Urban Land Institute

UNDERSTANDING THE LIFE SCIENCES SECTOR IN ASIA PACIFIC

The Case for Investment

A research paper by Didobi

COVER PHOTO: I-square, Pangyo, South Korea.

About ULI

The Urban Land Institute is a global, member-driven organisation comprising more than 45,000 real estate and urban development professionals dedicated to advancing the Institute's mission of shaping the future of the built environment for transformative impact in communities worldwide.

ULI's interdisciplinary membership represents all aspects of the industry, including developers, property owners, investors, architects, urban planners, public officials, real estate brokers, appraisers, attorneys, engineers, financiers, and academics. Established in 1936, the Institute has a presence in the Americas, Europe, and Asia Pacific regions, with members in 80 countries.

The extraordinary impact that ULI makes on land use decision making is based on its members sharing expertise on a variety of factors affecting the built environment, including urbanization, demographic and population changes, new economic drivers, technology advancements, and environmental concerns.

Peer-to-peer learning is achieved through the knowledge shared by members at thousands of convenings each year that reinforce ULI's position as a global authority on land use and real estate. In 2020 alone, more than 2,600 events were held in about 330 cities around the world.

Drawing on the work of its members, the Institute recognizes and shares best practices in urban design and development for the benefit of communities around the globe.

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Acknowledgements

ULI Asia Pacific would like to thank the following companies for sponsoring this research:

AXA Investment Managers

Baker McKenzie.

Charter Hall

IGIS Asset Management
INTEGRATED GLOBAL INVESTMENT SOLUTION

nuveen
A TIAA Company

savills

The preparation of this report was supported by the following ULI Asia Pacific staff, researchers and steering group members.

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EXECUTIVE SUMMARY

In Asia Pacific, despite the size of the sector and predicted continued growth, the life sciences sector is not yet understood well by the real estate industry or recognised as a distinct investment sector. National and local governments are realising the growth opportunity and importance of this sector, with COVID-19 bringing a renewed focus to developing domestic facilities and supplies. The property development and investment community is at a relatively embryonic stage of building knowledge, and understanding of the sector's potential and its involvement in the delivery and management of the sector is limited.

With the life sciences real estate transactional markets in Asia Pacific still at an early stage of development, availability of data is limited. This lack of transparency and information on demand and supply is accepted by some domestically focused investors but is a deterrent to others operating on a more global platform. Matters will undoubtedly improve as the major brokers become more involved.

However, the real estate sector has a role to play, as is visible in the United States where real estate investors have capitalised on the demand. As a result the life sciences sector has become a mature and standalone real estate investment sector, featuring both specialised[1] and diversified[2] players whose activities range across clusters whether mature or emerging, with large-scale multi-purpose communities that cater to life sciences businesses at every stage of their life cycle, from start-up to scale-up and developed corporates.

Established real estate players in the U.S. life sciences market have started to look further afield for the next top life sciences destinations, and some have begun to explore opportunities in Europe and Asia Pacific and to make acquisitions. They are being followed by real estate players within Europe and Asia Pacific, who are beginning to recognise the life sciences sector as an emerging investment class with space to grow.

This research report provides a comprehensive overview of the Asia Pacific life sciences industry, including the drivers of successful locations and the nature of the real estate required by life sciences companies. It describes the wide range of entities that are active in this space and outlines recent investment trends.

The research addresses the following key challenges that the Asia Pacific life sciences sector faces:

- Lack of data and transparency;
- Lack of product for occupiers;
- Lack of investment stock;
- Lack of understanding in the investor/developer community;
- Lack of operational expertise; and
- Government control (in some territories) over land and buildings.

[1] Such as Alexandria REIT (urban clusters only).
[2] Such as Harrison Street (life sciences real estate and other alternative assets).

Opportunities to invest in life sciences real estate (LSRE) across the Asia Pacific markets will vary, particularly where government ownership of land and sites restricts private interests. In these cases, some form of partnering or joint venture arrangement may provide an acceptable lower-risk entry point. To take advantage of the opportunities the life sciences sector provides from a structural growth and diversification perspective in Asia Pacific, the real estate industry needs to act in the following key ways, helping overcome the barriers to the sector: Lack of data and transparency:

- Overcome the lack of reliable data.
- Create a life sciences real estate building specification guide.
- Be prepared to work closely with government, whether national or local.
- Factor in mega-trends in LSRE decision-making.
- Work towards a shared definition of LSRE and of related key terms.
- Work with major life sciences tenants to better understand their needs and develop appropriate facilities.
- Government control (in some territories) over land and buildings.

1. INTRODUCTION

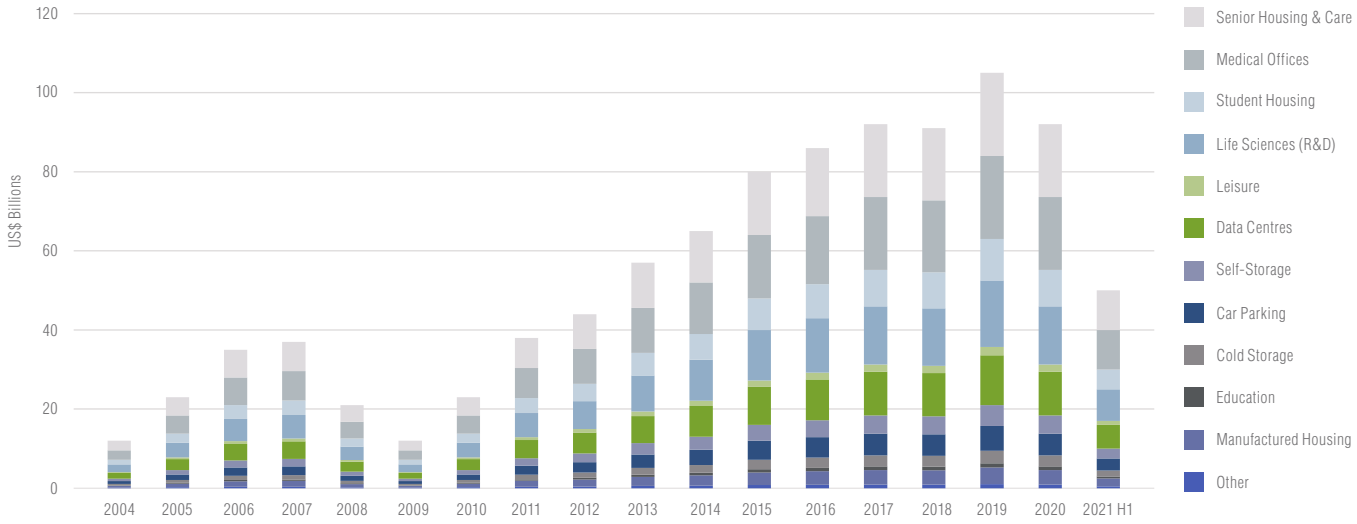
The life sciences sector has grown significantly in recent years and continues to benefit from structural growth drivers that have only been further accelerated by the impact of COVID-19 over the past 18 months. As health and well-being become an increasingly important focus for developed economies, the life sciences sector is developing into a critical growth area of national and global economies. Consequently, the demand for a diverse range of real estate product to meet occupier needs is also on a growth trajectory.With the life sciences real estate transactional markets in Asia Pacific still at an early stage of development, availability of data is limited. This lack of transparency and information on demand and supply is accepted by some domestically focused investors but is a deterrent to others operating on a more global platform. Matters will undoubtedly improve as the major brokers become more involved.

Global capital flows into life sciences real estate have also increased significantly since 2004, as figure 1 illustrates.

The United States has led the way in life sciences, with major clusters in Boston and California. Life sciences real estate is now a mature and significant sector and continues to attract substantial capital investment, in part because the sector has shown income stability and resilience during the 2020/2021 disruptions caused by COVID-19. Specialist real estate investment trusts (REITs) and funds are leading the way, but a wide range of global capital is now looking to deploy in emerging life sciences hubs worldwide.

Whereas PwC and ULI's *Emerging Trends in Real Estate: An uncertain impact; Europe 2021* identifies life sciences as one of the top three sector prospects, the parallel Asia Pacific report gives scant attention to life sciences, although it does

Figure 1: Global capital flows to alternative real estate



Sources: CBRE and Real Capital Analytics.

note that "investors are more focused on finding deals among particular asset classes than geographies, with an emphasis on those providing income streams that are resilient in a down-trending market. In the current environment, this translates into a rotation of capital away from mainstay asset classes experiencing cyclical or secular headwinds (such as office, retail and hotels) and towards those previously regarded as niche (such as logistics, multifamily residential, data centres and tech-oriented business parks catering to disciplines such as life sciences)."

The purpose of this report is to assess the potential and requirements for the sector to develop into a more mature real estate investment sector of Asia Pacific. Before turning to the specifics of the life sciences, the report provides some general background to investing in Asia Pacific real estate.

Overview of Asia Pacific markets

The primary challenges for investors to overcome when assessing the potential of any real estate sector in Asia Pacific are to understand the sheer geographic scale and economic complexity of the region.

Some simple statistics illustrate the issues: the size of the entire population of Australia is equivalent to the size of the population of Shanghai (about 22 million people). China occupies a 24 per cent bigger land area than Australia but with 55 times greater population. The seven-hour flight from Singapore to Tokyo is equivalent to a New York to London transatlantic flight.

Everything is different

Asia Pacific is not a homogeneous market in the way that North America or the European Union can present itself, and this difference applies to every sector, including life sciences. Pretty much everything is different – language, culture, legal systems, tax regimes, levels of economic development, and available talent pools. All these factors need to be looked at carefully and then placed against a backdrop of individual country risk: certain countries in the region lie far beyond the investment risk appetite of some investors, whatever the inherent attractions might be.

There are good reasons to invest in the region and some challenges. The Investment Intentions Survey 2021 by the Asian Association for Investors in Non-Listed Real Estate Vehicles (ANREV) cites international diversification, access to new markets, and asset class diversification as reasons which attract investors to commit in non-listed real estate funds in the region. On the flip side, availability of suitable products, transparency and market information, and currency risk exposure have been deemed as the most challenging obstacles in several years of surveys.

Japan and Australia are key destinations for inbound capital

From a real estate perspective, most of the inbound capital to Asia Pacific tends to be aimed at Japan and Australia, countries that offer large, securitised markets which can be entered and exited with relative ease. This ability to trade, to transact easily, is vitally important. Markets such as Hong Kong and Singapore are of great interest but, in reality, are fairly small and tightly held by domestic investors, making investment-grade product hard to access. Regional gateway cities tend to be the focus – thus Tokyo in Japan, along with Osaka; Seoul in South Korea; and in Australia, Melbourne and Sydney, are key capital destinations. China has vast scale and potential but complex capital controls that do not suit the risk appetite of every investor, although this does not worry domestic investors, who are significant, or those with long-term interests in China. For those with interest, tier one and two cities tend to be the focus.

Non-traditional real estate is of growing interest

Most of the institutional investment capital pouring into the Asia Pacific region is directed to the traditional real estate sectors – office, retail, industrial/logistics, and to some extent residential. One feature of the real estate markets is a relative lack of investment-grade product, with low property yields being one sign of this trend. This aspect of the market has been compounded by the considerable amount of capital raised for investment in the region over the years, together with as yet undeployed dry powder. What this has meant is growing interest in non-traditional real estate sectors such as health care, student housing, and development strategies as investors have sought a more diversified approach to capital deployment. Interest in the life sciences sector is simply the latest manifestation of this recent trend.

Short lease terms can make life easier for investors

Lease terms tend to be short in the region. Two- or three-year leases are common in the office sector, though in some cases, such as in Australia, longer leases are offered with periodic market reviews for larger occupiers. Investors will well understand the pros and cons of shorter leases as they relate to risk of occupier churn, quicker access to vacant possession for asset refurbishment purposes, and so on. In countries where the real estate industry standard is for shorter leases, it is likely that at least some life sciences ecosystems will simply follow the industry norm.

At the same time, the unique nature of certain life sciences real estate product will also mean that some end users, having invested in equipment and in the specifics of the facilities, will want longer-term tenures. Different business models can lead to different kinds of leases:

1. Under the "Direct Asset Investment Model", investors buy the building, fit it out, and operate it themselves. It attracts small tenants (e.g., small and medium businesses), which do not need a sophisticated set-up, for example, doctors. Under this model, leases are usually short term (two or three years).

2. Under the "Built-to-Suit Model", an investor repositions an existing asset it so as to accommodate or suit a particular use, for example, from manufacturing factory to high-end space for the tech industry. It attracts more established players. Under this model, leases are usually long term (eight to 10 years, depending on the nature of the business).

As a result a two-tier leasing model is highly likely to develop depending on the circumstances of the end users. Investors will be looking for "stickier" tenants who are willing to pay for longer leases.

Role of government

The role of government in Asia Pacific is generally rather laissez-faire as it relates to the traditional real estate sectors, other than provision of land through appropriate overall land use planning, provision of infrastructure, meeting public housing needs in certain markets, and specific industrial-related land use requirements. In other words, real estate markets are to a large extent left to themselves to develop along market-led lines.

By contrast, the life sciences sector, being seen by virtually all governments as a "strategic growth industry". is often backed by a raft of government-led initiatives aimed at stimulating the growth of investment and employment in the sector, and therefore ultimately its contribution to the country's gross domestic product (GDP). At the same time, the sector may be treated as a matter of national security in the longer term. There has been media coverage in Australia about the need for its own manufacturing facilities of vaccine and personal protective equipment, commonly referred to as PPE, to protect the country during pandemics. Other countries are also likely to be looking at this angle. If viewed through the national security lens, governments may increase regulation, resulting in possible foreign investment restrictions.

Unsurprisingly, this concern can shift the dynamic for the sector from a real estate perspective, depending on the extent and nature of government intervention. For example, Special Economic Zones (SEZs) are prevalent throughout most of ASEAN (Association of Southeast Asian Nations), having been established to facilitate greater trade through various fiscal and non-fiscal incentives, as a cornerstone for efforts to encourage more foreign investment. SEZs include industrial parks, special export processing zones, technology parks, and innovation areas. SEZ occupiers are from a wide range of industries including electrical machinery, textiles, and semi-conductors.

