapore at Jurong Pier and Tuas South, the company is set to open a third logistics facility later this year. "Yang Kee's integrated logistics hub at Tuas South Link was conceptualized and built in line with the nation's Industry Transformation Map for the logistics sector, to continue securing Singapore's position as a globally leading logistics hub that is underpinned by operational excellence, innovation and a strong Singaporean core. Strategically located two minutes from the future Tuas Mega Port, it will be a six-story ramp up warehouse with a total floor area of 66,000 square meters, and ideal for regional distribution center operations," said Jason Goh, CEO Asia, Yang Kee Logistics.

Jason Goh, CEO Asia, Yang Kee Logistics.

## RISING DEMAND FOR ISO TANKS

Singapore's logistics firms are also strengthening their hands in anticipation of demand growth across the region. Bertschi Singapore doubled its storage capacity with a second warehouse completed on Jurong Island in January 2018 that accommodates dangerous-goods storage. Following a downturn in the ISO tank market due to overcapacity, both Bertschi and Suttons Group have recently begun expanding again. Bertschi increased its fleet by 3,000 in 2017, purposely making the investment when steel prices were low. "Last year we made an investment of 800 ISO tanks and we have just placed an order for an additional 1,000. There is an ongoing program to expand and upgrade our global fleet," said Jochen Krapp, regional director of Southeast Asia, Suttons Group.

## GOING DIGITAL

Industry 4.0 is further encouraging logistics providers to augment and improve their customers' operations. Damco, a freight forward and supply-chain management service company with its regional HQ in Singapore, has launched Twill Logistics – a digital forward – that simplifies and digitalizes customer experience around quoting, booking, billing, cargo tracking and dashboarding. Moreover, BDP International has incorporated digitalization into their process to make their customers' supply chains more seamless. "We integrated a transportation management system to help our customers manage their businesses with maximum productivity and efficiency. We have also provided complete end-to-end visibility to our customers for over a decade with our BDP Smart® technology. BDP Smart® is a market-facing visibility tool that aggregates data, tracks our customer's inventory, and provides instant traceability including documentation timeliness, amongst others," said Gary Chan, managing director for APAC at BDP International.

Goetz von Dresky, managing director at Out of the Box Logistics, also sees Industry 4.0, and new technologies, positively affecting logistics through greater efficiency in the supply chain: "Currently, a lot of customers entering the supply chain do not look at the main drivers of cost, namely infrastructure and inventory costs. It is only possible to find a balance through simulation, using algorithms based on accurate sales from an operating plan. Automation and data-driven decision-making plays a huge role, not only for improving costs, but also efficiency and quality," said von Dresky.



## GAS RISES: SHIPPING AND IMO 2020

The introduction of the International Maritime Organization's mandate (IMO 2020) to reduce marine fuel-sulfur content from the current limit of 3.5% to 0.5% is set to have a major effect on bunkering ports, with fuel costs expected to rise by up to US$60 billion annually from 2020 according to PCI Wood Mackenzie. IMO 2020 would in theory hurt Singapore's business as a bunkering port, but Mike Beviss, director of special projects at Eastport Maritime, does not believe this will be the case. "We have heard that there is some concern that Singapore might lose some of its volumes to China because China has a lot of surplus gas oil, but we do not anticipate that happening to any great extent. To a ship owner, Singapore is a great location and a one-stop shop, because it is fast, efficient and now has a much more transparent bunker market with the mandate of the use of mass-flow meters," said Beviss.

On the other hand, IMO 2020 rendered the bulk-storage market more inconsistent by creating volatility in the oil bunker market. Tony Quinn, director and CEO at Tankbank International, believes that IMO 2020 has created difficulties and is changing the market. "Initially companies tried to deal with this by retro installing scrubbers, which was an inefficient process due to cost and refit timescale. Blending fuel oils has become a preferred process for traditional fuel oil terminal businesses. They are thinking about becoming blend farms or mini refineries. The downturn in fuel oil is due to this uncertainty. There is still the same demand for fuel but transporting it anywhere is difficult because of the uncertainty," said Quinn. ■

***"We have been continuously strengthening our position as a connected marketplace. We build regional and global networks, which add to Singapore's position as a world class logistics and supply chain management hub. To grow, the chemicals trading sector require such services."***

