Industry 4.0 - future-proofing Singapore's industrial landscape
We believe Industry 4.0 brings exciting opportunities and challenges to Singapore’s industrial landscape. The Singapore government has been supporting the transformation with national directives and innovating new spaces. In our view, Industrial space of the future should offer 3 "A’s": Accessibility, Affordability, Adaptability. Even as pilot schemes for flexible land uses for industrial purposes are being tested, we envisage supply for business park and high-specification spaces doubling by 2030. Occupiers in high-growth manufacturing sectors should take advantage of the improved infrastructure to re-evaluate their business models and space requirements. Owners of older industrial properties should consider upgrading or redevelopment to stay relevant.

Executive Summary

Disruptive technologies are here to stay. How well industrialists and their stakeholders adapt to the vastly changed landscape depend on various factors. Firstly, industrialists and space owners need to be nimble and be receptive to innovation. The fourth industrial revolution or Industry 4.0 should see industrialists embrace technologies such as big data and analytics, augmented reality, additive manufacturing, simulation, Internet of Things (IoT), autonomous robots, and others. Colliers has examined the far-reaching implications of these themes in recent pan-Asian research.

Secondly, national strategic directives and support from the government are pivotal. The Singapore government has been instrumental in promoting the manufacturing sector since 1960s. Industrialists have been able to draw on various grants, subsidies and tax incentives. More recently, schemes like RIE 2020 have been launched, which will see the government invest SGD19 billion (USD14 billion) to encourage research, innovation and enterprise. 23 Industry Transformation Maps (ITMs) are also being rolled out progressively.

Thirdly, the infrastructure and workforce need to keep up with trends and technologies. Pilot schemes such as flexibility in land uses for industrial purposes are being tested out in major planned projects. More integrated "live-work-play-learn" spaces are being rolled out to access, attract and train talent. We envisage business park and high-specification spaces supply could double by 2030.

In this report, we analyse the evolution of Singapore’s industrial landscape and analyse what it may take to continue innovating for “Factories of the future” and maintain Singapore’s competitiveness in the world stage.

Singapore Industrial Landscape by year 2030

Source: Colliers International Singapore Research, JTC, URA
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The evolution

Singapore’s industrial landscape

Since independence in 1965, Singapore’s industrial landscape has undergone a few transformations. The early days of industrialisation in the 1960s led to basic ready-built industrial facilities for labour-intensive industries, and multi-storey industrial buildings for heavy and light industries in the 1970s.

In the 1980s, Singapore shifted its focus to capital-intensive and high-technology industries for Research & Development (R&D) activities and computer software in the 1980s. This led to the development of Singapore Science Park.

In the 1990s, led by an industrialisation restructuring programme, business parks and specialised industrial parks providing modern building specifications were conceived and developed. In the late 1990s, high-specification industrial buildings outside of business parks were constructed to meet the demand for better building specifications.

With a strong drive for innovation, knowledge and R&D, the industrial landscape continues to transform in the new millennium. More specialised industrial parks for key growth industries and business parks such as one-north, located in the central region of Singapore were developed in phases.

As a result, the total stock of industrial property has more than trebled since 1998 to 513.3 million sq ft (47.7 million sq m) as of Q3 2017. Of the stock, 74% consists of factories, 21% warehouses, 5% business parks.

Total Industrial Stock in Singapore, as of Q3 2017

Source: JTC Corporation (JTC), Colliers International Singapore Research

The rise of disruptive technologies will continue to transform manufacturing. Hence, to cater to the immediate and future needs and taking into consideration of the impact of Industry 4.0, we are expecting another transformation of the Singapore industrial landscape.

Singapore industrialisation: From labour-intensive, knowledge-based industries to a Smart Nation

<table>
<thead>
<tr>
<th>Period</th>
<th>Focus</th>
<th>Types of industrial space</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960s</td>
<td>Labour-intensive industrialisation</td>
<td>• Basic ready-built standard factories for mass production of low value products such as garments, textiles, toys, wood products and hair wigs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Development of Jurong Industrial Estate as Singapore’s first industrial estate</td>
</tr>
<tr>
<td>1970s</td>
<td>Diversification to more sophisticated industries, and investments from electronics industry</td>
<td>• Multi-storey factory buildings for heavy and light industries</td>
</tr>
<tr>
<td>1980s</td>
<td>Capital-intensive, and high-technology industries such as R&amp;D and computer software services.</td>
<td>• Industrial buildings that allow for high-technology assembly lines</td>
</tr>
<tr>
<td></td>
<td>Growth of petrochemical industry</td>
<td>• Birth of the first Singapore Science Park, catering to modern businesses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Development of islands off Jurong for petrochemical plants</td>
</tr>
<tr>
<td>1990s</td>
<td>Moved up the value chain for manufacturing. Key focus on Chemicals, electronics, engineering, biomedical science industries</td>
<td>• Development of Business Parks to cater to the needs of R&amp;D activities and located close to research institutions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Other types of industrial spaces such as stack-up factories were developed</td>
</tr>
<tr>
<td>2000s</td>
<td>Innovation, Knowledge and R&amp;D</td>
<td>• Industrial buildings offering high-specification spaces catering to R&amp;D, continued growth for business parks and specialised industrial parks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Start-up spaces for promotion of entrepreneurship</td>
</tr>
<tr>
<td>In the next decade</td>
<td>Aim: to foster key industries to cater for Industry 4.0</td>
<td>• To create &quot;work, live, play and learn&quot; environment</td>
</tr>
<tr>
<td></td>
<td>Knowledge-based, innovation-driven</td>
<td>• Exploration of mixed use clusters and more flexible use of industrial spaces</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• More specialised clusters to tap on ready ecosystem for more collaborative projects</td>
</tr>
</tbody>
</table>

Source: Colliers International Singapore Research, Economic Development Board (EDB), RIE2020 Plan
Industry 4.0: Opportunities

Industrial revolution 1, 2, 3…

The use of steam energy for mechanized production kick-started the first industrial revolution in the late 18th century. Urbanization and innovation contributed to the second industrial revolution in the 20th century when electrical power and assembly lines for mass production were introduced. Next, the third industrial revolution brought computers and automation to production processes. Ground-breaking advances in technology and the continual quest for speed and efficiency through enhanced productivity have now paved the way for the next revolution.