But the point of this example from a real estate perspective is this: SEZs are not meant to facilitate trading of properties. Once built, they are generally government-run and occupied by long-term end users who are unlikely to trade their properties. When one looks at the life sciences sector, one sees a similar element: the government on the one hand is an enabler but at the same time may not necessarily establish a life sciences ecosystem that is accessible from the standpoint of institutional investment capital.

Means of capital deployment – flexibility pays

According to data published by ANREV in its Capital Raising Survey 2021, US$150.9 billion was raised for real estate globally in 2020 compared with US$220 billion in 2019. In 2020, some 17 per cent of the total was raised for Asia Pacific strategies, compared with 14.9 per cent in 2019.

The weight of capital pointed at the Asia Pacific region currently, coupled with the potential growth of the region in future, all layered over a diverse and fragmented set of geographies and economies, has meant that wise investors have adopted a variety of means to deploy capital.

One of the most popular means is through non-listed fund structures (the destination for 60 per cent of capital raised for Asia Pacific strategies in 2020), but capital is also deployed through listed vehicles, directly held real estate, joint ventures and club deals, separate accounts, non-listed real estate debt, and funds of funds.

Trends in Asia Pacific life sciences real estate

The report reviews the main trends affecting the life sciences sector in Asia Pacific and how the drivers and dynamics are affecting the demand for LSRE. The ULI Asia Pacific survey forming the basis for this report which went out to ULI members found that over half (57 per cent) of respondents were interested in the life sciences sector because of competitive risk-adjusted returns compared to other asset classes and the potential for capital growth.

The specific and diverse occupier requirements from within the life sciences sector imply more complexity than for more traditional sectors, such as offices. This research aims to provide a solid platform to better understand the intricacies of the life sciences sector and the challenges inherent in meeting occupier demands – and to bring some transparency to what remains an opaque market to those investors lacking specialist knowledge. This was demonstrated by the survey, where one of the greatest challenges identified is the relative scarcity of information. In the top three responses to survey questions about investment in LSRE, respondents noted:

- Lack of data to make informed decisions, 43 per cent;
- Lack of experience, 43 per cent; and
- Lack of suitable real estate, 43 per cent.

Lack of knowledge about the sector (33 per cent) and lack of skilled labour (24 per cent) also featured in the top five responses in the survey.

Methodology

The report presents insights gained from market participants through a ULI Asia Pacific survey, case studies, two roundtable discussions, and a series of telephone interviews. An extensive literature review, including reports from government, academia, real estate advisers, professional services businesses, media, and websites has also contributed to the knowledge base. A survey of ULI members garnered 75 responses on topics such as growth drivers, leasing models, challenges, and investment purposes. In addition, interviews with 19 industry experts were undertaken to examine more deeply some of the survey responses. More than 130 transactions between 2015 and 2021 were analysed to reveal patterns concerning the origins of and destinations for capital. The survey, interviews, and roundtable discussions were held in August and September 2021. Natural language processing software was used to assist in drawing out key messages from the interviews and roundtable events.

Structure of the report

Chapter 2 briefly reviews the evolution of life sciences from "modern medicine" through formalised research and development (R&D), to the wide-ranging field of life sciences that one sees in the 21st century. It also sets out the definitions and typical characteristics of LSRE, including purpose-built science parks, science clusters, incubators, and accelerators, to familiarise readers with the types of built environment focused on in LSRE. This section also introduces the all-important life sciences ecosystem.

Chapter 3 considers the key growth drivers and trends for the life sciences sector, all of which are driving demand for LSRE and funding.

Chapter 4 focuses on country and city selection and details elements that contribute towards the relative attractiveness of locations. How does a location score against the metrics forming part of the triple, quadruple, or quintuple helix? Indicators include talent attractors, such as strength of academic institutions, availability of employment, cost of living, and housing affordability.

Chapter 5 provides an overview of the real estate characteristics of life sciences and the challenges facing a sector seeing robust demand, often from immature businesses with a requirement for flexible space and specialist facilities. This chapter provides an analysis of the transactional activity across the Asia Pacific region in recent years and discusses four potential routes to market. The chapter ends with a comparison between the views of market participants in Asia Pacific and Europe, as revealed by interviews held with a total of 37 experts across the two regions, and some very high-level cost estimates.

Chapter 6 draws together the conclusions of the research, highlighting the challenges and opportunities for the real estate sector. Recommendations are provided on how the real estate industry can move forward and unlock potential for this wide-ranging and often bespoke sector.

The report includes six case studies, each one representing a leading life sciences cluster (five in key Asia Pacific markets as well as Kendall Square in Boston in the United States, which is seen as an exemplar of a life sciences and tech urban cluster).

2. EVOLUTION AND BACKGROUND

The first three stages in the evolution of modern medicine through to the wide-ranging life sciences industry of today, identified by a number of academics, is now supplemented by a fourth stage encompassing greater technology:

1. c. 1850–1950: characterised by little new product research based on relatively primitive methods and organised in an informal manner.

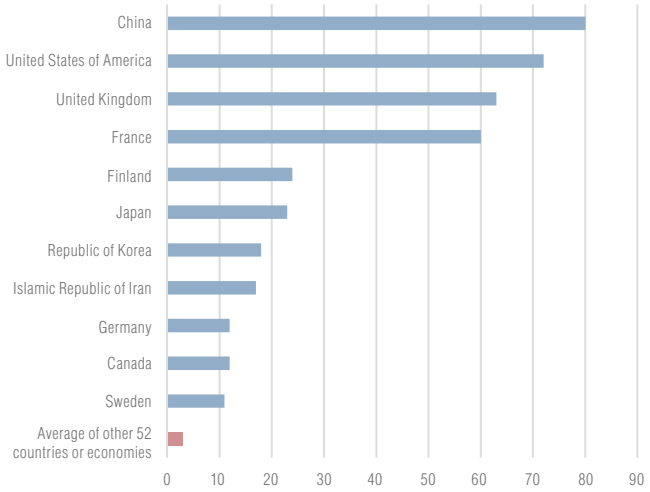
2. c. 1950–1970: an era characterised by relatively rapid rates of new product development based on increasingly formalised in-house R&D programmes.

3. Post-1970: "drug development by design", making use of genetic engineering in the discovery and production of new drugs. This third epoch saw consolidation amongst pharmaceutical businesses, the growth of new biotech businesses working with biological products and systems rather than chemicals, and pharmaceutical companies only re-engaging with biotechnology since 1995.

4. A fourth, recent phase, more prevalent in North America and Europe, is the increasing crossover being witnessed between health care and technology innovation, enabling rapid product development and increasing personalisation of treatments. The diverse geographies of the Asia Pacific region and the different stages of evolution of the life sciences industry represented there deliver a more mixed picture.

The growth and development of purpose-built science parks, campuses, and clusters can be traced to the early 1950s Stanford University Science Park, Silicon Valley, in the United States, followed by Antipolis, near Nice, France, in the 1960s and Tsukuba Science City, Japan; Cambridge Science Park, UK; Boston, Kendall Square, United States; and Macquarie Park in Sydney, Australia, in the 1970s. According to the United Nations Educational, Scientific and Cultural Organisation (UNESCO 2018a), there were an estimated 534 science and technology parks (STPs) worldwide in 2017, including 169 STPs in the Asia Pacific region (see figure 2).

Figure 2: The number of STPs by country or economy, 2017



Source: Prepared by the authors, based on United Nations ESPA, 2019.

Note: (1) The numbers of STPs in the figure should be interpreted with caution due to different definitions of STPs. A facility may have all the functions of typical STPs but may not be called an STP, and therefore, may not be counted as an STP when the statistics in this figure were prepared; (2) the other 52 countries are not listed in the figure. The number of STPs in these countries range from 1 to 9.

The critical factor in the establishment and growth of these and other clusters is proximity to academia and knowledge centres: science and medical centres of excellence at universities and teaching hospitals. The benefits of collaboration, critical mass, and talent attraction enabled by clusters and purpose-built parks are further developed later in the report.

The life sciences sector has witnessed unprecedented growth in recent years and several macro-drivers will continue to support growth and investment in the sector. In addition, COVID-19 has provided a catalyst for large-scale global investment in R&D and medical devices that has resulted in further innovation and an accelerated pace of change.

Brief definitions and characteristics

A key factor for investors in LSRE is the need for specialist knowledge. When asked about the differences between LSRE and traditional real estate in the survey, the respondents' top five answers were as follows:

- Specialised knowledge required to operate/manage, 38 per cent;
- Capital expenditure required, 29 per cent;
- Additional oversight required from investor/fund manager, 24 per cent;
- Performance benefits of clustering, 24 per cent; and
- Risk profile, 24 per cent.

Specialised knowledge, capital expenditure, and cluster benefits featured as the top three differences in the European study.

The specialisation and differences are illustrated by the variety of location and building types required by the range of tenants operating within the sector, as outlined under the headings "Location definitions" and "Occupational property types" below.

Location definitions

Science cluster: an agglomeration of complementary (and competing) businesses engaged in all aspects of science-based research and development, commercialisation of products, manufacturing, and sales. Occupiers include academic research, hospitals, science and tech business start-ups, small and medium enterprises (SMEs), and major corporates.

Cluster characteristics are in many ways similar to the science park but not contained in a purpose-built park. Clusters cover a much broader geography, sometimes crossing international borders, are on a much larger scale, and contain a comprehensive mix of office, R&D, lab, and manufacturing premises. Clusters, through their larger geographical spread, will have access to several universities, higher education establishments, and university teaching hospitals. The ultimate goal is the same – academic and business collaboration, nurturing and growth of start-ups and SMEs, cross pollination of ideas and research, innovation of new product, and acceleration to market. The importance of strong digital infrastructure and international connectivity should not be underestimated in the success of large clusters.

Innovation Quarter Westmead, Sydney, Australia

Innovation Quarter (iQ) Westmead,[3] located close to Sydney in the Australian state of New South Wales (NSW), aims to become the Southern Hemisphere's leading commercial, health research, and education precinct. The term "precinct" is used in Australia to define purpose-built facilities serving specialist health, medical, R&D, and, increasingly, life sciences businesses alongside commercial and amenity space.

Westmead is located 26 kilometres west of Sydney's central business district (CBD) and draws upon a population of 1.6 million within a 15-kilometre radius. Over the next decade, 5,200 new homes are to be developed in Westmead and the surrounding area. Western Sydney University (WSU) is a multi-campus university with more than 44,000 students. The location is close to the M4 motorway and has

iQ Westmead
Source: Charter Hall

[3] Innovation Quarter, Western Sydney University and Charter Hall, https://www.iqwestmead.com.au/.

improving public transport links, with an existing three-minute train link to Parramatta, Sydney's second CBD, and a proposed light-rail connection to Parramatta and the Sydney CBD that opens in 2023, reducing travel time to Sydney CBD to just over 20 minutes. Westmead is also located just 30 minutes from the new A$75 billion (US$54 billion) Western Sydney Airport.

The 50/50 joint venture between WSU and Charter Hall will deliver 43,000 square metres of mixed-use research, health, commercial, and retail space across three state-of-the-art towers. The first two towers will share a central square that will form a focal point surrounded by retail and dining offers at ground level. Due to COVID-related construction site shutdowns, Phase 1 is expected to complete in the first quarter of 2022, with Phase 2 targeted for completion in the first quarter of 2023.

iQ will be a multidisciplinary research space that encourages collaboration between business, health, and research with the goal of creating a "living lab" that nurtures the sharing of knowledge and resources. iQ and Westmead will benefit from A$5.8 billion (US$4.2 billion) of public- and private-sector investment over the next few years, having been selected as one of only three NSW Government Lighthouse Projects in Sydney identified to drive economic growth. Westmead hospital will be redeveloped in 2022 at a cost of A$1 billion (US$0.72 billion), and the Murdoch Children's Research Institute is also due for completion in 2022.

The area currently employs 18,000 in health sector–related jobs and predictions from Deloitte (Deloitte 2016) suggest 50,000 high-value specialist jobs by 2036.

CSIRO, Australia's national science agency, is committed to Phase 1 of iQ alongside a range of other major health and life sciences corporate tenants, including WSU's MARCS Institute, the Translational Health Research Institute, and the NICM Health Research Institute. All the health, research, and commercial space in Phase 1 was fully committed more than seven months before completion.

The iQ Innovation Quarter will complement existing health and life sciences occupiers and provide greater collaborative opportunities for existing health and research-based institutions, which include University of Sydney Clinical School, Sydney Nursing School, Westmead Breast Cancer Institute, Westmead Institute of Medical Research, and IVF Australia, Westmead.

> "I believe that Westmead is the most important health and medical research precinct in the country."
>
> — **Professor Peter Shergold AC, Chancellor, Western Sydney University**

As a new-build facility, iQ will incorporate the latest in digital and sustainable technology and will set a new benchmark for mixed-use development.

Currently, no rents are being quoted, but this best-in-class space in a genuine life sciences precinct will provide a compelling offer to tenants seeking a collaborative ecosystem.

> "Australia has been a world leader with its health management response to COVID-19, and research infrastructure like Innovation Quarter will ensure Australia remains a competitive driver of cutting-edge research, technology and innovation."
>
> — **Stuart Ayres, NSW Minister for Jobs and Investment**

iQ Westmead
Source: Charter Hall

Science park: a purpose-built development of office space, labs, workrooms, and collaborative space designed to support research and development in science and technology.

Science park characteristics: The park has a close relationship with at least one leading university and is involved in promoting the university's research and development through industry partnerships, assisting growth of new ventures through incubation and spin-off processes, product innovation and commercialisation, and the transfer of technology and business skills between university and industry. The out-of-town/edge-of-city locations tend to benefit from good domestic and international infrastructure, the availability of a range of science and technical skilled labour, and high quality-of-life credentials.