**Satvinder Singh,**
Assistant CEO, Enterprise Singapore

# DISTRIBUTION AND TRADE

## Streamlining the Channels

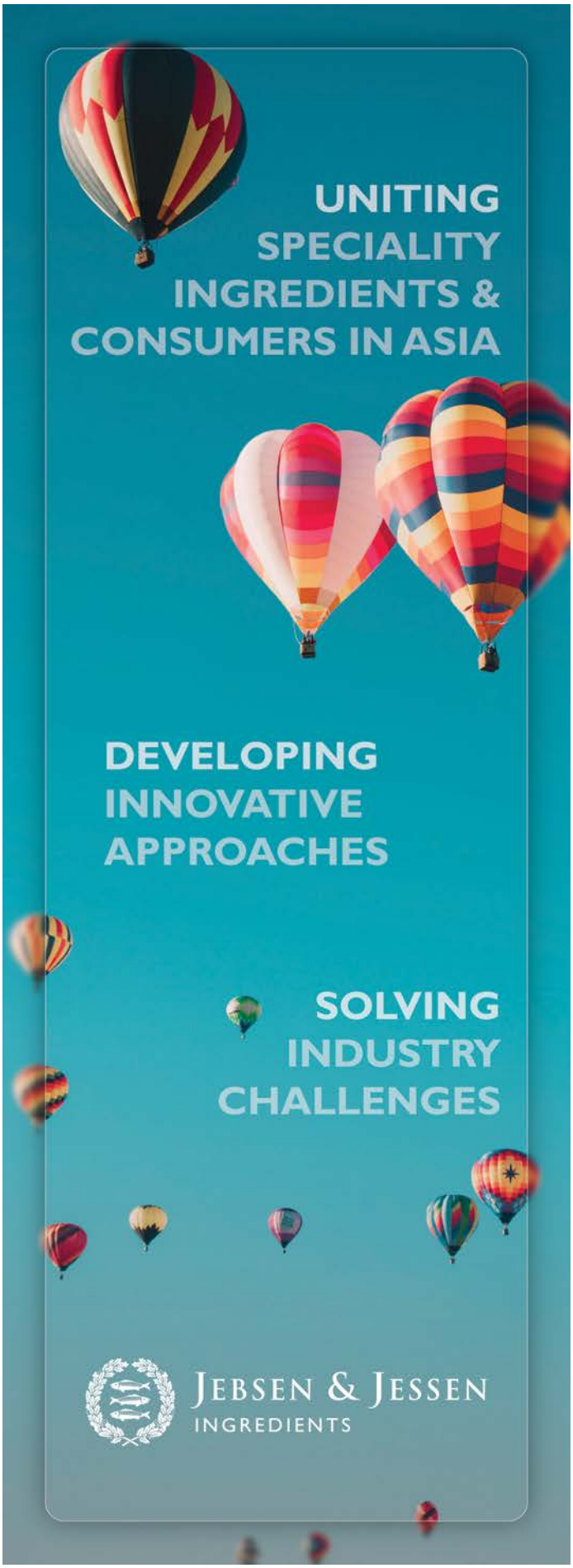
In recent years, there has been an awakening in specialty chemical distribution across the globe. From 2012 to 2017, specialty chemical distribution increased by a compound annual growth rate (CAGR) of 5.6% each year, which was far greater than the chemical industry's growth of 2.9% and specialty chemicals consumption of 4.9% in that same period, according to Boston Consulting Group (BCG). Moreover, during this five-year period, Asia Pacific distributors experienced the fastest growth globally at a CAGR of 6.8%. This is expected to remain high at 6.2% from 2017-2022.

But what lies behind the increase in specialty chemicals distribution? The central reason is that there is still a relatively low share of sales through distributors for specialty chemicals (17%) compared to 80% in pharmaceuticals, according to BCG. Singapore's market itself is also changing, which presents opportunities for companies that are thinking ahead. Moving away from simply being a 'middle man' to reach small customers in the value chain, distributors can now add value to suppliers and consumers alike through their expertise in market research, application laboratories, increased R&D capabilities, and logistics services. For distributors operating in the ASEAN, this means understanding each country's differing regulatory framework, meeting the growing demand from customers and suppliers for value-added services, and streamlining distribution relationships.

At the same time, these opportunities to serve the entire ASEAN region and further afield pose serious challenges. The region's customer base is quite diverse, so applying a one-size-fits-all approach cannot carry the day. Instead, distributors must build trust and long-lasting partnerships with the major chemical producers across a range of jurisdictions.