.. and then there is Industry 4.0

The term "Industrie 4.0" was first coined as part of Germany’s High-Tech Strategy 2020 Action Plan. "Industrie 4.0" was identified as one of the 10 "Future Projects" that provides an opportunity for Germany "to secure its technological leadership role and establish itself as an Industrie 4.0 lead market and provider" by promoting for more intensive technology-aided manufacturing.¹

There are many interpretations and definitions set out by various groups about Industry 4.0. What exactly is Industry 4.0? According to Germany and Trade Invest, "Industrie 4.0 refers to the technological evolution from embedded systems to cyber-physical systems. It represents a paradigm shift from “centralised” to “decentralised” production- made possible by technological advances which constitute a reversal of conventional production process logic. Industrie 4.0 connects embedded system production technologies and smart processing processes to pave the way to a new technological age”.

The nine technologies

Additionally, as highlighted by Boston Consulting Group², the transformation of Industry 4.0 is powered by nine technologies that look set to revolutionise industrial production in the future. The adoption of a combination of these technologies is likely to bring enormous benefits to companies. How will these 9 technologies help the industries?

> Big Data & analytics: Analytics of voluminous data sets could benefit organizations with insights into consumer preferences, patterns and other useful information. Businesses will be able to tap on digitisation and detailed analytics to make informed business decisions within a shorter time frame.

Different phases of industrial revolution since the 1800s till today. Industry 4.0 encourages more sophisticated automation with the use of cyber-physical system that will transform the global manufacturing sector up to the next level.

Source: DFKI, 2011

¹ INDUSTRIE4.0: Smart Manufacturing for the Future by Germany Trade & Invest
² BCG Perspectives: Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries
Augmented reality (AR): delivers immersive, engaging experiences that seamlessly blend virtual objects with the real world. This technology while in its infancy now, is likely to play a pivotal role to the workforce in the near future. The use of AR technology in sensors, heads-on displays and perceptual system, allows the non-physical controlling of devices, and increases the efficiency of the workforce and maximise resources effectiveness.

Additive manufacturing: or 3D printing is an advanced manufacturing technology that could 1) vastly accelerate innovation, 2) compress supply chains, 3) minimize materials and energy usage, and 4) reduce waste. Currently, manufacturers from aerospace and biomedical industries are using this method to produce customised products.

Simulation: While simulations are currently used in many engineering fields, we foresee increased usage of such technologies. Combined with data analytics, simulations will allow intense testings of new products to ensure quality standards are met, with reduced failures and wastage of materials.

Industrial Internet of Things (IIoT): Companies could unlock business growth potential, by tapping on the Internet of Things (IoT) to facilitate in their operational efficiency. Additionally, IoTs ought to encourage more innovation and creativity in developing new business models or products.

Cybersecurity: Moving from embedded system production to cyber-physical environment will involve increased online connectivity for both systems and communications. Cybersecurity will be crucial to ensure heightened security for user system access and operations for smooth running of the businesses, as well as to protect the data privacy of clients against potential cyber-hacking.

The Cloud: Cloud-based computing is increasingly common as enterprises tap on the Cloud to store and share data. With the benefits of cloud-based storage, companies should be able to share data more efficiently across boundaries for better collaborations.

Horizontal & vertical system integration: Multiple systems within organizations will be integrated to allow for more cohesive, universal data-integration and improvements in overall value chain.

Autonomous robots: Although there are many industries that use robotics for complex manufacturing processes, this is expected to increase as robots become more autonomous and less costly. With the help of the increased capabilities of autonomous robots, human beings will be able to undertake more challenging tasks safely.

Nine technologies that will transform the manufacturing sector

All of these nine technologies have the potential to disrupt established industrial processes and systems. We should note that we consider Artificial Intelligence (AI) under a broad definition to be the platform underlying at least three of these technologies, namely Big Data & Analytics, Autonomous Robots and the Internet of Things (IoT). AI has huge implications for manufacturing operations, and has the potential to reduce demand for both space and people significantly, although it should also complement high-value human roles and so boost productivity. We explored the implications of AI for Asian and Indian property in our report “Impact of Artificial Intelligence on Indian Real Estate” (5 October 2017) and subsequent research.

The combination of AI, IoT and emerging alternative workplace solutions promises to transform buildings and building management. Workplaces of the future will use space more efficiently, have more collaborative space, and be greener and healthier. This applies not only to offices but also to industrial buildings, and we expect the
boundaries between different categories of property to blur over time\(^3\).

In summary, Industry 4.0 harnesses disruptive technologies to transform the overall manufacturing sector, by offering increased abilities to handle more complex processes efficiently and safely. While the adoption of such advanced technologies will further automate and provide more growth opportunities for the overall manufacturing sector, the impact of Industry 4.0 goes beyond smart factories. The full integration of the entire value chain including services will be enhanced by the adoption of these technologies.

### Industry 4.0: Challenges

#### Manufacturing a key pillar of Singapore’s economy

Manufacturing is one of the twin pillars of Singapore’s economy, contributing about 20% of the country’s Gross Domestic Product (GDP). This should continue in the mid-term as recommended by the Committee of Future Economy (CFE). Additionally, Singapore is an export-driven country. Thus, it is key for the manufacturing sector to be receptive and quick in responding to the changing demands in a highly competitive global environment.

**Manufacturing contributes c.20% of total GDP, 2000 - 2016**

[Graph showing GDP and proportion of total GDP contributed by different sectors from 2000 to 2016]

Source: Singapore Department of Statistics, Colliers International Singapore Research

As Singapore moves towards a Smart Nation and to be a leading manufacturing hub in the region, it is timely for the country to embrace Industry 4.0 and integrate it into our manufacturing processes. Looking ahead, it should be an exciting journey to rethink and transform the overall manufacturing scene in Singapore.