A science park forms part of the "knowledge economy" by creating an ecosystem of partners, industry professionals, and suppliers. The curation of tenants is extremely important in driving the success of the park, the right mix bringing collaboration between public and private sectors at a national and international level. Such curation is often easier if the park is under single ownership. Some parks in Europe, such as Oxford and Cambridge Science Parks, in the UK, are owned by university colleges. Sydney's Innovation Quarter is the result of a close collaboration between WSU and Charter Hall, a fully integrated property group.

The scale or size of science parks across Asia Pacific varies, but research suggests that they range from less than 50,000 square metres to more than 300,000 square metres. Singapore's Biopolis measures 185,000 square metres in total, containing space for laboratories, research facilities, offices, and retail operations.[4] Hong Kong Science Park provides a campus-like environment of 330,000 square metres suitable for high-technology enterprises.[5]

Occupiers will range from business start-ups within dedicated incubator or innovation centre premises to spin-offs, SMEs, and major corporates representing specialisms across the spectrum of life sciences and technology.

[4] JTC Corporation, Biopolis, 16 Oct. 2021, https://www.jtc.gov.sg/industrial-land-and-space/Pages/biopolis.aspx.
[5] Hong Kong Science & Technology Parks Corporation, https://www.hkstp.org/.

Pangyo I-Square, Sungnam-si, Korea

Pangyo is a planned city located about 10 kilometres southeast of Seoul. It was built to alleviate excessive demand for apartments in Gangnam and other parts of the capital. Construction of the city began in December 2003, and Phases 1 and 2 were completed by 2010. The town was designed to be an eco-friendly city with lowest population density among new cities and expansive green spaces. Waste management facilities, energy plants, and sewage treatment facilities in the community were built to maximize energy efficiency with the use of green technology.

Within Pangyo Techno Valley (PTV) there are different locations:

- "Techno Valley One" (661,000 square metres) is reported to produce a GDP of US$72 billion and houses 1,270 companies of different sizes, from start-ups to giants such as NAVER and KaKao. There are approximately 71,000 people working there. Biotech tenants make up 13 per cent of the total; most of the other tenants are in the IT sector (Source: Colliers).

I-square skyshot (C1 & C2 block)
Source: IGIS Asset Management

- "Techno Valley Two" or PTV 2 (425,760 square metres) and "Techno Valley Three" or PTV 3 (583,581 square metres) are not yet completed.
- PTV 2 is forecast to be completed in 2022 and PTV 3 in 2025.

Within PTV 2, the I-Square complex was opened in April 2021, targeting mainly life science companies and other tech companies. The gross floor area is 255,000 square metres comprising five office buildings, one four-star 280-bedroom hotel, a shopping mall, a 700-bedroom co-living facility, an auditorium, and a cultural and exhibition space. The complex was designed to provide a one-stop service where employees can live, work, and play.

One of the biggest tenants (occupying more than 25 per cent of the office space) is Huons Global, one of Korea's major pharmaceutical companies. This 65-year-old company was originally famous for its botulinum toxin product and recently started to produce a COVID-19 vaccine.

Market experts have attributed I-Square's success to several key advantages. The first is excellent transport links to Seoul. The second is proximity to Gangnam and Bundang, two of Korea's most desirable and affordable residential areas. The third is financial benefits for landlords and tenants: to attract companies, the government set the price of a land parcel for development lower than market value – around 50 per cent of the value, and rents are priced at 60 per cent of rents in Gangnam district. The fourth is unique building structures: I-Square is styled to look like a campus of the actual Silicon Valley (Source: JLL, IGIS Asset Management).

Science incubator: the primary role of a science incubator is to assist in the establishment and growth of early-stage companies by providing resources, access to industry mentors and specialists, interactions with other entrepreneurs and, importantly, access to patient capital to facilitate survival and growth.

Characteristics of an incubator: The science incubator can take the form of a purpose-built unit or the conversion of existing premises. It normally forms part of an existing park or cluster, thus benefiting from academic links and highly skilled labour. Typically, an incubator will provide access to flexible "ready-to-go" lab and office space/write-up suites, high-end equipment, technical rooms, collaborative and social space, meeting rooms and conference facilities, flexible office space and storage, business support and training, IT and administrative support.

Incubators "offer shared laboratory space, office space, and shared equipment to early-stage life sciences companies in order to turn innovative ideas into reality."

– **https://www.universitylabpartners.org/blog/incubator-vs-accelerator-whats-the-difference**

Occupational property types

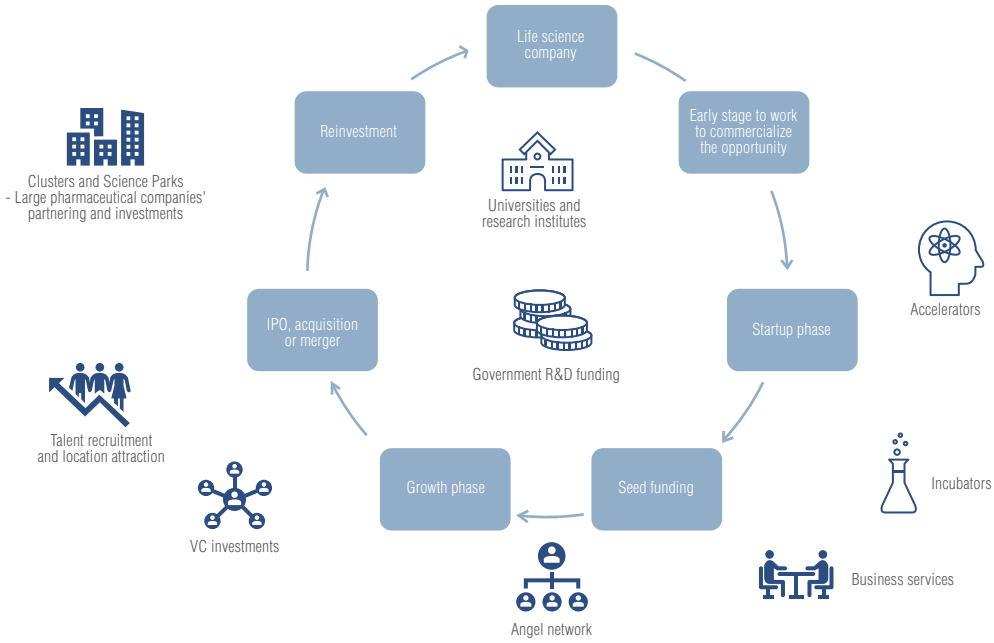
- **Clean room/lab:** a room specifically designed to limit the number of airborne contaminants. Special air filters and air distribution systems keep the environment clean.
- **Collaborative lab:** modern science is a highly collaborative activity. The best lab designs not only facilitate but also encourage collaboration, providing meeting spaces where ideas can be discussed as well as labs that encourage teams to work together. Office space and write-up areas are also important design elements to be included. These allow people working in different areas to come together and work in teams on developing and analysing research, which is often the foundation of breakthroughs. From meeting areas and communal spaces to labs that can be reconfigured to facilitate collaboration between interdisciplinary team members, labs that promote collaboration are often the cornerstone of successful teams.

"For those early-stage occupiers and start-ups, flexibility is the key."

– **Global agent**

- **Dry lab:** an environment that focuses on applied or computational research and analysis and, as such, requires the requisite power and cabling. With advances in technology and lab automation, there is a trend towards more dry space. This "office plus" environment is more attractive to landlords/developers as it is not as expensive to deliver as sterile lab space.
- **Flexible lab:** allows the space to be adapted to new teams and new research without having to employ a team of contractors to reconfigure the lab. Involving a larger initial outlay, the flexibility will generally pay off in meeting the changing needs of tenants.
- **Generic lab:** part of a group of labs that are all the same size and have the same basic fit-out and engineering services. The best generic labs have an element of flexibility. Extractors and sinks are be fixed, but storage can be in mobile units for flexibility.
- **Wet lab:** a wet lab is a type of laboratory where drugs, chemicals, and other biological matter can be analysed and tested using various liquids. The space usually includes fume hoods, sinks, chemical-resistant surfaces, and other bespoke equipment. Wet labs should be designed, constructed, and controlled to avoid spillage and contamination.

Figure 3: Life sciences ecosystem and spatial structures



Source: Adapted by ULI from Majava et al. 2016.

The life sciences ecosystem

The creation or curation of the right ecosystem is critical to the innovation and collaboration that form a fundamental part of the life sciences business life cycle, from seed idea to start-up, through to SME, product launch, and commercial success.

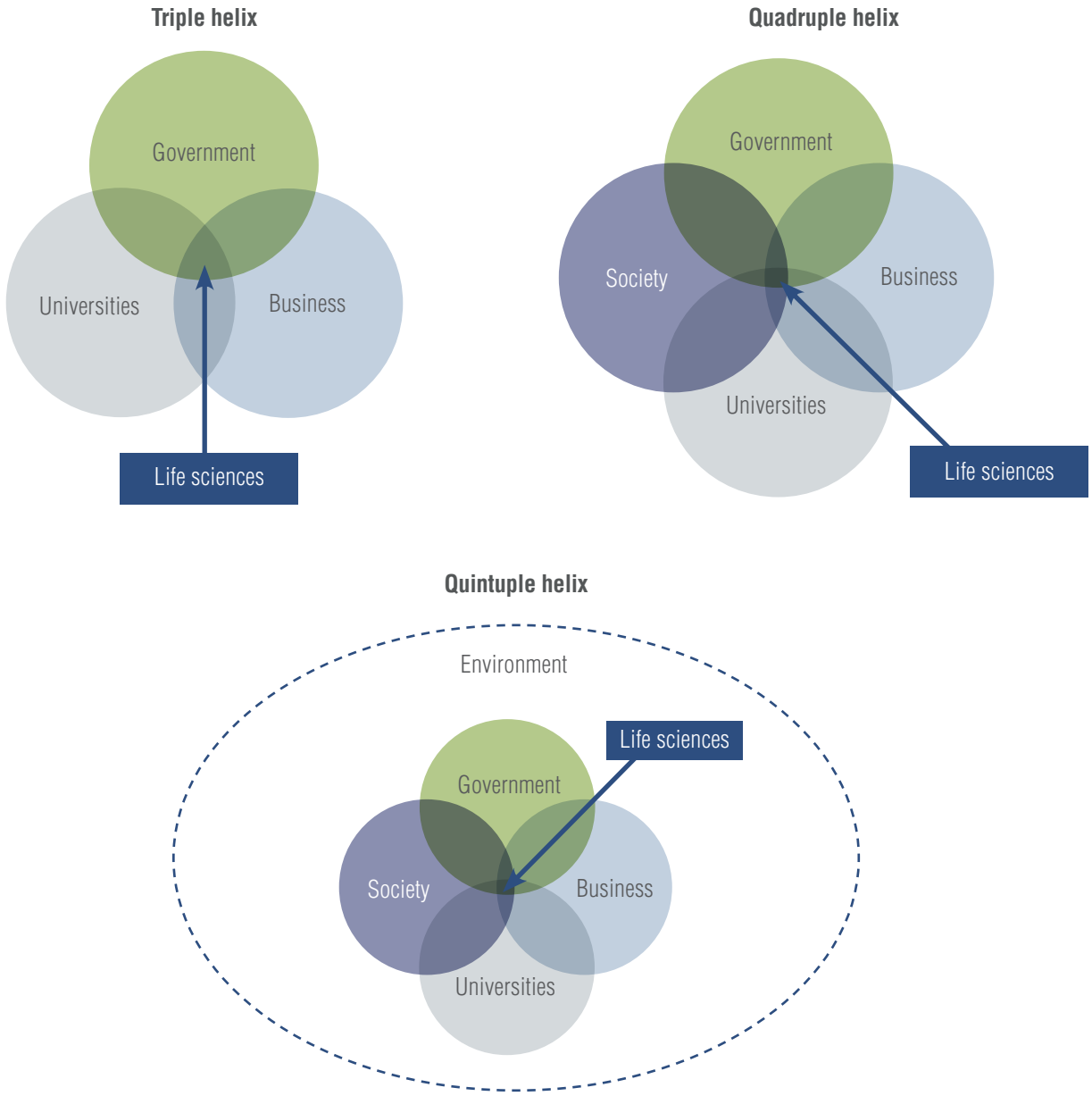
There are several ways of defining the life sciences ecosystem. The triple, quadruple, and quintuple helix approach (figure 4) reflect the belief that innovation is an outcome of an interactive process involving several stakeholder groups.

The triple helix model of innovation describes the interaction among three stakeholder groups: industry, university/science, and government.

The quadruple helix brings in a fourth stakeholder group – the public or civil society. This fourth element has become a backbone of several national science, technology, and innovation policies, strengthening regional innovation systems and enabling better evaluation of research organisations and research proposals (Schütz, Heidingsfelder, and Schraudner 2019). South Korea provides a good example of engaging with the public. Throughout the COVID-19 pandemic, South Korean authorities have provided the public with updated data on the virus and clear guidelines on how to avoid infection. The efficacy of its approach to COVID-19 suppression has been enabled by effective communications with the public and widespread public compliance with masking, physical distancing, and hygiene recommendations (Dyer 2021).

The quintuple helix adds a fifth element to the helical system, that of the natural environment. With a global climate crisis rising to the top of most political agendas, it is only right that environmental impact and sustainable development form part of the discussion.

Figure 4: Triple, quadruple, and quintuple helix models



Sources: Various.

This ecosystem and the helix models are explored in more detail in chapter 4, where a number of indicators have been scored to provide a relative attractiveness score for a select number of Asia Pacific countries.

3. GROWTH DRIVERS AND SECTOR TRENDS

This section reports on the key drivers of growth and trends that are affecting the sector as a whole. This, in turn, has resulted in increased demand for appropriate real estate, a mix of generic, flexible, and specialist space, in dedicated science parks, in urban clusters, and near university and medical institutions.

Growth drivers

Demographics – an ageing population

People are living longer and healthier lives because of advances in treatments, medication, and technology. Even those with pre-existing conditions and chronic or long-term illnesses can now live longer and more productive lives. The ageing population drives continued development of preventative treatments, prescriptive drug cures, and innovation across all aspects of life sciences and development of advanced medical equipment. With continued step changes in technology, there is a recognisable trend towards personalised solutions and e-health (health care services provided electronically via the internet).