Dirk Lorenz-Meyer, Member of the Board, Behn Meyer.

In many cases, this landscape gives family-owned businesses and small and medium-sized enterprises (SMEs) advantages. Behn Meyer, the first German company to arrive in Singapore in 1840, founded an R&D company, Behn Meyer R&D services, to support its business units across the region and carry out quality assurance/quality control (QA/QC) for its production units. The company has




grown its capacity for co-development with its customers by opening a number of application laboratories across the region. These include rubber and latex and food laboratories in Malaysia as well as an aquaculture research center, WetLab, in Southern Vietnam. Dirk Lorenz-Meyer, member of the board at Behn Meyer, highlighted that despite the company's growing R&D and production capabilities, its identity will remain as a specialty distributor. "This is our DNA. But the addition of own production signals to our partners that we are truly committed to these industries, and that is why we are willing to increase our investments," said Lorenz-Meyer.

Jebsen and Jessen Ingredients has also moved away from the traditional distribution model and recently invested in three new regional innovation laboratories for Asia. Marc Deschamps, regional managing director for Jebsen & Jessen Ingredients, underscored the company's movement further downstream and into new jurisdictions: "We have set up a new strategy, expanded from six to nine countries and brought in new technologies. We have moved further into food ingredients, personal care, pharmaceuticals and agrochemicals as we opened the emerging markets of Myanmar and Cambodia in 2010," said Deschamps.

More discerning and upscale customer preferences are also driving Brenntag to expand its service offerings. "There is a real demand in the food and beverage space driven by changes in consumption behavior. Upward trends include the pharmaceutical, personal care, coatings, lubricants and blending industries: these are spaces in which we provide services to our customers and our suppliers. There is added regulatory demand from our customers and suppliers. One place where we see a good opportunity is supporting SMEs, as we can offer safety and technical services," said Henri Nejade, CEO and president of Asia at Brenntag.

## SUPPLY: THE FICKLE FACTOR

In the past, distributors would generally source their products from the West and developed Asian nations such as Japan and Taiwan, but distribution channels have shifted somewhat over the past decade. China now portends as a supply source due to its cheaper, more efficient product offerings. The Chinese government's anti-pollution drive, however, upended this calculation and prompted the closing of numerous refineries and plants and a supply shortage. Lim Chin Leong, managing director at Vistachem, identified these contradictory developments as the greatest difficulty that distributors face in planning for the future. "Although we constantly monitor the situation and prepare in advance, it has become increasingly difficult. However, due to our strong international network, with connections in India and China, as well as our diverse product offering, we have been able to survive," said Lim Chin Leong.

Nicholas Lim, managing director at Unilite, also mentioned China's new strict laws on pollution as a key factor in altering the company's strategy. At the end of the day, however, he sees this development as an enabler rather than a hindrance. "As prices have increased and supply has decreased, we have not had to compete with the lower-cost Chinese chemical products as much in the market," said Lim.

Marc Deschamps, Regional Managing Director, Jebsen & Jessen Ingredients.

Teng Chen Ji, country head for Singapore at WWRC, noted that supplies from Europe and the United States are even returning to the market as a result. More producers have also moved into Southeast Asia to take advantage of the ASEAN Free-Trade Agreement. "We are increasingly sourcing our products from outside of China. One example is India, which continues to underline its capabilities especially with respect to life sciences, more specifically pharmaceuticals. Across Southeast Asia we have been utilizing a number of new local companies, for example in Thailand's petrochemicals space. We have also identified opportunities in the United States as the shale gas revolution has made US products more competitive," said Teng.

## TRADE: LOOKING TO THE LONG HAUL

Trade has been a hot topic in 2018, but not for the right reasons. The Trump Administration's implementation of levies on steel and aluminium imports has set alarm bells ringing across the globe. The current trade war between the United States and China could negatively affect global GDP by 1% to 3%, leaving global business operators hopeful it subsides. Geopolitics aside, the petrochemical and chemical trading landscape is shifting in a number of ways, thanks to relatively low crude oil prices, the continued effects of the shale gas revolution in the United States as well as new gas supplies from Australia, Canada, and elsewhere, and China's next-wave ethane-cracker projects.

Gina Fyffe, Executive Director, INTEGRA.