### Key challenges

While industrialists are encouraged to be receptive in embracing Industry 4.0 to innovate and increase their productivity by adopting technologies to expedite their manufacturing processes, challenges abound especially for small-and-medium enterprises (SMEs)\(^4\). According to Singapore’s Department of Statistics, as of end-2016, SMEs make up 99% of the total enterprises in Singapore, 65% of total employment, and contributing close to 50% Singapore’s annual GDP.

Challenges faced by companies in adopting Industry 4.0 include:

- **Lack of adequate skillset and expertise**: workers may not have the necessary expertise and skillset to operate or oversee the more advanced technologies and processes.

- **Lack of understanding**: Some firms may not understand the far-reaching impact of disruptive technologies and the synergies they will bring to the overall operations. Thus, they could be less willing to consider adapting technologies to increase their productivity.

- **Lack of capital**: Adopting advanced technologies could be costly. Industrialists who are cost-conscious or who face difficulties in getting financial support may be discouraged. Additionally, some of these industrialists could be unaware of the available grants or support from the various government agencies.

- **Lack of guidance**: While some companies see the tangible benefits of incorporating Industry 4.0 aspects into their business models, they do not have a clear guidance or strategy to begin their transformation journey. However, the newly released Singapore Smart Industry Readiness Index will attempt to overcome this challenge.

### Government initiatives

To attract high-value industries to set up their bases in Singapore, as well as to encourage entrepreneurship, the government has often offered assistance and

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\(^3\) Colliers Radar | Asia | Tech Trends in Asia: Talent, Chindia, CBD, Artificial Intelligence (5 December 2017)

\(^4\) Small-medium enterprises (SMEs) are defined as enterprises with operating receipts not more than SGD100 million or employment of not more than 200 workers for all sectors.
incentives. Similarly, assistance and incentives are also provided for qualified existing businesses.

**Some Incentives for Businesses**

<table>
<thead>
<tr>
<th>Grants</th>
<th>Tax Incentives</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Research Incentive Scheme for Companies (RISC)</td>
<td>• Land Intensification Allowance (LIA)</td>
</tr>
<tr>
<td>• Training Grant for Company (TGC)</td>
<td>• Aircraft Leasing Scheme (ALS)</td>
</tr>
<tr>
<td>• Productivity Grant (PG)</td>
<td>• Finance &amp; Treasury Centre (FTC) Incentive</td>
</tr>
<tr>
<td>• Maritime Innovation &amp; Technology (MINT) Fund</td>
<td>• Pioneer Certificate Incentive (PC) and Development and Expansion Incentive (DEI)</td>
</tr>
</tbody>
</table>

Note: More details of the grants and tax incentives can be found in the Appendix. This list is not exhaustive.

Source: EDB, Maritime & Port Authority (MPA)

Given the continual need to maintain the country’s competitive edge, a Committee of Future Economy (CFE) was convened in 2016 to evaluate, develop strategies and recommendations to drive further growth and transformation of the Singapore economy for the next decade.

Recommendations were proposed and various government agencies have embarked on launching initiatives and programmes to facilitate businesses to stay competitive and attract new business entrants from high-value industries into Singapore. Programmes are targeted at facilitating growth for industrial sectors, and at providing upgrading skills and expertise for workforces. Accelerated efforts are expected especially for the identified key growth clusters of advanced manufacturing and engineering, urban solutions and sustainability, digital and cybersecurity.

**Research, Innovation and Enterprise (RIE) 2020 Plan**

To lay a strong foundation for Singapore’s future economy and to transform the country into a Smart Nation, investment commitments into research and development (R&D) activities is of utmost importance. Since 1995, the government has invested funds into research and innovation. Based on the most recent RIE 2020 Plan, the government will invest SGD19 billion (USD14.2 billion) over 2016 to 2020 to sustain research, innovation and enterprise. It was announced during the Future Manufacturing Summit in September 2017 that SGD3.2 billion (USD2.4 billion) has been committed for the Advanced Manufacturing and Engineering (AME) domain, to support the development of technological capabilities.

In the RIE 2020 Plan, eight key industries were identified under the AME domain— aerospace, electronics, chemicals, machinery & systems, marine & offshore, precision modules & components, biologics & pharmaceutical manufacturing and medical technology manufacturing. Moreover, four cross-cutting technologies were also identified as “essential enablers” with the main role of supporting the growth of the key industries— robotics and automation, digital manufacturing, additive manufacturing and advanced materials.

**Industry Transformation Maps (ITMs)**

During the Singapore Budget 2016, a SGD4.5 billion (USD3.4 billion) Industry Transformation Programme was announced to facilitate and achieve synergies in industry transformation in the next few years. An industry-focused approach with proposed programmes is undertaken through the launch of Industry Transformations Maps (ITMs). These maps outline plans for the transformation through an integrated approach targeted at developing skills, innovation and productivity. These roadmaps should ensure that the Singapore workforce and industries are equipped with adequate skills and technologies to meet the future global economic challenges.

An initial feedback from business and industry leaders during a recently held ISCA Pre-Budget Roundtable 2018 highlighted that not all businesses, especially some smaller SMEs benefit from the roadmaps. The lack of awareness of such roadmaps were also brought up. Additionally, with a potential convergence of industries and their needs in the rapidly changing market conditions, the roadmaps seem to lack links between the sectors.

Nevertheless, it was reiterated by Mr S Iswaran, Minister for Trade and Industry (Industry) that due to the fast changing environment, the roadmaps rolled out by the government are adaptable according to changing conditions.