It was noted in the European study that there is a move in more developed economies for the middle classes to become less dependent upon the state for health care and, at the same time, the state is under pressure to keep the elderly out of hospital.

Asia Pacific's population accounts for 60 per cent of the global population. All countries in our study area – China, South Korea, Japan, Singapore, and Australia – are facing an ageing population and increasing life expectancy, albeit at different stages on the curve. Further, an expanding middle-class population suggests a higher demand for health care and life sciences services (CBREb).

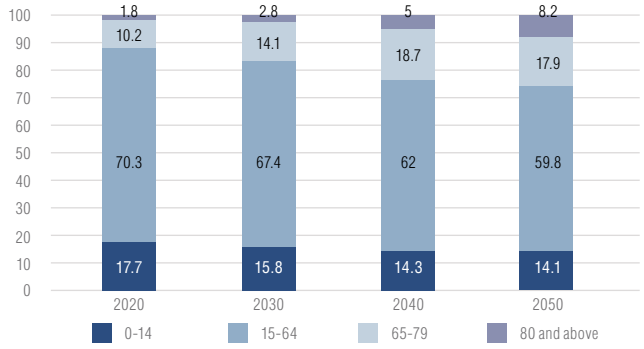
As a benchmark for the following life expectancy data by country, **the world average life expectancy in 1950 was 47 years, rising to 73 years in 2020**. The 2020 life expectancy for all of the five study countries exceeds the world average by some margin.

> "The further ageing of the population imposed continued pressure on the long-term balanced development of the population in the coming period."
>
> – **National Bureau of Statistics of China, the Seventh National Population Census**

China

According to the Seventh National Population Census, the 2020 total population of China was 1.41 billion. Figure 5 illustrates how the proportion of elderly people is expected to grow between 2020 and 2050. The 65–79 years cohort is forecast to increase significantly from 10.2 per cent in 2020 (141.9 million) to 17.9 per cent in 2050 (242.4 million), while the 80+ cohort is expected to more than quadruple from a very low 1.8 per cent (25.9 million) to 8.2 per cent, representing 111.6 million persons.

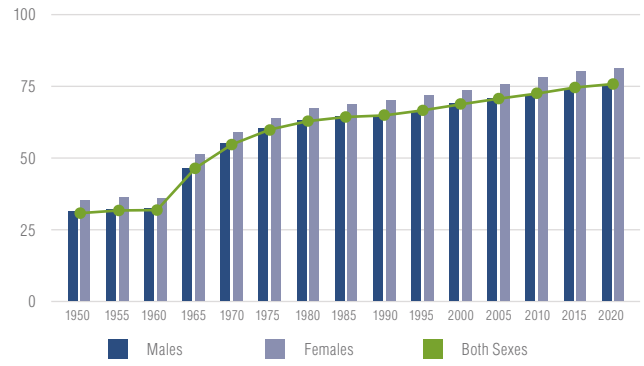
Figure 5: Population structure by age groups, China, 2020-2050
(per cent of the total population)



Source: World Bank 2021.

Life expectancy has continued to increase in China, up from 44 years in the 1950s to 77.5 years in 2020 following a significant improvement in the 1960s (see figure 6).

Figure 6: Life expectancy in China from 1955 to present
Males, Females, and Both Sexes Combined

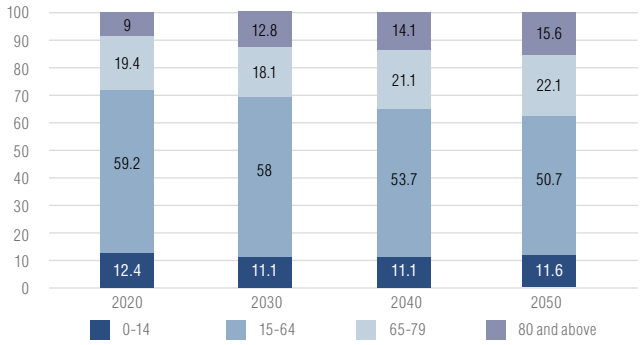


Source: Worldometer, 2021.

Japan

The World Bank reports that the 2020 population of Japan was 125.8 million. Japan is renowned as being ahead of most other countries in terms of dealing with an increasingly elderly and dependent population: 28 per cent of its population (35.7 million) is 65 years and older, rising to 38 per cent (39.5 million) in 2050 (see figure 7). In the 80 years plus bracket, the proportion almost doubles from 9.0 per cent (11.3 million) in 2020 to 15.6 per cent (16.3 million) in 2050.

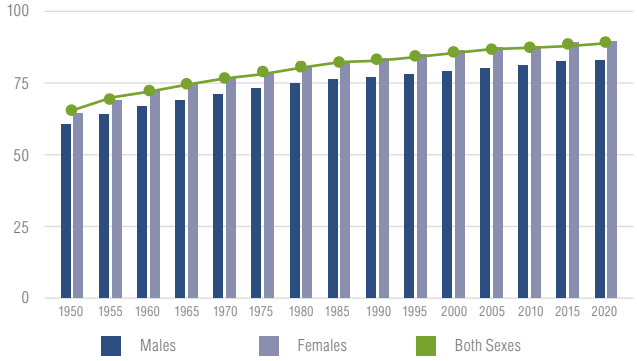
Figure 7: Population structure by age groups, Japan, 2020-2050
(per cent of the total population)



Source: World Bank 2021.

Life expectancy has trended up at a steady pace, from 63 years in 1950 to 85 years in 2020 (see figure 8).

Figure 8: Life expectancy in Japan from 1955 to present
Males, Females, and Both Sexes Combined



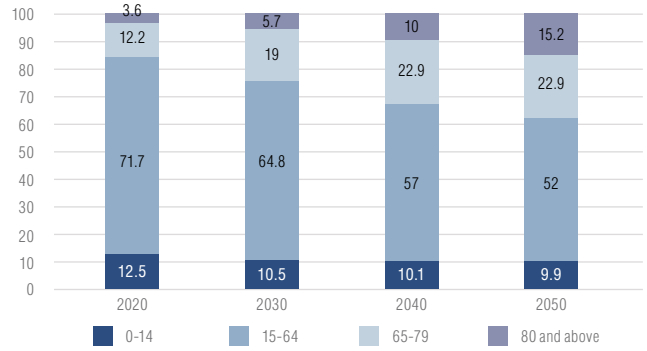
Source: Worldometer, 2021.

South Korea

South Korea's population was 51.8 million in 2020. The proportion of elderly in the total population is accelerating, with 65- to 79-year-olds currently representing 12.2 per cent (6.3 million) of the population, almost doubling to a forecast 22.9 per cent (10.7 million) in 2050 (see figure 9). Similarly, the 80 years–plus age group increases from a modest 3.6 per cent (1.9 million) by over 400 per cent to 15.2 per cent (7.1 million).

Figure 9: Population structure by age groups, South Korea, 2020-2050

(per cent of the total population)

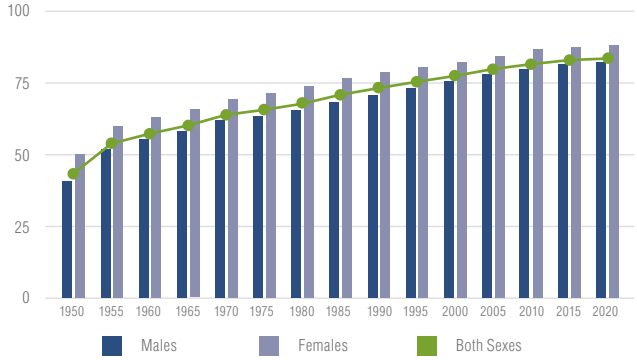


Source: World Bank 2021.

Life expectancy in South Korea was only 42 years in 1950 but has increased steadily in the period from 1955 and now stands at 83.5 years, almost on a par with that of Japan (see figure 10).

Figure 10: Life expectancy in South Korea from 1955 to present

Males, Females, and Both Sexes Combined



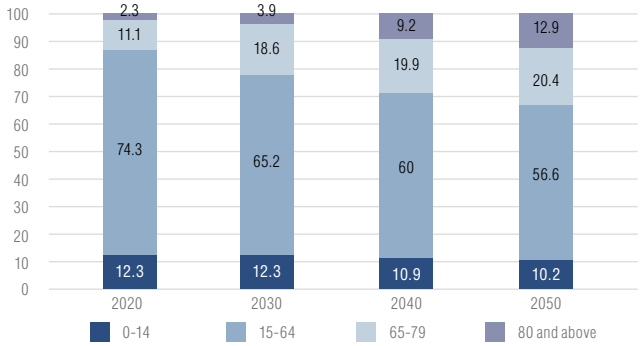
Source: Worldometer, 2021.

Singapore

The reported population of Singapore in 2020 was 5.7 million, and the island country is, like China, at an early stage of the ageing population curve. In 2020, 11.1 per cent (627,000) of the population is in the 65- to 79-year-old cohort, and is predicted to almost double to 20.4 per cent (1.25 million) in 2050 (see figure 11). The most significant growth is in the "very old" group of 80-plus years, rising six-fold from 2.3 per cent (132,000) in 2020 to 12.9 per cent (795,000) in 2050, which will surely represent a challenge to the government.

Figure 11: Population structure by age groups, Singapore, 2020-2050

(per cent of the total population)

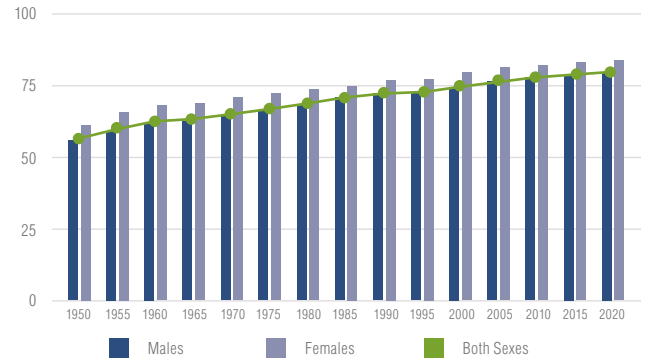


Source: World Bank 2021.

Even in the 1950s, Singapore's population benefited from a longer life expectancy (60 years) than that of many of its Asan neighbours. Longevity has continued to improve over the past 70 years, and the country now boasts an impressive 84-year life expectancy.

Figure 12: Life expectancy in Singapore from 1955 to present

Males, Females, and Both Sexes Combined



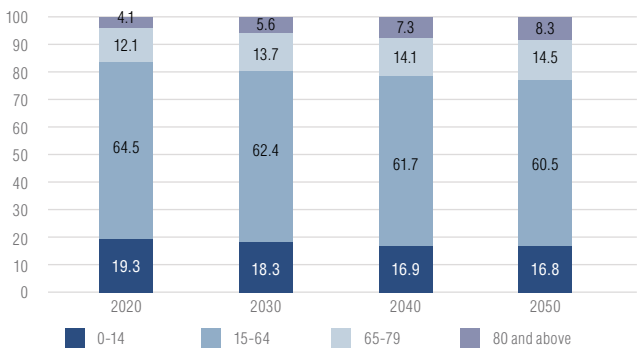
Source: Worldometer.

Australia

While Australia, with a 2020 population of 25.7 million, is prone to similar demographic ageing trends, it retains a relatively young population profile in the long term, with 16.8 per cent of its population in the 0- to 14-year-old group in 2050 (compared with 9.9 per cent in South Korea, for example). The proportion of those in the 65- to 79-year-old bracket increases from 12.1 per cent (3.1 million) to 14.5 per cent (4.7 million) in 2050 (see figure 13). During the same period, the 80 years–plus cohort more than doubles its representation from a modest 4.1 per cent (1.06 million) to 8.3 per cent (2.7 million).

Figure 13: Population structure by age groups, Australia, 2020-2050

(per cent of the total population)

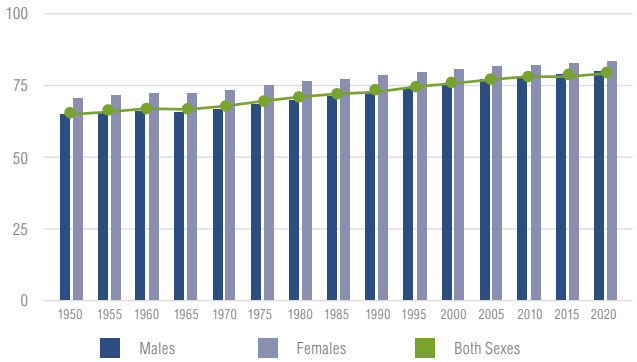


Source: World Bank 2021.

Life expectancy in Australia has been comparatively long since the 1950s (69 years), as illustrated in figure 14. It has continued to improve to the current level of 84 years.

Figure 14: Life expectancy in Australia from 1955 to present

Males, Females, and Both Sexes Combined



Source: Worldometer.

The increasingly elderly profile of the population across Asia Pacific will place additional demands on national health service providers and governments to provide the necessary funding and support for the latest drugs, medical devices, and supporting services. This investment in longer life well-being will continue to drive demand for the wide variety of life sciences.