Singapore is expected to play an even larger role than in the past in the current trading environment because of its location along major trading routes, business acumen, and cultural and linguistic connections. Gina Fyffe, executive director at Integra, highlighted that the seismic changes happening in both China and the United States will elevate Singapore's significance to global trade. China's market is becoming more diverse and complicated due to new producers and domestic traders entering the market. "Any company working in China needs to develop an expertise to survive. China is a vibrant, exciting market and our understanding of it is greatly benefited by being based in Singapore. [...] Singapore is finely balanced between East and West and can play a key role in bridging and understanding the relationships between the United States and Northeast Asia as well as the Middle East and North-East Asia. China is still challenging in some aspects and recently we have noticed a growing number of traders setting up camp in Singapore," said Fyffe.

## THE IMPORTANCE OF FREE TRADE AGREEMENTS

In a time of increased populism, protectionism, and ramped up tariffs from the United States, nations continue to underline their commitment to free-trade agreements (FTA) and collaboration with other

jurisdictions. At the time of writing, the EU and Japan had just signed a landmark trade deal, which included the free flow of personal data between both parties, creating the world's largest area covered by mutual agreement on data protection standards.

Singapore has benefited tremendously from trade ever since it signed its first FTA in 1992 – the ASEAN Free Trade (AFTA). The opportunity for a jurisdiction of its size to export bilaterally or multilaterally with no tariffs is a massive advantage – transferring its market of less than six million to more than 580 million in the ASEAN. Since then, the city-state has signed 18 FTA agreements and is the EU's largest trading partner in the ASEAN according to the European Commission. The EU-Singapore FTA, which completed goods and service negotiations and investment protection in 2012, is still in the process of being ratified – it is expected in 2019. The current EFTA-Singapore Free Trade Agreement eliminates tariffs on 99.8% of Singapore's domestic exports to the European Free Trade Area.

## RIDING THE LNG WAVE

Singapore previously relied on gas imports via pipelines from Malaysia and Indonesia to serve its energy needs. Since 2013, however, Singapore's liquefied natural gas (LNG) capabilities have boomed. It recently completed a third phase of expansion to the regasification facilities at its LNG terminal, bringing overall capacity to 11 million tonnes, enough to meet its total gas demand. For an island nation with no natural resources, this further enhances Singapore's energy security and commercial competitiveness.

At the same time, Singapore is also emerging as an LNG-trading hub. There are now 45 LNG companies in Singapore and, with the increasing commoditization of LNG, volumes are being accumulated for greater optimization. According to a survey by Deloitte, 80% of senior industry leaders identified Singapore as the most likely destination for Asia's next LNG-trading hub. With its ever-growing LNG infrastructure, robust regulatory framework, and historical trading know-how, Singapore can add another string to its bow. ■

# INDUSTRY 4.0 SOLUTION PROVIDERS

## Evolution or Revolution?

The dawn of Industry 4.0, or the Fourth Industrial Revolution, is well and truly upon us. For a country that has always prioritized increased productivity and efficiency to forge ahead, the adoption of new technologies is the next logical step. In the World Economic Forum's Readiness for the Future of Production Report 2018, Singapore was among the top 25 countries set to benefit most from the rise of advanced manufacturing and smart factories. It was also identified as one of the early leaders in this space. Clearly, scale is not a prerequisite for future readiness.

Two years ago, some may have been asking themselves what Industry 4.0 was and wondering whether it was simply another buzzword. Since then, however, the concept and what it can achieve has started invigorate all levels of the value chain. Jonas Barge, senior director of applied technology at Emerson, highlighted: "Over the past two years, digital transformation has become a larger discussion, with a top-down approach accelerating its adoption."

In theory, Industry 4.0, Digitalization, or Digital Transformation is a meeting of trends and technologies that are set to reshape a number of processes in dynamic ways. Senthil Ramani, digital business lead of APAC for Accenture, noted that whereas in 2016, the digital focus was on cloud, mobility and analytics-driven concepts that could create efficiencies and cost reductions, there is now a drive to build new business models through the digitalization of the manufacturing process. One example of this is predictive maintenance, which, in addition to manufacturing, can also reshape supply chains and revolutionize client-customer relations. For instance, Prüftechnik's VIBSCANNER – a high-speed data collector with triaxial sensors – can collect both portable and online data to implement predictive maintenance for its customers. "We analyze portable data at regular intervals; in most cases, we will run it through our analytical machinery on a monthly basis to analyze changes and trends over time. When we identify potential issues, we can then use our specialized software to run a deeper analysis and predict any issues that may arise," said Arun Nair, managing director for Singapore at Prüftechnik.