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5 MTI: Speech by Mr S Iswaran, Minister for Trade and Industry (Industry) at the Future of Manufacturing (FOM) Summit at Singapore 2017 (5 September 2017)
6 Business Times: Industry transformation maps ‘disconnected from needs of businesses’ (10 January 2018)
7 Business Times: ITMs not static but adaptable: Iswaran (18 January 2018)
The Singapore Smart Industry Readiness Index

On 13 November 2017, the Economic Development Board (EDB) announced the development of Singapore Smart Industry Readiness Index⁸. This index should provide a clear framework and systematic approach to guide companies across all industrial sectors to overcome potential challenges during their transformation journey of adopting Industry 4.0 concepts. Given that SMEs are vital to Singapore's economic growth, this index will most likely provide SMEs a clearer vision to formulate a strategic plan that guides them towards incorporating Industry 4.0 concepts into their businesses. Hence, while recognising the huge impact and potential challenges raised by Industry 4.0, we believe that Singapore's government's determination to facilitate innovation, research collaborations will set positive directions for the manufacturing sector to remain globally competitive in the next decade.

Factories of the future

As companies embrace Industry 4.0 concepts into their core operations, their needs for industrial spaces are likely to change to fit into their business models. What comes as a challenge is providing the right type of space, right amount of space within the right timing, at the optimal cost, especially given the space constraints in land-scarce Singapore.

Therefore, forward planning is essential to remain competitive and prevent constructing obsolete industrial spaces. We list down the three qualities of industrial space of the future. They are the 3“As”- Accessibility, Affordability and Adaptability.

Accessibility

In this context, accessibility does not refer to solely locational attributes such as being close to major transportation nodes. For companies to set up their bases, the ease of access to resources is of utmost importance. This includes skilled workforce with suitable expertise and collaborative opportunities.

⁸ EDB: The Singapore Smart Industry Readiness Index (13 November 2017)
Affordability

Cost remains a pertinent consideration for firms to enter or expand in Singapore. Given that Singapore has limited land resources, we expect that JTC, Singapore's key industrial space master planner and landlord will ensure that affordability will not be compromised by speculative activities. Companies which wish to utilise space for industrial purposes will need to meet JTC's stringent qualifying requirements. Additionally, it monitors the industrial market closely to release industrial lands under its Industrial Government Land Sale (IGLS) programme to ensure there will not be an undersupply situation that could drive costs upwards.

Adaptability

Industrial spaces should be flexible for ease of adaptation based on the business models. The convergence of manufacturing and services is likely to accelerate in the future, resulting in the blurring of the actual usage of sites and properties. The flexibility of space design and utilisation will be another key differentiating factor for industrial space of the future.

Singapore's roadmap

New spaces to facilitate innovation and flexibility

According to the CFE's report, the committee recommended that greater flexibility in uses for industrial spaces should be allowed, as part of building partnerships for economic clusters and to adapt to changing business needs. Additionally, more innovation spaces should be catered to support the ecosystem of start-ups.

Considering that the manufacturing landscape is evolving rapidly and life cycles of companies are getting shorter, the planning authorities understands the need to adopt new planning concepts to “future-proof” the infrastructure and to cater to the needs of new growth industries. Thus, pilot schemes such as flexibility in land uses for industrial purposes will be tested out in some of the major planned key projects such as Woodlands North Coast and Punggol Digital District (PDD).

Jurong Innovation District (JID): “industrial park of the future”

Envisioned as the “industrial park of the future”, the new JID should transform the manufacturing landscape to offer a "live, work, play, learn and create" environment. The 600-ha innovation district will be developed in phases with the first phase target for completion by 2022. JID will include Nanyang Technological University (NTU), CleanTech Park and the surrounding areas of Bulim, Bahar and Tengah.

Key growth industries - robotics, advanced manufacturing, urban solutions, cleantech and smart logistics will be hosted in JID. It will house the full value chain for companies in manufacturing sector, including R&D, design, prototyping, production and supply chain management. Additionally, to achieve the vision for innovation, the District will serve as a test-bed for innovations with places allocated for start-ups, incubators, accelerators and coworking spaces with a focus on advanced manufacturing. Currently, within the JID, there are start-up spaces in LaunchPad@Jurong Innovation District and JTC has launched an Open Innovation Call aiming to encourage companies such as start-ups to develop new ideas on infrastructure solutions. The feasibility of these selected proposals will be tested in a real-life environment within the District.

Woodlands North Coast: first business park in northern Singapore; flexible land for SMEs

Woodlands North Coast is envisaged as an integrated waterfront business and housing destination, consisting of 70 ha of land in four unique precincts: 1) waterfront living, 2) office and retail, 3) the first business park cluster in the north, and 4) land set aside for small and medium-sized enterprises (SMEs) in a grid network that allows for flexible size configurations.

Additionally, new land use guidelines will be piloted in a multi-tenanted industrial building on a site zoned Business 1-White, to be developed by JTC. A wider range of uses will be allowed within the Business 1 component, including industrial-related uses that are closely-linked to or provide critical support for the industrial sector. For example, engineering and industrial design activities that are currently not allowed in an industrial development will be allowed in the Woodlands pilot development, given that these activities play a key role in the manufacturing value chain.

The Singapore authorities perceive there is an increasing need for companies to co-locate other business functions such as R&D and sales and after-sales service centres together with their core manufacturing activity, so that all functions across their product development cycle are well-integrated.
The integrated live-work-play environment also contributes to attracting and retaining of talent. Based on recent interviews that Colliers carried out with technology sector occupiers, attracting and retaining talent is the top challenge faced by technology companies in the region, ranking ahead of competition, regulation or any other business issue.

**Punggol Digital District: targeted at digital and cybersecurity industries**

Located within Punggol North, the 50-ha Punggol Digital District (PDD) will be a mixed-use district integrated with the new Singapore Institute of Technology campus. Housing key growth industries such as digital and cyber security, PDD aims to foster strong collaborations between industry and academia, and also to facilitate testing and prototyping of new innovations.