Lifestyle diseases

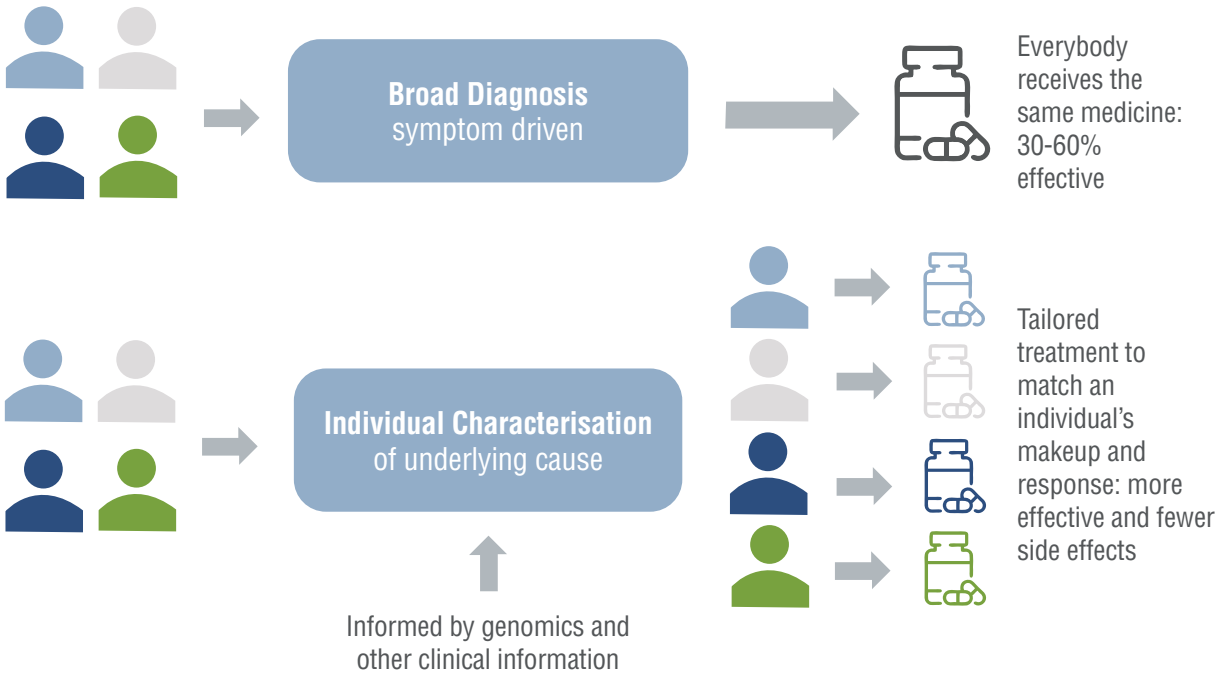
Lifestyle diseases are associated with the way people live their lives. The prevalence of such diseases has increased as, generally, large parts of the world population have seen increasing wealth and greater access to technology and services that have led to more sedentary lifestyles. Lifestyle diseases are often caused by a lack of physical activity, unhealthy eating, alcohol, drugs, and smoking. This leads to heart disease, stroke, obesity, cancer, and the like. Life expectancy decreases with each additional chronic condition. A 67-year-old with no chronic conditions will live for another

22.6 years, but with five chronic conditions, life expectancy will reduce by 7.7 years and with 10 or more chronic conditions, life is shortened by 17.6 years (Multiple Chronic Conditions and Life Expectancy).

There has been significant success in launching new drugs to extend life and improve the quality of life of those suffering long-term health issues, as evidenced in the previous figures showing life expectancy trends. A crucial contribution to life expectancy and improved well-being amongst the elderly and chronically ill has been the development of personalised medicine, which is based upon each patient's unique genetic make-up. Advances in this area are beginning to overcome the limitations of traditional treatments. Importantly it is allowing health care providers to shift from reaction to prevention and to better predict susceptibility to disease (see figure 15). Generally, the situation with lifestyle diseases in Asia Pacific is similar to that reported in the ULI Europe report, with some country nuances.

The shift into preventative medicine and genetic R&D is being accelerated by the influence of technology and, in particular, the application of digital tech, artificial intelligence, and machine learning. This transition is generating new start-up and SME businesses that, in turn, drive demand for specialist and appropriately located real estate. Labs become more flexible and adaptable to changing technology. Lab design is based around humans and robots working side by side. Scientists spend more time in an office-like environment as wet lab processes become more automated. Medical products are being transferred to manufacturing sites to upscale products to market. All of these require a unique set of real estate provision and design that is flexible and adaptable to cover a broad range of activities.

Figure 15: Targeted treatment approach



Source: NHS England 2016.

China

China has experienced rapid urbanisation, and research indicates that the combination of rural-to-urban migration, population growth, and ageing are projected to more than double cardiovascular disease events in urban areas (Chen et al. 2012). The premature mortality rate in China is caused by four major chronic diseases – cardiovascular and cerebrovascular diseases, cancers, chronic respiratory diseases, and diabetes. Although the premature mortality rate from these diseases has declined (down two percentage points between 2015 and 2019, to 16.5 per cent), the control and prevention of such diseases remains a considerable challenge in the face of unhealthy lifestyles. The Chinese National Health Commission (2020) has reported areas of concern including high levels of salt and oil in food, consumption of sugary beverages by the young, and insufficient physical activity. Obesity is another problem area, with over half of Chinese adults being overweight or obese, leading to higher incidences of hypertension, diabetes, hypercholesterolemia, chronic obstructive pulmonary disease, and cancer – all on the rise since 2015.

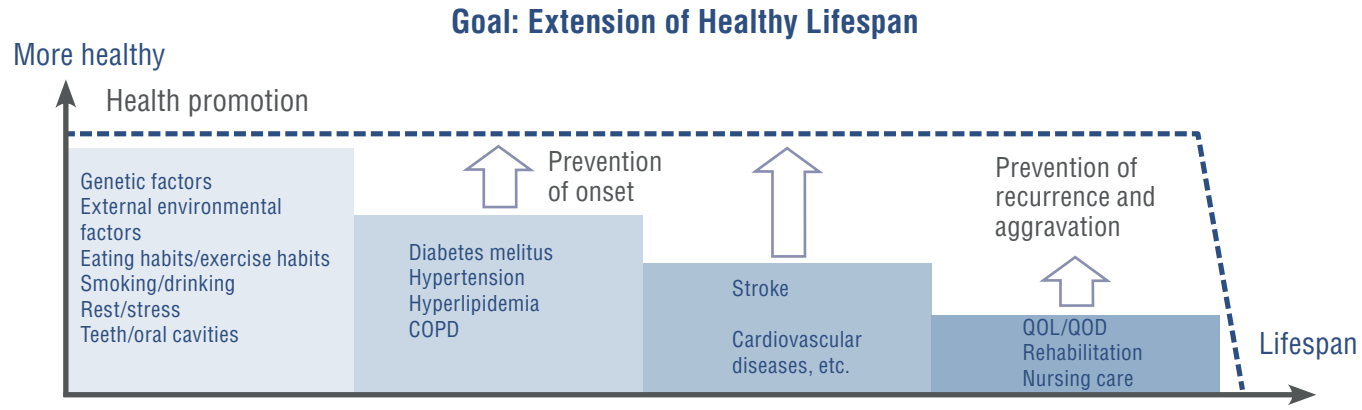
South Korea

According to data from the Institute for Health Metrics and Evaluation, the top five diseases causing death in 2019 were stroke, ischemic heart disease, lung cancer, Alzheimer's disease, and lower respiratory infections.[6]

Japan

Japan is performing differently from other developed countries in terms of lifestyle diseases. Cultural habits, isolation, and a universal health care system are contributory factors. It has a higher mortality from stroke and lower mortality from coronary heart disease. This is partially due to the lower saturated fat (meat) and higher n3 polyunsaturated fat (fish) in the Japanese diet, which lowers the prevalence of hypercholesterolemia and risk of coronary heart disease. As for the associations between lifestyle and cardiovascular disease, higher sodium, lower calcium, and lower animal protein content in the diet and, for men, higher alcohol consumption may account for the higher prevalence of hypertension and higher risk of stroke for Japanese than for Western populations. Japan's coronary heart disease mortality has been low and keeps declining, while stroke mortality has declined substantially. However, recently, coronary heart disease has been on the increase amongst urban men (Iso, 2011), and diabetes remains a concern. Figure 16 illustrates Japan's approach to extending life expectancy.

Figure 16: Lifespan extension programme



Source: Japan Agency for Medical Research and Development, 2021.

[6] IMHE, Republic of Korea, http://www.healthdata.org/south-korea, 2021.

Singapore

Singapore boasts one of the highest life expectancies and has an efficient health system. However, its proximity to Malaysia and Indonesia, two heavy air polluting countries, generate related health issues in Singapore. Unlike many of its Southeast Asian neighbours, Singapore generally suffers from the same health concerns as Europe and North America. Cardiovascular diseases, including ischemic heart disease, and diabetes are the two leading causes of mortality. Singapore, as a highly advanced nation, is prone to Westernisation, which often involves an increased amount of fast food. Much of the threat of these diseases is preventable through lifestyle changes (Source: Reddy, The Borgen Project, 2017).

Australia

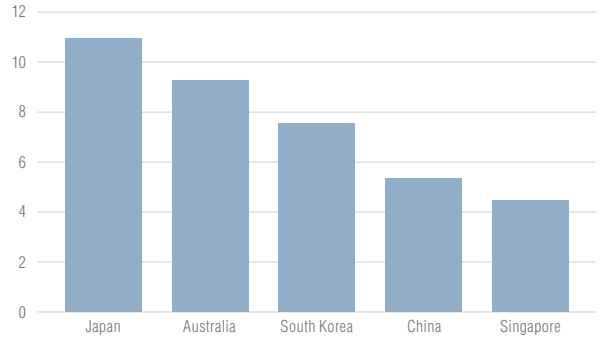
Data from the Australian Government Department of Health National Health Survey of 2017–18 reports the following common chronic health conditions: back problems, arthritis, asthma, diabetes mellitus, cardiovascular disease, obstructive pulmonary diseases, cancer, and kidney disease. An increasing number of people are living with one or more of these chronic conditions due to earlier diagnosis and improved treatments. The Department of Health has developed, or is in the process of developing, policies and strategic action plans to support the prevention, management, and treatment of chronic conditions.

Health care expenditure

Health care expenditure is a key driver of investment in life sciences R&D. This expenditure is only increasing as governments strive for leadership in meeting the challenges and demands of an ageing population.

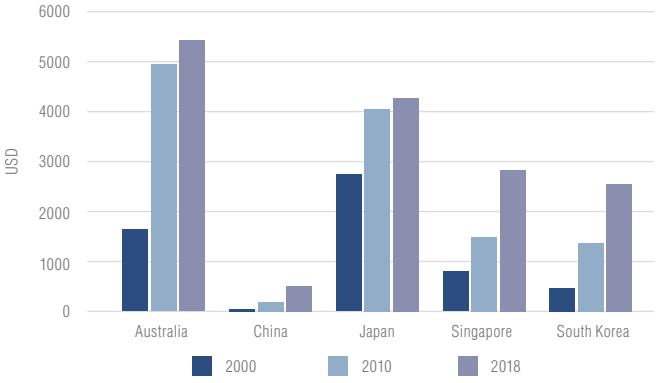
Despite the large market size, health expenditure in Asia Pacific stood at just half of that in the United States (US$3,475 billion) in 2018. While mature markets such as Japan and Australia spend about 10 per cent of their GDP on health, most other countries in the region spend just 2 to 7 per cent (CBRE 2021c). Mainland China is the second-largest drug market in the globe, with health care spending of about US$1 trillion in 2019 (KPMG 2020), which accounts for 5.3 per cent of GDP. Singapore's health care expenditure reached 4.6 per cent of GDP in 2018 while South Korea had a relatively higher percentage of 7.56 per cent in 2018 (World Bank 2021). With health expenditure in the United States accounting for close to 17 per cent of GDP, this indicates substantial room for growth in Asia Pacific (CBRE 2021c). Figures 17 and 18 illustrate the national health care expenditure as a percentage of GDP and health care expenditure per capita. Japan and Australia lead the way under both metrics. For the five countries in the study, all are increasing their expenditure per capita, Singapore and South Korea the most aggressively. China's expenditure per capita is lagging by some measure, but this reflects the sheer size of the population.

Figure 17: Health care expenditure as a percentage of GDP



Source: World Bank 2021.

Figure 18: Health care expenditure per capita



Source: World Bank 2021.

Sector trends

Urbanisation

Choice of location is driven to a large extent by function (availability and price are also factors). Where the function is manufacturing or distribution, suburban locations with good transport links to airports, ports, railways, and the road network are generally preferred. Space is cheaper and more plentiful than in urban locations; planning requirements are less onerous; greenfield development of bespoke facilities is a possibility. Where the function is R&D, collaboration and the ability to attract and retain talent are paramount, and urban locations may be preferable, though not always. Innovation is closely connected with universities, hospitals, and research institutes. These may already be located in the city centre, in which case it makes sense for life sciences R&D to be in the centre too. But every city is different, and if the universities, hospitals, and research institutes are in out-of-town suburban locations, then life sciences R&D may be better placed in those locations. Finally, where the function is the corporate headquarters for a major player, the CBD is preferred.

"We have no generic view of locations because our focus is on the tenant's business. If it works for the tenant, it's a good location."

– **Australian fund manager**

Many commentators believe that cities will drive future innovation and growth in life sciences, but that does not necessarily mean that innovation will happen in the centre of those cities. The Kendall Square/King's Cross model will work for some but not all cities.

Kanagawa Science Park, Kawasaki, Japan

Kanagawa Science Park (KSP) is Japan's first urban science park, though not the country's first science park (that accolade goes to Tsukuba Science City established in the 1970s[7]). The Kawasaki City Government and Kanagawa Prefectural Government initiated the creation of the Kanagawa Science Park in 1984. In addition to these local government bodies, KSP Inc. and the Kanagawa Academy of Science and Technology (KAST) have played a significant role in shaping the park ecosystem.

The concept launched in 1986, construction began in 1987, and the park was completed in 1989. It is situated in the prefecture of Kanagawa, just south of Tokyo. This small science park, comprising three buildings and covering 5.5 hectares, is located in Kawasaki City (population 1.4 million), which is sandwiched between Japan's two largest cities, Tokyo (population 11.3 million) and Yokohama (population 3.7 million). Tokyo Haneda Airport is about half an hour away, and Tokyo Narita Airport is about 90 minutes away. The science park is linked to Tokyo's CBD by train and there is a regular shuttle bus to the nearest station.

"KSP has benefitted from being located close to Tokyo, a dense urban population, high-performance universities and major seaports."