## EARLY IMPLEMENTERS

The vast majority of Jurong Island's producers are already in the process of adopting some level of advanced manufacturing solution. Chevron Oronite's plant on the island has piloted an Industrial Internet-of-Things (IIOT) solution for its manufacturing process. With the use of a tracker system to boost worker safety and efficiency, the company has started saving roughly 30,000 man hours a year. It then plans to expand this pilot scheme in the future to include energy-efficiency improvements and predictive-maintenance solutions. Shell has also developed its own Smart Torque System, which uses digital technology to

Senthil Ramani, Digital Business Lead of APAC, Accenture.

Jonas Berge, Senior Director of Applied Technology, Emerson.

enhance flange maintenance-execution quality. In doing so, this improves overall plant safety and performance. Lastly, Syngenta opened a Digital Innovation Lab at Foundry Unilever's LEVEL3 collaborative space with five strategic digital initiatives focused on increasing smallholder productivity. "We established an innovation lab, specifically in Singapore, with the goal of providing a portal between the Syngenta organization and the digital ecosystem that exists in Singapore," said David Ryan, head of commercial excellence for APAC and leader at the Digital Innovation Lab, Syngenta.

Numerous local small and medium-sized companies are also embracing the new opportunities created by the arrival of Industry 4.0 to enhance their business models. Avetics – winners of Shell's Livewire competition in 2014 – has been using a fleet of drones to service petrochemical plants, which has increased operational efficiency and safety. Another company, CYC International, has created a range of tank-cleaning robots that it has deployed to a number of major petrochemical plants. SourceSage, meanwhile, has built an app and an electronic platform to facilitate physical trades, specifically of oleochemicals.

## A HELPING HAND

While some Industry 4.0 applications and technologies have already gained wide-scale traction across the chemicals industry, companies still do not fully understand how to leverage them. Moreover, this technology wave is not one-size-fits-all; each company seems to develop its own customized approach. Some are also more ready and willing to turn to Industry 4.0 than others. To encourage them to do so, the EDB, in a partnership with TÜV SÜD PSB, devised the Smart Industry Readiness Index (SIRI), as a company-specific interpretation of the abstract concepts of Industry 4.0. "There is not one Industry 4.0 solution; the key point is for the companies to interpret what Industry 4.0 means for their businesses, and to develop a comprehensive strategy and roadmap. For this, the Index acts as a checklist and guideline to ensure that all relevant aspects are considered in a systematic way," said Jacky Tan, senior program manager at TÜV SÜD Singapore.

Andreas Hauser, Director of Digital Services, TÜV SÜD Asia Pacific.

But what are the benefits of adopting these technologies and when will a company expect to see real benefits? In a recent McKinsey global survey, 50% of CEOs said that they did not see a positive return on their company's digital investment. Doan Hansen, head of Mckinsey's chemicals and agriculture practice in Southeast Asia, highlighted that to support digitization, one needs a flexible IT architecture in their middleware. "It can be a major investment that can be worth it if there is still a good business case in the context of the company's IT infrastructure requirements," said Hansen.

Companies should not, in other words, rushing headlong into Industry 4.0 simply because it exists.

## WHY SINGAPORE CAN EMERGE AS A GLOBAL DIGITAL HUB

Every company and country will have to undertake its own journey of Industry 4.0 to reap the potential benefits, but there is a particularly strong case for companies to do in an advanced, forward-thinking market like Singapore. This is proven by the numerous solution providers, and even manufacturers, that have opened digitalization hubs and centers of excellence in the city-state over the past few years, including GE, Accenture, McKinsey, Emerson, Yokogawa, Siemens and TÜV SÜD. "Singapore's Smart Nation initiative sets the right framework for the early adoption of innovative technologies. We always position ourselves in regions where these new technologies are deployed to develop our services as close to partners and customers as possible. Our decision has been vindicated over the last three years," said Andreas Hauser, director for digital services at TÜV SÜD Singapore.

Jack Goh, Managing Director APAC, SICK Automation.