More flexible land use will be tested out under a pilot scheme known as the Enterprise District. This scheme will stipulate land use at a district level, instead of at a building or strata-unit level. Each land parcel will be allocated its own combination of different user by JTC, the master developer. The total gross floor area (GFA) for each use will not exceed the maximum permissible GFA on a district level. This will allow companies to share facilities and collaborative spaces.

**Regulatory sandboxes**

To encourage industry players to explore and experiment with innovative solutions in a relaxed regulatory environment and within a limited timeframe, so-called regulatory sandboxes have also been introduced in recent years. A regulatory sandbox is a safe space that allows businesses to test innovative products, services and business models within a relaxed regulatory environment.

While this concept is relatively new, the introduction of regulatory sandboxes should allow entrepreneurs and industrialists to mitigate risks of errors through rigorous testing of their innovations before they launch into the market. The regulators can also assess the likely impact of the innovations and provide the necessary regulations to safeguard the dangers faced by the sectors. As such, a regulatory sandbox with clear guidelines should encourage more industrialists to explore and come up with new innovative solutions that will benefit their respective sectors. In Singapore, there are currently two

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**Land use at district level in Enterprise District**

<table>
<thead>
<tr>
<th>Site</th>
<th>Land Use</th>
<th>Existent Guidelines GFA as % of all sites</th>
<th>Enterprise District GFA of district total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>35%</td>
<td>35%</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>20%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: URA
Graphics: Colliers International

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9 Colliers Radar Asia | Tech Trends in Asia: Talent, Chindia, CBD, Artificial Intelligence (5 December 2017)
10 URA: Factsheet on Enterprise District (7 March 2017)
11 FCA Regulatory sandbox (November 2015): The concept of a Regulatory Sandbox was first introduced by the Financial Conduct Authority (FCA) in the United Kingdom when it investigated the feasibility of developing a regulatory sandbox for financial services. A regulatory sandbox is a safe space, to allow businesses to test innovative products, services, business models, etc within a relaxed regulatory environment.
regulatory sandboxes targeting the financial technology and energy sectors.

> **Financial Technology (FinTech):** The Monetary Authority of Singapore (MAS) set up a Regulatory Sandbox for the FinTech industry in 2016. This allows fintech players and financial institutions to explore and experiment with innovative fintech solutions within a limited timeframe, while the authorities can assess and work out suitable regulations for the sector.

> **Energy:** The Energy Market Authority (EMA) launched a regulatory sandbox for the energy sector in October 2017, to allow energy industry players from the gas and electricity sectors to test innovative new products and services. This allows EMA to assess the impact of new services before deciding on the appropriate regulations.

### Expanding and enhancing the existing business parks and specialised industrial parks

In the meantime, the existing business park and specialised industrial park concepts remain relevant.

Specialised industrial parks offer industrial spaces for specific trades that are unable to co-locate in mixed-use buildings in typical industrial estates or business parks, due to their stringent needs such as sterile premises, storage of dangerous goods, fabrication yard, etc. Additionally, companies can benefit from the available convenience provided by clusters of companies in similar trades and greater accessibility for more efficient collaboration support. These specialised industrial parks are typically situated near tertiary institutions, hospitals, major seaports or airports. Examples of these are: Jurong Island, Seletar Aerospace Park, Offshore Marine Centre and Medtech Park.

According to JTC, business parks are meant for “non-pollutive industries and businesses that engage in high-technology, R&D, high value-added and knowledge-intensive activities”. Unlike the typical industrial estates, qualifying companies get to enjoy the numerous benefits of located within a ready ecosystem environment that offer:

- high quality spaces;
- convenience of co-locating with similar businesses for collaborative opportunities;

> proximity to tertiary institutions and hospitals for sharing of available research network and resources;
> complementary amenities such as F&B outlets, gymnasiums and childcare facilities; and
> strong support from nearby industrial estates for manufacturing needs.

Hence, companies situated in these specialised industrial parks and business parks are able to exploit the synergies offered by an integrated ecosystem, while enjoying economies of scale that accrue from tapping into the resources and networks available for incubation of innovative solutions and technologies.

Over the years, Singapore has seen very rapid growth in science parks and business parks. As of today, there are a total of nine business parks (including two science parks)\(^\text{12}\). Since 2002, total business park supply has more than trebled to 23.1 million sq ft (2.1 million sq m) as of Q3 2017, and currently registers an overall healthy occupancy of 85.9%.

### Existing Business Park supply and Occupancy Rate, as of Q3 2017

With strong advocating efforts and directions from the government to capitalise on new technologies for greater innovation, we expect R&D activity to intensify in Singapore, thereby increasing demand for more business park spaces. There will be a few upcoming known business park developments in the pipeline. JTC will be developing a multiple-user business park project in CleanTech Park, as part of its further development of that park.

On the private sector front, there are three redevelopment projects in Science Parks that are expected to be completed by 2018 - 2019. Meanwhile, a new multiple-user business park development project in Mediapolis, developed by Boustead Projects, will be ready by end-2018. JTC has recently offered a plot of development site in Media Circle within Mediapolis under

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\(^{12}\) The nine business parks include: Singapore Science Parks I & II, International Business Park (IBP), Changi Business Park (CBP), Mapletree Business City I & II, one-north, CleanTech Park and Viva Business Park
a Concept & Price Tender. If awarded successfully, this project will come onstream by 2021.

**Spaces for tech entrepreneurship**

**Start-up and Incubator spaces**

Singapore considered itself to be one of the world’s leading centres of technology entrepreneurship. Based on Colliers’ findings in our recent Asia Tech Trends report, it clearly indicates that Asian technology companies consider Chinese and Indian cities - especially Beijing, Shanghai and Bangalore - to be the greatest sources of talent within Asia. However, Singapore is well-known as a centre of excellence within South East Asia; and some of the technology companies in our study at least cited Singapore as a source of talent, whereas none cited its regional rival, Hong Kong.

To encourage the formation of start-ups for tech entrepreneurs that can devise more innovative solutions and products, the Singapore government offers initiatives to facilitate the smooth operations of such start-ups. One of the many initiatives is the JTC LaunchPad@one-north and the recently completed JTC LaunchPad@Jurong Innovation District, which supplies industrial spaces to qualified start-ups and incubators.