– **United Nations, *Establishing Science and Technology Parks: A Reference Guidebook for Policymakers in Asia and the Pacific* (2019)**

[7] See United Nations ESPA, 2019 report.

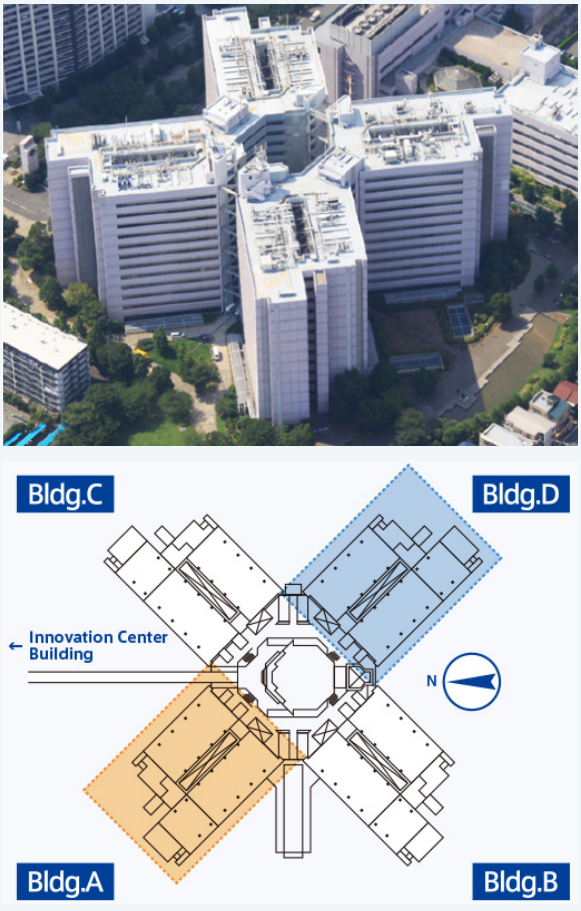
Kanagawa Science Park is not the only such facility in the Kawasaki area: the Kanagawa Life Innovation Centre, another government-sponsored entity, lies about 15 kilometres to the southeast, and the Mitsui Link-Lab, owned by Mitsui Fudosan, is slightly farther away to the northeast. All three offer office space and R&D labs. Mitsui Fudosan's facility was launched to help address the short supply of rental laboratory facilities. Rent in Kanagawa Science Park is US$600 per square metre; in Mitsui Link-Lab it is US$690, according to CBRE.

Kanagawa Science Park's three buildings are clustered together in a mid-rise, dense setting with some landscaping (but no parkland). The first building, the 12-storey R&D Business Park, contains research rooms, laboratories, and offices and is the tallest of the three. The second building, the Innovation Centre Building, has an east wing (six storeys) and a west wing (10 storeys) that are interconnected. The east wing is an incubator providing work and research rooms for start-ups and SMEs that are less than five years old. It offers offices of about 15 to 30 square metres for new ventures, each room being private and lockable, something not found in shared offices. It also offers an office lab space of 36 to 75 square metres for companies that have achieved some business traction and need to expand. The lab is set up with appropriate water supply/drainage, exhaust, and load capacity. The incubator also offers desk space for one-person ventures to help get established.

The west wing has a broader spread of facilities including research rooms, offices, a hotel, convenience shopping, and a post office. Co-working spaces are available in the Innovation Centre Building.

The science park is owned by a government joint venture with private companies which include REITs and life assurers. One of the partners is NTT UD REIT Investment Corporation (NUD), a J-REIT which manages a diversified portfolio of office buildings and residential properties. This J-REIT part owns the largest building in the park, which it values at JP¥6,060 million (about US$55 million), which is approximately 7.5 per cent less than it paid for the building in 2002.

Larger tenants include Du Pont, LIKE TODO Japan Pharma, BrightPath Biotech, and L'Oréal Research & Innovation. L'Oréal is long-term tenant, having set up its R&D unit in the science park in 1990. It is one of three R&D centres that the company has in Japan.



Kanagawa Science Park
Source: www.ksp-c.co.jp/en/guide/

War for talent

Hiring the best and brightest is important if a life sciences company of any size is to hit its research milestones. Today, access to a pool of skilled workers is equally critical to growth. Attracting and retaining the most talented employees is competitive (hence the phrase "war for talent"), and the location of the company's premises is an important weapon in that war. Location in this sense is both micro (that is, the amenities in and near the premises) and macro (at city level).

- Micro-location: an urban or strong suburban location with proximity to cultural activities, shops and restaurants, and the fun factor makes for happy employees. Providing a broad range of amenities and services is seen as increasingly important in "softening" the often-sterile commercial environments of science and business parks.
- At city level, things that matter in the war for talent include the affordability of housing and the cost of living. Notably, life sciences employees may not always be the highest-paid employees in academia or hospitals. If the employees cannot afford house prices in the city and have to live farther out, they face longer commutes with high travel costs, and this could deter talented and skilful workers.

"If the industry is to maintain its recent strong growth, it will need to address three key areas: building talent, handling complexity, and improving commercial and development execution."

– **McKinsey, "What's ahead for biotech: Another wave or low tide?" (2021)**

"Today's biotechnology and AI advances rely on blue sky research conducted not that many years ago."

– **Economist Intelligence Unit, "Supporting an Innovative Life Sciences Ecosystem in Japan" (2020)**

Technology

The wave of digital disruption has reached the health care sector, changing the way care is provided. Digital ecosystems are playing an increasingly important role. Using data will further boost the life sciences sector as it provides transparency into product performance. Advanced analytics, automation, and the cloud are making it easier to improve the quality of decision-making and increase manufacturing and productivity of new products. Increasingly, personalised medicines are being offered (Joyce et al. 2020). As a result, life sciences firms are employing more data scientists, and traditional research is becoming more digitalised – that is, less chemistry but more biology, more automation, and more computer testing. Collaboration between the worlds of "tech" and "life sciences" is likely to grow, and there may be some blurring of the edges in time.

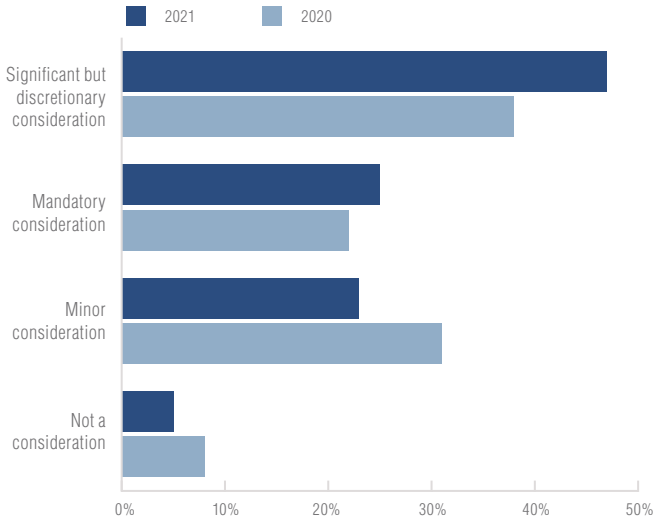
Sustainability

Even before COVID-19 began boosting the profile of environmental, social, and governance (ESG) issues, regional real estate industries had already come round to the idea that compliance was more than just a nod to social responsibility (see figure 19). In particular, landlords today increasingly understand that ESG often translates directly to corporate bottom lines because buildings failing to make the grade are likely to be less appealing to investors (PwC and ULI 2020a) and tenants.

Australia and New Zealand are market leaders in regional ESG rankings, especially in terms of carbon emission reductions. Certified sustainability initiatives are now the norm in investment-grade office buildings, albeit adhering to different national guidelines and standards. One can see this happening across high-quality life sciences product going forward.

The main driver persuading landlords to adopt ESG features is that institutional funds – particularly those based in Europe – increasingly have mandates only to buy assets (or to place capital with funds that buy assets) that meet certain ESG standards.

Figure 19: Role of ESG factors in investment decisions



Source: Emerging Trends in Real Estate Asia Pacific 2021 survey.

"It's the same discussion about measuring the uplifts in rent by making buildings green. In the long term we may be able to measure it in terms of the bottom line, but short-to-medium term it's better to say you can't afford not to, because if you don't, these are the potential implications in terms of the value of your property, in terms of reputation, and in terms of the reaction of the market, be it as a tenant or as an investor. Initially, valuers are going to start by making the odd remark in their valuation, but before long I think they're going to reflect this in the values themselves. And that brings it home in a major way."

— **PwC and ULI, *Emerging Trends in Real Estate Asia Pacific 2021* (2020)**

Industry leaders believe climate change and sustainability will have the biggest impact on real estate in the future (PwC and ULI 2020b). It is beneficial for life sciences companies to take a step towards sustainability. Science and technology are evolving at such a rapid pace that it is difficult to predict future needs, and bespoke spaces can become obsolete before they are even occupied. Firms that pursue a sustainable strategy and solidify their reputation as a sustainable company will gain the trust of governments, global institutions, and other stakeholders – partners on whom the long-term success of the industry depends.

Spaces that can easily adapt to changing needs not only support the science long term, but they can provide the most sustainable solution as well. The sustainable lab is arguably a growth trend rather than a definition, but as ESG concerns climb the corporate agenda, labs are being built with sustainability in mind, using ethically sourced materials and designed to make the most of natural resources. From using sunlight to reduce the need for artificial heat and light, to reducing the exhaust rate through fume hoods to get a better balance between safety and sustainability, there are many examples of sustainable lab design. These not only provide significant cost savings over time, but they also reduce the environmental impact.

Given that the life cycle of a life sciences company may be very different from a typical office user, with tenants less likely to stay in situ for the duration of a long lease, it is important that the second-generation space will be just as attractive to the next tenant and a building can pivot to service the needs of those companies (Goodwin Insights 2020).

4. CRITERIA FOR SELECTING LOCATIONS

In this chapter, we analyse the potential for life sciences to develop in cities and countries that display certain characteristics in terms of the life sciences (innovation) ecosystem as well as the triple and quadruple helix.

Innovation ecosystems today play a key role in the economic development of cities in Asia Pacific and beyond. They attract mid- and high-income jobs talent and offer opportunities for more efficient land use, movement patterns, and better liveability and environmental outcomes. Governments are aware of their importance. For example, the Australian government has funded Growth Centres to drive innovation, productivity, and competitiveness in six key growth industry sectors (one of which is medical technologies and pharmaceuticals).[8]

> "The best bet is to partner with institutions, universities and governments. These will be leading the way in the early stages of the sector growth."
>
> — **Hong Kong conglomerate**

The real estate community is starting to play an active role in these ecosystems. Real estate is making space for invention and meeting the changing needs of new enterprises including the life sciences sector. More players and more opportunities are creating the impulse to innovate in emerging sectors with high impact and high growth potential.

At the micro-scale, the innovation ecosystem is fuelling the demand to locate in cities. Cities are the 21st-century "Petri dishes" for commercial innovation and cross fertilisation (Storper and Venables 2004). They bring together a wide range of sectors, deep international networks, customer and client opportunities, and cultural and artistic quality. For the innovation ecosystem, the workplace is a key enabler of organisational success, talent attraction, and company brand (Clark and Moonen 2015). The cities and countries that are best placed for life sciences are those with the ability to attract and retain top life sciences talent and the best functioning innovation ecosystems.

Assessing attractiveness of countries, cities, and locations

When assessing the ability of a location to attract and retain top talent, comparing the quality of the amenities between one location and another can be difficult; however, it is reasonable to assume that an out-of-town location such as a business park or university campus will have less to offer than a city centre location. An incubator or accelerator in a city centre location may have the best of both worlds, offering urban vibrancy and the opportunity for cross-disciplinary collaboration that comes from close proximity during work hours and afterwards.

The following set of key indicators (followed by the data source in round brackets) has been chosen because they are thought to indicate the macro-location's ability to attract and retain top life sciences talent:

1. Presence of a top 20 Asian biotech (Torreya);
2. Cost of living (Expatistan);
3. Affordability of housing – purchase (Numbeo);
4. Affordability of housing – rental (Numbeo); and
5. Jobs currently available (Indeed).

[8] Australian Government, Department of Industry, Science, Energy and Resources, "Industry Growth Centres", https://www.industry.gov.au/policies-and-initiatives/industry-growth-centres.

Figure 20. Attractiveness factors

	Australia	China	Hong Kong	India	Japan	New Zealand	Singapore	South Korea
Number of top 20 Asian biotechs (Torreya)	5	1	4	6	3	6	6	2
Cost of living (Expatistan)	4	2	8	1	5	7	6	3
Affordability of housing to purchase (Numbeo)	3	5	8	1	4	2	6	7
Affordability of housing to rent (Numbeo)	4	3	8	1	5	6	7	2
Number of jobs currently available (Indeed)	4	5	2	3	7	8	1	6

Sources: Torreya, Expatistan, Numbeo, and Indeed.

More job opportunities and a more experienced talent pool may be available in countries that host the largest companies, and therefore the presence of a top 20 biotech firm can be a relevant factor for potential employers and employees.

The cost of living varies considerably across global cities and is a major consideration for any business employing large numbers of staff and for individuals considering a move there. Expatistan provides this data at country and city levels.

The life sciences industry employs many people across junior to middle-ranking roles as lab assistants and technicians, research assistants, data analysts, programmers, and the like. The affordability of housing for employees, from both purchase and rental perspectives, is a critical factor for companies looking to establish and grow their businesses. This data has been sourced from Numbeo.

The fifth factor refers to jobs available in the life sciences industry. Those locations with more jobs advertised (by Indeed) are deemed to be more attractive in having the relevant employment skills base to draw upon.

This elementary analysis is intended only to provide indicative relative rankings across a select sample of Asia Pacific countries. However, these are the types of metrics that should be understood in detail by investors and businesses seeking to establish new business locations. China and India are the best placed in this regard, followed by the Australia and South Korea. Japan and Singapore are ranked fifth and sixth, respectively. New Zealand and Hong Kong both suffer from a high cost of living and high rental costs, and this results in these two countries being placed seventh and eighth, respectively.