The ability to collaborate, engage and foster Singapore as a hub of knowledge and technological development has a chance, therefore, to give the chemicals industry (as well as other industries) a competitive advantage. SICK Automation, one of the leading manufacturers of sensors and safety systems for factory automation, specifically chose Singapore to base its R&D and production operations for its advanced research and forward-looking ecosystem. "Singapore has a very good talent pool and its two universities NTU and NUS were in the top ten in recent global rankings and one criteria for assignment is the research projects they performed based on Industry 4.0 technology. Second, Singapore has not just strong IP protection but IP compliant enforcement as well," said Jack Goh, managing director APAC at SICK Automation.

***"The government has been very supportive in encouraging the process industries in Singapore towards what is called Industry 4.0. We, as Shell, are very interested in this and have in parallel made strides to make Shell Singapore a living lab of innovations."***

**Andreas Krobjilowski,** General Manager, Shell Jurong Island

**The Brave New World of Chemicals** by Peter Nagler, Executive Director, Institute of Chemical and Engineering Sciences (ICES), Agency for Science,Technology and Research

In an increasingly "digital world" with rapidly changing technologies, one might assume that the 150-year-old chemicals industry must be outdated and in decline. Yet, studies project that it will outpace global GDP growth till 2030 – with Asia accounting for about two-thirds.

Chemistry forms the basis of our everyday lives, from our food, medicine, fuel and cosmetics to the furniture you are currently sitting on. The broad gamut of the chemicals industry's applications thus allow it to profit from a wide range of global trends.

Megatrends like a growing and ageing populations drive an increased demand for solutions for food, healthcare and urbanization. In addition, the use of chemicals across industries is increasing (e.g. composites in the automotive industry); all will fuel the industry's growth, predominantly taking place in Asia, Latin America, as well as Africa in the longer term. The chemicals sector accounted for more than 25 per cent of Singapore's manufacturing output in 2017, which itself represented about 20 per cent of the country's GDP.

That said, the landscape for the chemicals industry is expected to change dramatically for a variety of reasons. For example, new production capacities will emerge in growth regions or in proximity to raw material sources, with an increased focus on specialty chemicals, or performance chemicals, potentially affecting established producers in Europe and the US.

But there are other major trends. First, the continued will to increase sustainability and resource efficiency – a paradigm shift in consumer demands. Second, the notion of a "circular economy" is increasingly gaining attraction. And third, the digitalisation of industries. Together, they form the key ingredients for a revolution of the chemicals industry. The transformation has already begun. Welcome to "Chemistry 4.0" ■

*1. VCI: "Chemie 2030"; Roland Berger: "Chemicals 2035"*
*2. Economic Survey of Singapore 2017, Ministry of Trade and Industry*
*3. After coal based Chemistry 1.0, petrochemicals based Chemistry 2.0, and the recent globalisation and specialisation with increasing use of biorenewables being Chemistry 3.0.*

## LONG ROAD AHEAD

The adoption of Industry 4.0 applications and technologies is likely to be far more evolutionary than revolutionary. Companies looking for guidance on where to start their Industry 4.0 journey may be best served by looking at SIRI. And there are certainly some technologies that represent 'low-hanging fruit,' with the quickest step being digitalizing one's supply chain. Ramani at Accenture predicts companies can see monetary and efficiency improvements in their supply chains within 12 weeks of implementation, but a gradual, step-by-step approach is likely to reap greater rewards., Adnan Abdul Rahman, general manager of automation and engineering, vertical sub-segments at Siemens, underscores that digitalization is evolutionary. "Siemens' task is to facilitate the transition in small stages, by considering where the customers are today and also their expectations. Digitalization is not a solution – it is a journey, and every company will have their own destination. It is unique to each user, and to every site," said Rahman. ■

# SERVICE PROVIDERS

## Overcoming Challenges

### ENGINEERING AND CONSTRUCTION

Singapore's engineering and construction services have yet to reach anywhere near the growth levels that preceded the 2014 downturn. The sector shrank by 8.4% in 2017, a reversal of the 1.9% growth in 2016 (MTI), and it is set to remain lackluster in 2018 as a lack of demand, particularly from the private sector, continues to dampen activity in the construction sector. Wayne Yap, executive director at ASPRI, still sees rising business costs as the main headwind for most of Singapore's businesses. "We observed an overly competitive environment for the process construction and maintenance (PCM) companies. A barometer of this is that ASPRI's corporate memberships have not gone down but, in fact, increased slightly. This is consistent with a highly fragmented industry resulting from a price sensitive structure. With sustained depressed crude prices, the cost of feedstock has been reduced but asset owners are taking a more conservative outlook and postponing maintenance activities," said Yap.