To build on the leadership in tech entrepreneurship, more alternatives for start-up and collaborative spaces are likely to be made available in the future. This is especially so for qualified entrepreneurs in the R&D or advanced technologies who wish to utilise incubator or start-up spaces located close to research institutions or similar business communities. For instance, the upcoming multiple-user business park development in Media Circle developed by Boustead Projects will need to offer spaces for start-up graduates from LaunchPad.

**Coworking spaces**

Coworking platforms offer many benefits of shared network of resources for entrepreneurs and have taken off well in the commercial sector globally. Recently, two coworking operators, Spacemob and UrWork have launched operations in business parks in Singapore, in

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13 Start-ups graduates are companies residing in LaunchPad and have incorporated for five years or more. The companies will need to vacate from LaunchPad by seeking other suitable spaces to continue their operations.
partnership with the respective landlords and exploiting the synergies within the ecosystem of business clusters. Small startups in qualified businesses are able to capitalise on the shared workspace environment and collaborative opportunities that the coworking platforms offer, without committing large capital for fixed terms.

Rejuvenation/ redevelopement of older properties

Besides new sites in the pipeline, major private landlords have also taken the cue for increasing demand for better building specifications by redeveloping their existing properties. For instance, Soilbuild Group is redeveloping two of its developments in Kallang Way into Business 2 high-specialisations projects. With rising demand for more data storage, some conventional industrial buildings are being redeveloped into data centres. Rejuvenation of science parks has continued with redevelopment projects in Science Parks I & II too.

Based on Colliers International’s research, an estimated total new supply of 42.6 million sq ft (4.0 million sq m) net lettable area (NLA) is expected to come onstream in Singapore by 2021. Out of this total, at least 2.5 million sq ft and 2.3 million sq ft are intended for independent high-specialisation industrial spaces and business park developments, respectively.

Upcoming supply of industrial space, as of Q3 2017

![Graph showing the estimated net lettable area for different types of industrial space from Q4 2017 to 2021 and beyond.]

Notes: 1) Estimated net lettable area is based on an estimation of building efficiency of approved GFA; 2) Estimation of year of completion is based on assumptions of typical construction cycle and various news sources

Source: Colliers International Singapore Research, JTC (as of Q3 2017)

Conclusions

High-specification spaces to increase

While longer term plans for supply are fluid and JTC has not provided any concrete forecasts, we envisage the new districts namely JID, Woodlands North Coast and Punggol Digital District, will grow at a similar pace to one-north.

one-north, a 200-hectare cluster with predominantly business park spaces where construction started in 2001, now offers 6.6 million sq ft (0.6 million sq m) of industrial space. It is not fully completed as Mediapolis, part of one-north cluster is still undergoing further developments.

By 2030, we envisage high-specs space including business parks will double from the current 37 million sq ft (3.4 million sq m, 7% of total industrial stock).

Framework for the Future Economy

Disruptive technologies have impacted our daily lives in various aspects such as retail and transportation, and will continue to be an integral part of our lives. We expect the convergence of manufacturing and services to take place eventually. While people enjoy greater benefits from the implementation of new technologies into our lives, industrialists and companies will need to be receptive of the possible changes and be ready to transform their business processes to meet the heightened expectations.

We should add here that we have already argued strongly that Asian enterprises in general should embrace AI and related new technologies and invest in improving the skills of their staff.

For any economy to embrace such a transformational global trend, there will be a few areas to look out for:

> Innovation: Companies must adopt an innovative mindset to constantly improve their production processes to remain competitive. This could be through R&D initiatives or joint collaborations for incubation of new technologies and manufacturing processes. While these could be spearheaded by the public institutions with global companies, local companies could also explore solutions through programmes funded by the agencies.

> Government support/initiatives: Strong support from the government is desirable. Clear policy guidelines...
will provide certainty to new entrants. Financial support or providing collaborative opportunities for qualified companies will also be beneficial.

> **Infrastructure:** Is there adequate physical infrastructure with required building specifications to meet the demands for companies embarking on innovation or R&D activity? As working trends change over time and manufacturing processes are enhanced, available industrial spaces should be improved to meet the changing needs. This include pilot schemes for flexible use of space, and allocating spaces for start-ups.

> **Skilled workforce:** the future workforce must be trained with the knowledge and adequate skillsets to meet the new and fast-changing demands brought about by the changing needs of the businesses.

### Framework for the Future Economy

Source: Colliers International Singapore Research

**Recommendations for occupiers**

**Be receptive to change**

With Industry 4.0 transforming the manufacturing world, industrialists especially SMEs must be receptive to accepting the changes technologies bring about to their operations. Platforms such as the Singapore Smart Industries Readiness Index can provide guidance to facilitate the transformation of their businesses to stay relevant in the globally competitive market.

Additionally, with the available grants and incentives to facilitate qualified businesses, companies should consult the various government agencies to understand the requirements for possible aid to enhance their productivity.

**Re-evaluate business models and space requirements**

Speed in terms of increased productivity will continue to be one of the key thrusts for the future manufacturing processes. Companies will need to re-evaluate their existing business models to incorporate new technologies such as AI, IoT and other related new technologies into their daily operations. Drawing on these technologies, they can be more innovative and increase their productivity in the entire value chain of their businesses from manufacturing to after-sale services. Occupiers should also review their space requirements in the light of new technologies and consider the options available in the market.