Measuring a location's ecosystem

We now turn to a comparison of innovation ecosystems. There are innumerable ways to measure a location's ecosystem and, based upon our reading and research, we have chosen a basket of five key indicators, which are listed here with the data source shown in round brackets:

1. Competitiveness of economy (World Economic Forum);
2. Scientific publications dealing with biochemistry, genetics and molecular biology (Scimago Journal);
3. Availability of qualified staff (INSEAD Global Talent Competitiveness Index or GTCI);
4. Corporate tax level (Tax Foundation); and
5. Quality of life sciences academia (Leiden Ranking).

Using these indicators, eight Asia Pacific countries (including all those covered in this report's case studies) are ranked according to their relative performance. This is not an exhaustive analysis, and several caveats are needed: first, this is clearly not a full sample; second, there are dozens of indicators that could be chosen, and each would generate a different pattern; third, life sciences is very diverse, and excellence in specific sub-sectors may not be reflected in the broad indicators.

Figure 21. Sample countries' relative performance in the ecosystem

	Australia	China	Hong Kong	India	Japan	New Zealand	Singapore	South Korea
Competitiveness of economy (WEF)	5	7	2	8	3	6	1	4
Scientific publications (Scimago Journal)	4	1	7	3	2	8	6	5
Availability of qualified staff (INSEAD GTCI)	3	7	2	8	5	4	1	6
Corporate tax (Tax Foundation)	7	3	1	7	6	5	2	4
Quality of sciences academia (Leiden Ranking)	3	1	6	7	4	8	5	2

Sources: WEF, Scimago Journal, INSEAD GTCI, Tax Foundation, Leiden Ranking.

What this analysis provides is an example of how, based on the metrics selected, a sample of countries in Asia Pacific measure up against each other. The metrics chosen (e.g., corporate tax) should be familiar and self-explanatory with the possible exception of the Leiden Ranking[9] and the INSEAD Global Talent Competitiveness Index.[10]

For each of the chosen metrics, the top-scoring country is ranked 1, the second country is ranked 2, and so on down to the last country, ranked 8. The countries' rankings are then added up and divided by eight to give an average ranking; therefore, each metric is equally weighted. This crude league table indicates Singapore and Hong Kong lead the pack, followed by China and Japan. South Korea and Australia are ranked fifth and sixth, respectively, with New Zealand occupying the seventh spot, and India coming last. As stated previously, using different metrics (and applying different weightings) would undoubtedly result in changes to the rankings.

Funding R&D

Choice of location for companies and employees will also depend on the availability of funding, which comes from a variety of sources including venture capital, government funding, public markets, and R&D expenditure by established life sciences companies. In terms of choosing locations, total spend on R&D per capita is one useful indicator. Figures 22 and 23, which are based on UNESCO statistics, show absolute gross domestic expenditure on R&D (GERD) in current purchasing power parity (PPP) in billions of U.S. dollars, and GERD per capita in current PPP in billions of U.S. dollars. Population size is a determinant of absolute expenditure, and in this respect, China leads by some margin with expenditure in 2018 in excess of US$450 billion. Hong Kong,[11] New Zealand, and Singapore barely register on the chart. However, expenditure per capita illustrates how Singapore and South Korea are the highest spenders using this metric. While expenditure per capita has risen steadily between 2013 and 2018 in China, Hong Kong, India, New Zealand (2017), and South Korea, Japan's per capita expenditure has been fairly stable while Australia's commitment is lower in 2017 compared with 2013 and Singapore's per capita spend declined between 2015 and 2017.

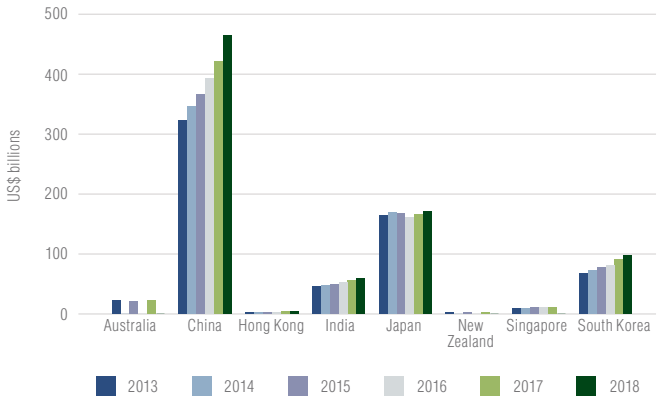
[9] Centre for Science and Technology Studies, Leiden University, the Netherlands https://www.leidenranking.com.
[10] INSEAD, Global Talent Competitiveness Index, https://www.insead.edu/global-indices.
[11] Hong Kong's R&D spend is set to increase following a recent announcement that Beijing has given Hong Kong approval to lead the development of a health technology hub in the Greater Bay Area. The Greater Bay Area refers to the Chinese government's scheme to link the cities of Hong Kong, Macau, Guangzhou, Shenzhen, Zhuhai, Foshan, Zhongshan, Dongguan, Huizhou, Jiangmen, and Zhaoqing into an integrated economic and business hub. The new role will build on research and development already taking place in the city and open the way for innovation in biomedical technology across a wide range of areas such as drugs, genetic science, and medical devices (as reported in the *South China Morning Post*).

"Many Asia-Pacific countries have identified life sciences as strategically important and introduced government policies to facilitate more development. China's 14th five-year plan and its 'Healthy China 2030' initiative both identified life sciences as one of seven strategic growth industries."

— **CBRE Global Midyear Outlook 2021**

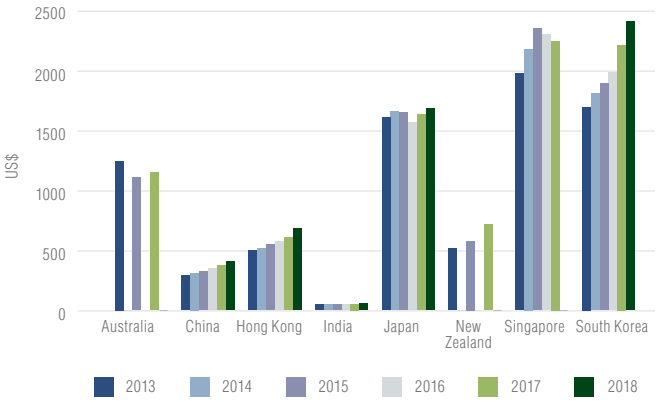
The latest data is for 2018 and clearly much has changed in the last two-and-a-half years. It will be interesting to review the data on expenditure when spending related to COVID-19 is incorporated.

Figure 22: Gross domestic expenditure on R&D in current PPP



Source: UNESCO Institute for Statistics 2021.

Figure 23: Gross domestic expenditure on R&D per capita in current PPPz



Source: UNESCO Institute for Statistics 2021.

Determining the level of demand for LSRE is challenging because of the lack of data and the sheer complexity of demand requirements. Demand is driven by four key factors:

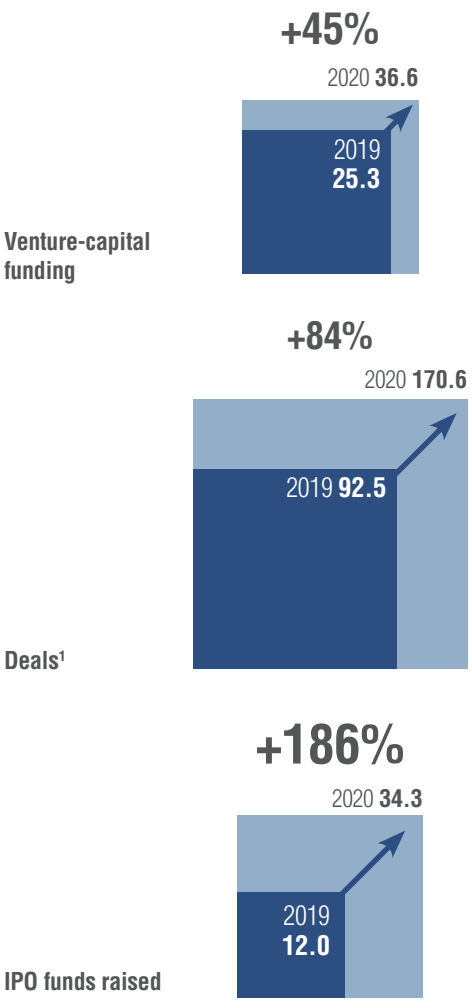
- The number of university spinouts. The success rate of spinouts will determine the level of real estate demand in a location, particularly for incubator and accelerator space.
- Venture capital (VC) funding is key to facilitating the non-linear growth of life sciences businesses.
- Demand type – that is, renters (early-stage and growth businesses) versus owners (established and mature operations, such as manufacturing).
- Rapid expansion and the demand for flexible use space remains a challenge to developers and landlords.

The biopharma sector continues to see significant investor interest and has seen a shift in the rationale behind fundraising and how they are choosing to raise funds. Pharma has seen an exponential increase in debt capital raising as it seeks to fund costly acquisitions, while VC and equity capital raising remain popular with biotech firms. Licensing deals between biotech and pharma companies are also on the rise as the appetite for risk and cost-sharing increases.

The life sciences industry response, globally, to the COVID-19 pandemic, its record of innovation, and its reputation as a safe haven for capital have served it well. McKinsey (Cancherini et al. 2021) reports that the biotech sector experienced double-digit annual growth in fundraising from VCs and deals, such as partnerships, co-developments, and joint ventures. It saw triple-digit growth in IPOs (see figure 24).

Figure 24: Venture-capital funding deals and IPOs reached record levels in 2020

Global venture-capital funding, and IPOs compared, $ billion



Sources: McKinsey - BCIQ, January 2021; IQVIA PharmaDeals, January 2021.

Note 1: Includes acquisitions, partnerships, co-developments, and joint ventures; covers only disclosed deal values (26 per cent of deals in PharmaDeals).

Venture Capital

VC activity grew by 45 per cent year-on-year, taking the global total to US$36.6 billion. The United States continues to lead, with Europe and China not far behind and seeing rapid expansion. In Europe, the average funding size grew at more than double the rate seen in the United States, while in China, the number of funding rounds grew four times faster than in Europe and the United States.

Some VC investors believe that the biotech sector has matured and now carries less risk than in its early days. Others are of the view that the sector has been underinvested historically, and others note that investment in the sector is driven by the need for VC portfolios to diversify.

Deals

The value of co-developments, partnerships, joint ventures, licensing agreements, and other deals almost doubled between 2019 and 2020, reaching US$170.6 billion. However, given that this figure represents only reported deals (about 26 per cent of the total), the actual figure is significantly higher. Deal growth was driven mainly by the United States where the average deal size doubled, and the number of deals increased by 25 per cent. China and Europe, playing catch up, also saw strong growth, but from a lower base.

IPOs

IPO activity has accelerated faster than any other fundraising category, with US$34.3 billion raised in 2020, representing a staggering 186 per cent annual increase. IPO activity is dominated by U.S. biotech firms, but China has also seen significant growth in recent years.

Despite some pessimism amongst the biotech community as COVID took a grip in 2020, the sector had one of its best years in 2020. By January 2021, VC houses had invested about 60 per cent more than they had in 2020, with more than US$3 billion invested worldwide in January 2021 alone (according to BCIQ, January 2021).

Figure 25: Biotech performance at the start of 2021

Venture-capital fundraising in January 2021 was about...

60%

...higher than in January 2020, with more than...

...$3 billion raised

Deals in January 2021 were on average more than...

66%

...larger than in January 2020, at an average of more than...

...$500 million per deal

The **number of IPOs** [note1] closed in January 2021 increased by...

19

...compared with January 2020, and raised an average of...

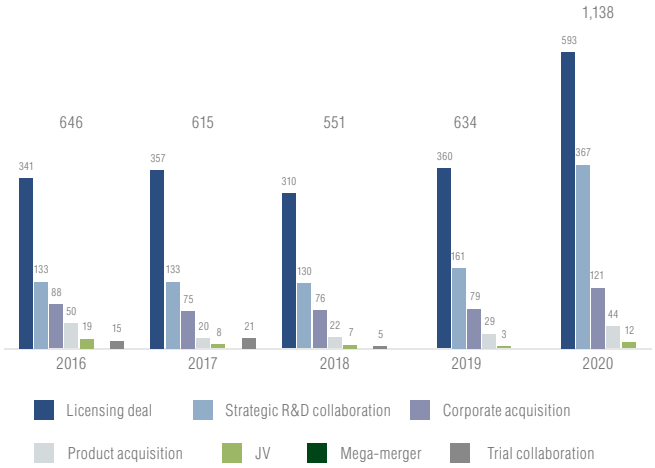
...$150 million per listing

Sources: McKinsey – BCIQ, January 2021; IQVIA PharmaDeals, January 2021.

Note 1: Includes follow-on public offerings.

KPMG similarly reports a record year in 2020 for biopharma deals (see figure 26), with increased volumes across the board and a significant increase in licensing deals and strategic R&D collaboration.