To survive, construction companies are diversifying their capabilities into other sectors as well as identifying opportunities across ASEAN in growth markets including Vietnam, Myanmar, Indonesia and Malaysia. For example, following the downturn in the energy sector, HSL Constructor began focusing more on the water industry and benefited from a number of public contracts, including the Changi Water Reclamation Plant Phase 2 and the Tuas Desalination Plant 3 (opening July 2018), both for the Public Utilities Board (PUB). Regional assignments for HSL have included power projects in Malaysia, Indonesia, and Myanmar.

Returning to the pre-2014 heyday, which was driven by large EPC projects across Singapore's chemicals industry, remains unlikely for now, but there are opportunities for service providers to take advantage of new capex and opex projects in ASEAN. A number of compa-

John Halfweeg, Regional Director for APAC, Mammoet.

nies have benefited from the construction of the nearby Pengerang Integrated Petroleum Complex (PIPC), most notably Mammoet, that was involved in eight of Refinery and Petrochemicals Integrated Development's (RAPID) ten heavy lifting segments. When discussing the project, John Halfweeg, regional director for APAC at the company, highlighted that, despite challenges ranging from ground issues and lightning, the safety of employees was assured with the use of lightning monitors. "Mammoet achieved time-saving efficiencies on the project as a whole, ensuring the work was completed safely and on-schedule. A great deal of the preparatory work occurred in Singapore and logistically, Singapore's close proximity to the PIPC made it the ideal location to work from," said Halfweeg.

## MANPOWER CONSTRAINTS A PERSISTENT BURDEN

Heavily linked to the process industry, the lack of manpower continues to be a major issue in Singapore. Industry 4.0 technologies, especially advanced-robotics-enabled procurement, will reduce the need for manpower in parts of the value chain, but other areas, where high-skilled labor is required but underrepresented, cannot be addressed simply with technology. Bertschi's Vander Elstraeten says that the manpower shortage and lack of quality is still his biggest challenge. "We hope the government will put in place smart actions and make the necessary changes to the existing foreign-quota system to address the extreme shortage of manpower, as it is slowing down our growth and further development on Jurong Island," said Vander Elstraeten.

Jon Proctor, regional director for Asia at Brunel, highlighted that the Ministry of Manpower has made it increasingly difficult to obtain foreign-worker permits, as they prioritize a Singaporean workforce. Nevertheless, Proctor sees this challenge as an opportunity for Brunel. "Singapore has depended on foreign labor for many years, particularly in heavy industries, but it has become increasingly difficult to bring in blue-collar workers, especially in high volume. We are having to educate our clients with respect to this situation. These restrictions have, however, allowed us to leverage more local talent, and we now understand the local manpower market very well," said Proctor.

Although parts of construction and operations in the chemicals industry will always remain manpower-intensive, workforces are becoming leaner as automated working conditions are becoming more common. Singapore's industry transformation maps (ITMs) and Smart Industry Readiness Index (SIRI) are fast-tracking digitalization and automated processes that are reducing manpower needs across the industry. This has, of course, led some workers to ponder what their future working prospects will consist of. Arnaud Despierre, partner at Spencer Stuart, emphasized that the government has historically shown its ability to anticipate fundamental changes in the labor force. "Government policies are very thoughtful when coming to reskilling the impacted workforce, as well as helping individuals whose jobs are at risk," said Despierre.

## SKILLSFUTURE FRAMEWORK

From Despierre's comments, it is little surprise then that the Singapore government is tackling the issue head on. A key component of the ITMs is the SkillsFuture Framework, which aims to upskill Singapore's workforce so as to be best equipped to benefit and thrive from the opportunities arising from Industry 4.0.

## **Interview** with Wayne Yap, Executive Director, **Association of Process Industry (ASPRI)**

**What has been the progress on the ASPRI-Westlite Dormitory-Papan since 2016 and what other initiatives has ASPRI been working on?**

ASPRI-Westlite Dormitory – Papan, in collaboration with Centurion, is the first dormitory in Singapore that embodies a Live, Learn and Play concept. This workers' accommodation, which was soft-launched in May 2016, plays a vital role in increasing productivity and training PCM industry workers. Located close to Jurong Island, home to more than 100 global energy and chemical companies, the accommodations help reduce travel time and fatigue.