### Recommendations for landlords

Besides redevelopment, owners of existing or older industrial properties should consider doing asset enhancements. Subject to the relevant authorities’ approval, property owners may consider providing other supporting amenities as gymnasiums, childcare facilities or retail spaces to provide a more conducive environment of “work, live, learn, play and create” elements. Additionally, building specifications could also be improved. Such improvements could include upgrading of shared facilities such as toilets, lift lobbies, with the aim of improving the general amenity of buildings, or enhancement of the building’s existing power supply to cater for possibly higher power consumptions of their tenants.
### Appendix

Incentives for Businesses

<table>
<thead>
<tr>
<th>Tax Incentives</th>
<th>Land Intensification Allowance (LIA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>To ensure more efficient utilisation of industrial lands and higher-value activities, this allowance allows businesses with large land sites but low Gross Plot Ratios (GPRs) to intensify their land use for higher-value activities.</td>
</tr>
<tr>
<td></td>
<td>Approved LIA incentive recipients will enjoy the following:</td>
</tr>
<tr>
<td></td>
<td>• Initial allowance: 25%</td>
</tr>
<tr>
<td></td>
<td>• Annual allowance: 5% on qualifying capital expenditure incurred for construction or renovation/extension of qualifying building or structure. This will be granted until total allowance amounts to 100% of qualifying capital expenditure</td>
</tr>
<tr>
<td></td>
<td>• Approval for incentive will be granted by EDB from 1 July 2010 to 30 June 2020 (both dates inclusive)</td>
</tr>
</tbody>
</table>

#### Summary of key qualifying criteria with effect from 25 March 2016 to 30 June 2020:

<table>
<thead>
<tr>
<th>Qualifying Criteria</th>
<th>25 March 2016 - 30 June 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoning</td>
<td>• B1/B2 land</td>
</tr>
<tr>
<td></td>
<td>• Airport / Port land</td>
</tr>
<tr>
<td>Trade or Business</td>
<td>• Specified manufacturing activities</td>
</tr>
<tr>
<td></td>
<td>• Specified logistics activities</td>
</tr>
<tr>
<td>Minimum GPR</td>
<td>• Prescribed GPR benchmark for specified qualifying trade of business for buildings that have yet to meet</td>
</tr>
<tr>
<td></td>
<td>• Incremental 10% GPR improvement for buildings that met prescribed GPR benchmark</td>
</tr>
<tr>
<td></td>
<td>• Highest GPR benchmark among those prescribed for each specified qualifying trade or business</td>
</tr>
<tr>
<td>User(s) and use(s)</td>
<td>• Single user</td>
</tr>
<tr>
<td></td>
<td>• Multiple users related by ≥75% shareholding</td>
</tr>
<tr>
<td></td>
<td>• Used by multiple qualifying trades or businesses</td>
</tr>
<tr>
<td>Relationship between</td>
<td>• Must be related by ≥75% shareholding</td>
</tr>
<tr>
<td>user(s) and owner of</td>
<td></td>
</tr>
<tr>
<td>the building</td>
<td></td>
</tr>
</tbody>
</table>

### Aircraft Leasing Scheme (ALS)

|                              | To allow approved aircraft leasing companies to develop and grow the aircraft leasing industry                                                                                                                                 |
|                              | Approved aircraft leasing company will be eligible for the following:                                                                                                                                                        |
|                              | • Concessionary tax rate of 8% on income derived from the leasing of aircraft or aircraft engine, and qualifying ancillary activities                                                                                           |
|                              | • Withholding tax exemption on interest and qualifying related payments on loans obtained for the purchase of aircraft or aircraft engines                                                                                     |
|                              | • Incentive period: limited to 5 years, extension may be considered, subject to the company’s commitment to undertake further expansion plans on its aircraft leasing activities                                                   |

Source: Economic Development Board
## Incentives for Businesses - Continued

### Tax Incentives

<table>
<thead>
<tr>
<th>Incentive</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Finance & Treasury Centre (FTC) Incentive** | Aims to encourage qualified companies to grow their treasury management capabilities and to use Singapore as a base for conducting strategic and treasury management activities. Approved FTC company is eligible for the following:  
• Reduced corporate tax rate of 8% on income derived from qualifying FTC services to approved network companies, as well as qualifying FTC activities carried out on its account with funds obtained from qualifying sources  
• Incentive period: limited to 5 years. Extension may be considered, subject to FTC company's commitment to undertake further expansions for its FTC activities/services |
| **Pioneer Certificate Incentive (PC) and Development and Expansion Incentive (DEI)** | Aims to encourage approved qualified companies to expand their capabilities and conduct new or expanded activities in Singapore.  
• Companies that carry out global or regional HQ activities of managing, coordinating and controlling business activities for a group of companies may also apply for either incentives for the HQ activities.  
• Open to companies that are willing to make significant investments in contribution to the economy or in advancement capabilities towards globally leading industries.  
• Approved companies under the PC or DEI are eligible for:  
  • Corporate tax exemption; or concessionary tax rate of 5% or 10% respectively, on income derived from qualifying activities.  
  • Incentive period: limited to 5 years. Extension may be considered, subject to company's commitment to undertake further expansion plans. |

### Grants

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Research Incentive Scheme for Companies (RISC)</strong></td>
<td>To support projects of companies that develop their R&amp;D capabilities and technologies in areas of science and technologies</td>
</tr>
<tr>
<td><strong>Training Grant for Company (TGC)</strong></td>
<td>To support training programmes for companies’ employees with the development of manpower capability in new technologies, industrial skills and professional expertise.</td>
</tr>
<tr>
<td><strong>Productivity Grant (PG)</strong></td>
<td>For firm-level projects targeting at improvements to energy, water, land or labour efficiencies through transformation efforts to enhance companies’ operations or involving adoption of technologies.</td>
</tr>
</tbody>
</table>
| **Maritime Innovation & Technology (MINT) Fund** | To support local maritime companies and development of Singapore maritime technology cluster to enhance innovation through R&D. There are two schemes available:  
• **MINT- Research & Development (MINT-RD):** promotes upstream research and creation of knowledge, capability and IP within the maritime companies, as well as marine equipment makers and technology developers  
• **MINT- Product Development (MINT-PD):** encourages product and solution development, value creation, and the translation of state-of-the-art technologies from non-maritime industries for use within the maritime sector.  
• Summary of Key Eligibility Criteria:  
  • The applicant should be a company incorporated under the Companies Act (Cap. 50) and operating in Singapore, with a minimum paid-up capital of 50% of the total project costs; or a classification society appointed as a Recognised Organization under the Merchant Shipping (Authorised Organisations) Regulations.  
  • the R&D into or test-bedding of new or better products, processes and applications relevant to the maritime industry should be carried out in Singapore.  
  • Potential MINT Fund projects should be technology oriented with innovative content, relevant to the maritime industry, develop or test-bed products and services that have commercialisation potential, and satisfy either the MINT-RD or MINT-PD project scope.  
  • Co-funding: Grant of ≥50% of the total qualifying project costs (inclusive of input GST), comprising of manpower and equipment either engaged or acquired for the purposes of the project, and other operating expenditure incurred for the purposes of the project.  
  • Projects deemed by MPA as strategic to its interest or have industry-wide impact may be considered for an increase in funding support level. |

Source: Economic Development Board and Maritime & Port Authority
# Upcoming major industrial developments - independent high-specification and business park developments

<table>
<thead>
<tr>
<th>Project name</th>
<th>Street/Location</th>
<th>Developer</th>
<th>Est. Net Lettable Area (sq ft)</th>
<th>Gross floor Area (sq ft)</th>
<th>Est. year of completion</th>
<th>Planning region</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Independent high-specification development projects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Google Data Centre</td>
<td>Jurong West Street 23</td>
<td>Google Asia Pacific Pte Ltd</td>
<td>218,932</td>
<td>230,455</td>
<td>2017</td>
<td>West</td>
</tr>
<tr>
<td>Multiple-user Factory</td>
<td>Boon Keng Road/Kallang Place</td>
<td>Mapletree Industrial Trust Management Ltd</td>
<td>286,008</td>
<td>317,000</td>
<td>2018</td>
<td>Central</td>
</tr>
<tr>
<td>Continental Building (Expansion)</td>
<td>80 Boon Keng Road</td>
<td>BP-CA3 LLP</td>
<td>114,017</td>
<td>120,017</td>
<td>2018</td>
<td>Central</td>
</tr>
<tr>
<td>Single-user industrial development</td>
<td>Bulim Avenue</td>
<td>Angel Playing Card Singapore Pte Ltd</td>
<td>262,187</td>
<td>275,986</td>
<td>2018</td>
<td>West</td>
</tr>
<tr>
<td>Global Switch Data Centre</td>
<td>Woodlands Avenue 12</td>
<td>Global Switch Property (Singapore) Pte Ltd</td>
<td>255,643</td>
<td>143,052</td>
<td>2018</td>
<td>North</td>
</tr>
<tr>
<td>Awan Data Centre</td>
<td>1 Tuas Avenue 4</td>
<td>AWAN Data Centre Pte Ltd</td>
<td>333,460</td>
<td>269,098</td>
<td>2018</td>
<td>North</td>
</tr>
<tr>
<td>Single-user Factory (Data Centre)</td>
<td>Sunview Drive</td>
<td>DBS Trustee Ltd as Trustee of Mapletree Industrial Trust</td>
<td>229,772</td>
<td>351,011</td>
<td>2018</td>
<td>West</td>
</tr>
<tr>
<td>STT Defu 2</td>
<td>15 Defu Avenue 1</td>
<td>ST Telemedia</td>
<td>55,111</td>
<td>155,011</td>
<td>2018</td>
<td>Northeast</td>
</tr>
<tr>
<td>Multiple-user Factory</td>
<td>171 Kallang Way</td>
<td>SB (Waterfront) Investment Pte Ltd</td>
<td>288,112</td>
<td>338,955</td>
<td>2019</td>
<td>Central</td>
</tr>
<tr>
<td>Multiple-user Factory</td>
<td>164 Kallang Way</td>
<td>SB (Waterfront) Investment Pte Ltd</td>
<td>498,546</td>
<td>586,525</td>
<td>2020</td>
<td>Central</td>
</tr>
<tr>
<td><strong>Upcoming business park developments</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Headquarters</td>
<td>Changi Business Park Central 2</td>
<td>Kingsmen Creatives Ltd</td>
<td>134,264</td>
<td>141,330</td>
<td>2018</td>
<td>East</td>
</tr>
<tr>
<td>Mediapolis (MP8)</td>
<td>Media Circle</td>
<td>BP-DoJo LLP</td>
<td>251,332</td>
<td>295,684</td>
<td>2018</td>
<td>Central</td>
</tr>
<tr>
<td>BTS Facility</td>
<td>Pasir Panjang Road</td>
<td>Singapore Science Park Ltd</td>
<td>118,720</td>
<td>124,969</td>
<td>2018</td>
<td>Central</td>
</tr>
<tr>
<td>Business park development</td>
<td>1 &amp; 2 Science Park Drive</td>
<td>Ascendas-Singbridge Pte Ltd</td>
<td>235,019</td>
<td>276,094</td>
<td>2019</td>
<td>Central</td>
</tr>
<tr>
<td>Business park development</td>
<td>Cleantech Loop</td>
<td>JTC Corporation</td>
<td>572,017</td>
<td>673,067</td>
<td>2019</td>
<td>West</td>
</tr>
<tr>
<td>Redevelopment of Aquarius</td>
<td>21 Science Park Road</td>
<td>N.A.</td>
<td>312,153</td>
<td>376,737</td>
<td>2019</td>
<td>Central</td>
</tr>
<tr>
<td>MP11, Mediapolis</td>
<td>Media Circle</td>
<td>N.A.</td>
<td>679,725</td>
<td>799,676</td>
<td>2021</td>
<td>Central</td>
</tr>
</tbody>
</table>

Notes: 1) Estimated NLA is calculated by factoring an estimated building efficiency. 2) MP11 is currently undergoing Concept & Price Tender, and is expected to complete by Q1 2021 as stated in the tender documents.
Source: Colliers International Singapore Research, JTC (Information as of Q3 2017)
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