In Q3 2016, our training division, ASPRI-Institute of Process Industry (ASPRI-IPI), commenced operations at ASPRI Integrated Training Centre (AITC). With this new facility, residents are now empowered through 90% subsidized courses to upgrade themselves with ASPRI-IPI's comprehensive range of training courses encompassing IT & Literacy, Workplace Safety and Health, Teamwork, Quality & Productivity and Technical skills.

Early results have been promising. In 2017, ASPRI-IPI conducted 125,000 training hours for 8,600 trainees (of which 3,300 are residents), a four-fold increase from before shifting to AITC.

ASPRI-IPI aspires to be a premier SMART training center that promotes digitization through technology such as Virtual Reality (VR)/ Augmented Reality (AR) as well as online interactive training.

Beyond training, ASPRI is constantly exploring ways to enhance the dynamism, synergy and productivity of Jurong Island (JI). Together with various government agencies, we are exploring a pilot program to house a concentration of supporting service providers within JI, to provide essential services and support functions to the industry with a competitive advantage of proximity to plant owners.

**What is ASPRI doing to help its members?**

The Process Construction and Maintenance Management Committee (PCMMC) has been tasked with improving productivity for the sector, which led to the establishment of our dormitory. ASPRI is strongly represented in PCMMC and liaises with the government to calibrate manpower policies and lobby on behalf of our members companies. The government's Workforce Skills and Quality Framework (WSQ) looks at a more holistic development for general workers; this is where ASPRI comes in to train workers quickly and effectively. The Ministry of Manpower has been listening to the industry more in the last few years, for example from 2017 to 2019 they are enhancing the workers' levy criteria and have been engaging our Association closely for views and suggestions.

**What regulations will affect the industry greatly?**

The Ministry of Manpower and Workplace Safety & Health Council have come together to reinforce the "Vision Zero" movement, to drive excellence in the workplace and safety and health (WSH) outcomes, starting with Jurong Island. Fundamentally, Vision Zero requires a mindset that all injuries and health issues arising from work are preventable and that zero harm is possible. To achieve this, ASPRI is working closely with our counterparts to spread awareness and change safety mindsets.

**Where would you like to see the industry and ASPRI in the next few years?**

The launch of Singapore's Energy and Chemicals Industry Transformation Map (ITM) in October 2017 marks a renewed commitment to position this sector for the future. The ITM details Singapore's plan to transform its existing base of chemicals manufacturing through the adoption of innovative Advanced Manufacturing technologies to improve productivity and safety, rejuvenate assets and overcome resource constraints. ■

Jointly developed by SkillsFuture Singapore (SSG), Workforce Singapore and the EDB, together with the industry associations, training providers, organizations and unions, the Framework for Energy and Chemicals covers a total of 53 jobs, offering training on generic and technical skills and competencies. Skills in demand now, and in the future, include digitalization skills – for example, internet of things management; data analytics system design; robotic and automation technology application – and product development and innovation skills – for example, applied research and development; innovation management; and product design and development. Individuals, meanwhile, have opportunities for education and career guidance, as well as subsidies, fellowships and internships.

## A THOUGHT FOR THE FUTURE

Singapore's rapid development is testament to its well-defined and structured education system. It consistently ranks at the top of global primary and secondary education tables including The Programme for International Student Assessment (PISA). Yet, if you remove the importance of core subjects like math and science and identify what will be needed in the future of our dynamic world – entrepreneurship, creativity and innovation - Singapore has yet to fully embrace this within its educational system and across society as a whole. Its collaborative ecosystem of research and technology, nevertheless, has positioned it as high as ninth in Martin Prosperity Institute's Global Creativity Index 2015, while its technology and talent indicators ranked seventh and fifth, respectively. At the same time, Singapore surprisingly ranked relatively low in terms of tolerance at 23rd. As the city-state continues its relentless pursuit towards an ecosystem of utopian standards, Industry 4.0 will take it on a new course. This evolution will demand economic, social, and educational change. How Singapore manages these changes, having advanced so rapidly and efficiently since independence, will be a central question moving forward. ■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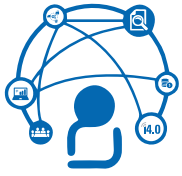


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