Figure 26: Volume of all biopharma deals reaches new record in 2020



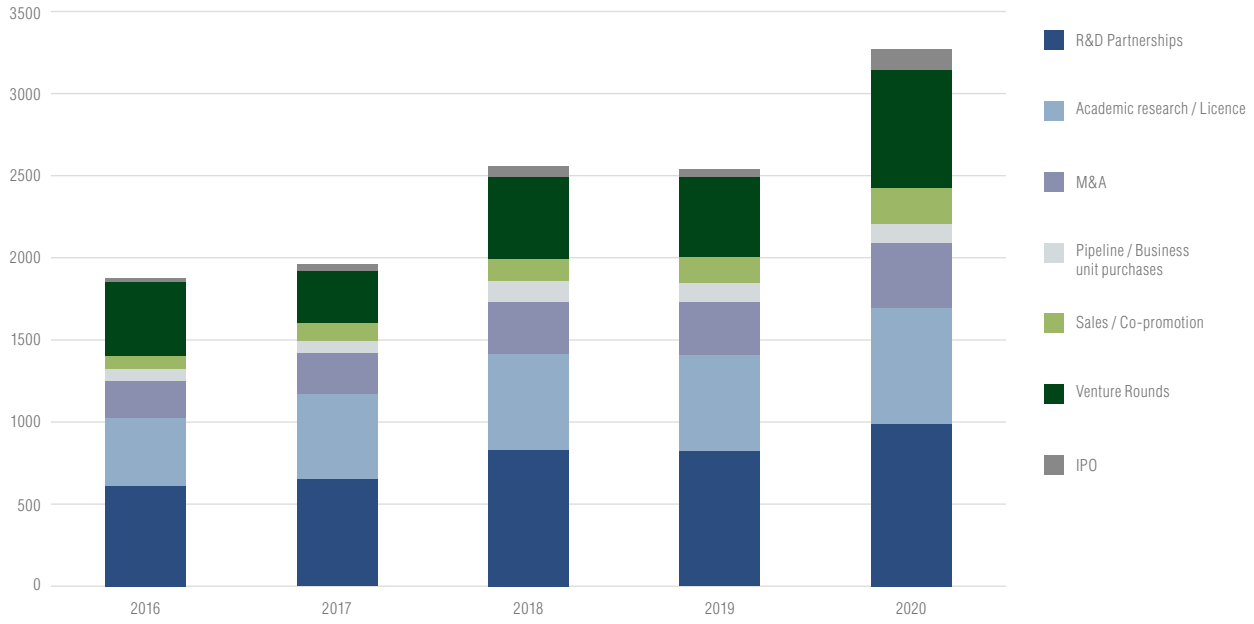
Sources: KPMG analysis; Informa: Strategic Deals 2020.

JP Morgan notes how COVID-19 has transformed the industry and created "immense opportunities for institutions and investors to drive health care through innovation". The third quarter of 2020 was the largest quarter on record for U.S. dollar VC investment in life sciences, but it also noted an increase in alternative sources:

- Corporate venture capital and corporate partnerships;
- Upfront payments and deal terms on partnership deals; and
- Non-traditional investors, including individuals, angels, family offices, corporates and hedge funds.

Mega-funding rounds (in excess of US$100 million) have continued to escalate across biopharma, medical technology, and tools and diagnostics. Figure 27 illustrates the number of health care and life sciences deals by general deal structure.

Figure 27: The number of health care and life sciences deals by general deal structure



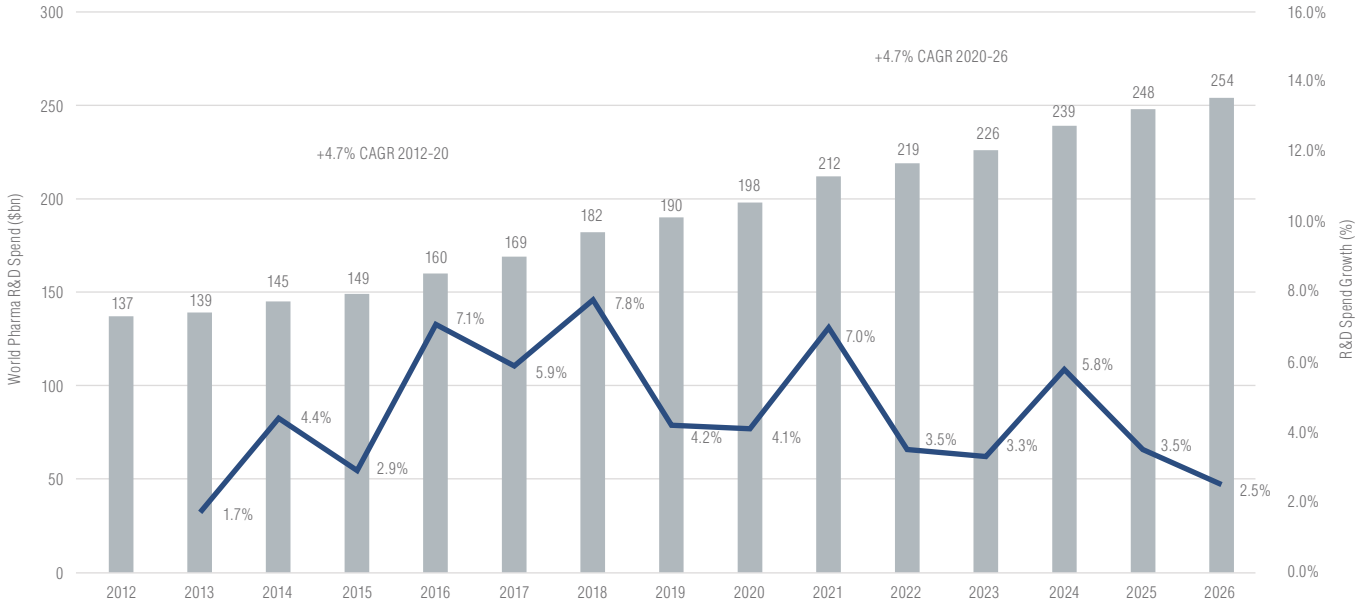
Source: J.P. Morgan, Life Sciences Startup Outlook 2021 (2021).

Note: DealForma, data as of 1/7/2021. Health care and life sciences sector coverage across biopharma, medtech, devices, diagnostics, tools, CDMOs, and related companies. Financials based on disclosed figures. M&A are for whole company acquisitions (or majority acquisitions) and not product, pipeline, or business unit purchases. Excludes terminated offers. Partnerships involving development and commercialization, joint ventures, options to license, partnerships with an option to acquire the company, and research partnerships. Excludes regional sales/distribution only and academic/government deals.
Definitions for figure 27:

- Academic Research/Licence: licence product research at early stage of development
- IPO: initial public markets offering
- M&A: mergers and acquisitions
- R&D partnerships: mutually beneficial business partnerships bringing together different specialisms, often led by pharma
- Pipeline/business unit purchases: the purchase of future product in the development pipeline
- Sales/Co-promotion: combining marketing and sales of a product under same brand and strategy
- Venture rounds: VC capital raising

Global pharmaceutical R&D spend is forecast to grow at an annualised rate of 4.2 per cent between 2020 and 2026 to reach US$254 billion (Evaluate Pharma 2021; figure 28), a slightly slower rate of growth than the 4.7 per cent annualised growth seen between 2012 and 2020. While biopharma is striving to improve R&D efficiencies, the strength of the financing climate suggests that drug development will see further expansion of investment. The availability of finance is allowing smaller developers access to funds and facilitating a significant expansion of research beyond the big pharma group of businesses.

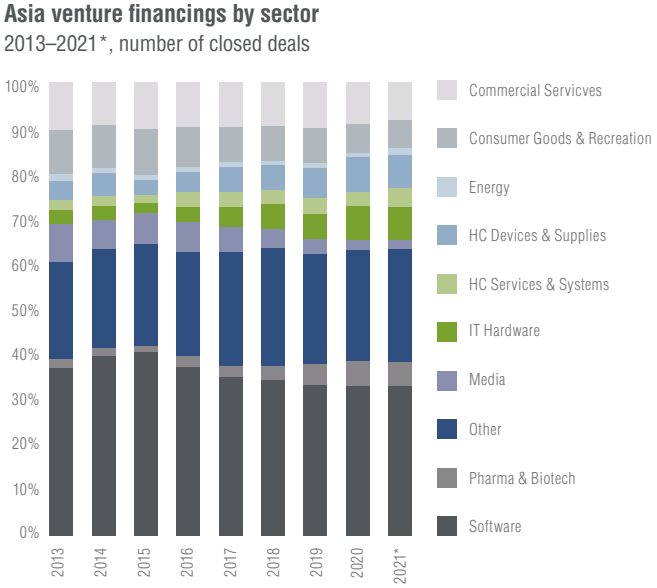
Figure 28: Worldwide total pharmaceutical R&D spend, 2012–2026



Source: Evaluate Pharma, World Preview 2021, May 2021.

The availability of VC is crucial to the growth of life sciences businesses as they move through the product life cycle. Pitchbook data allows the review of VC investment in Asia and specifically within life sciences–related areas of business. Figure 29 generally shows stable performance in Asia VC funding for health care devices and supplies and health care services and systems, with growth in pharma and biotech and IT hardware.

Figure 29: Asia venture financings by sector



Source: Venture Pulse, Q2'21, Global Analysis of Venture Funding, KPMG Enterprise. *As of June 30, 2021. Data provided by PitchBook, July 21, 2021.

CipherBio reports that Asia is becoming an increasingly active biotech region in terms of companies and investors headquartered in the geography (Gibbs 2020). By far the largest biotech funding location in Asia is China, with 10 of 16 deals in the calendar year to September 2020 (see figure 30). Two of the largest transactions involved Mabwell Biotech's Series A US$278.5 million funding and Lepu Biotech's US$186 million Series B funding led by Riverhead Capital, Sunshine Insurance Group, and Ping An Capital.

Figure 30: Top 10 biotech deals in Asia involving Asian companies – Jan. to Sep. 2020

Year: 2020; Investment Country: China & Japan; Investment Rounds: A, B & C

Name	Investment Country	City	Deal Date	Rounds	Deal
Mabwell	China	Shanghai	Apr, 2020	A	$278.5M
Lepu Biotech	China	Shanghai	Aug, 2020	B	$186.0M
Genor Biopharma	China	Beijing	Jun, 2020	B	$160.0M
Legend Biotech	China	Nanjing	Apr, 2020	A	$150.5M
Connect Biopharma	China	Taicang	Aug, 2020	C	$115.0M
JW Therapeutics	China	Shanghai	Jun, 2020	B	$100.0M
Vazyme Biotech	China	Nanjing	May, 2020	C	$78.0M
GenFleet Therapeutics	China	Shanghai	Mar, 2020	B	$55.9M
Modulus Discovery	Japan	Tokyo	May, 2020	B	$25.5M
ABM Therapeutics	China	Shanghai	Aug, 2020	A	$20.0M

Source: Gibbs 2020.

5. OVERVIEW OF PROPERTY CHARACTERISTICS AND PLAYERS

In **chapter 4** we examined the potential for life sciences to develop in cities and countries that display certain characteristics in terms of the life sciences ecosystem. Here we analyse the ownership of LSRE and its spatial dimension, what occupiers want, and link these to leasing models, investment trends, and costs.

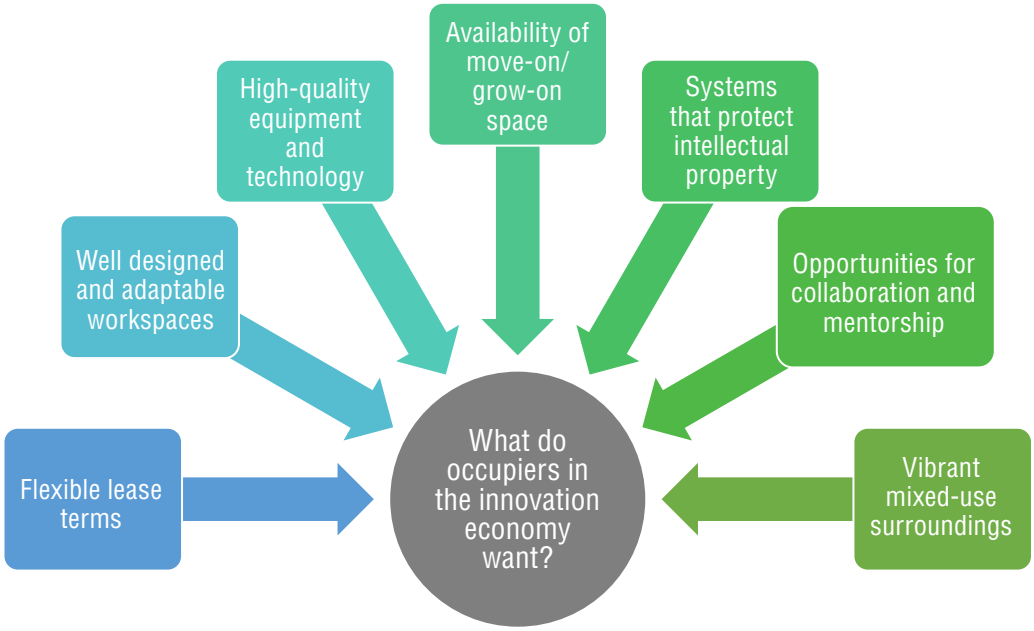
> "Proximity to a deep talent pool favours locations near universities and hospitals."
>
> – **Asset management company**

Occupier requirements

The specialised demands of innovation economy occupiers are often closely linked to the fledgling nature of their businesses. Start-ups in the volatile early stages of their business cycles require flexible space and contract terms as well as room to grow both their teams and their ideas. The importance of ideas to innovative firms means that shared and collaborative space are imperatives, and occupiers look for office and lab design that stimulates creativity and fresh thinking.

Of course, innovators in particular sectors may have specific real estate requirements. In pharmaceutical and biotech, for example, the rise of independent R&D providers has created demand for wet and dry lab space. Almost all occupiers will have exacting technology requirements, including high-quality fibre broadband connectivity and power systems (Clark and Moonen 2015) (see figure 31).

Figure 31: Occupier requirements



Source: Clark and Moonen 2015.

Stakeholders and property types

Life sciences real estate buildings are owned by an extremely diverse group:

- Fund managers;
- Government agencies;
- Hospitals;
- Institutional investors;
- Integrated developer/owners;
- Listed and unlisted property companies;
- Local authorities;
- Owner-occupiers;
- Private investors;
- Real Estate Investment Trusts (REITs); and
- Universities.

To better understand how such a mixed collection of owners are involved, one needs first to delve into the different target groups for LSRE (start-ups, scale-ups, and established companies) and the physical settings of life sciences real estate (incubator, accelerator, science park, and cluster).

Accelerators and incubators are often linked to and co-located with universities and teaching hospitals, whereas science parks and business parks are standalone locations, often set up by government agencies or local authorities. "Cluster" is a more flexible term, and a cluster can (a) feature elements of all the other location types and (b) be polycentric, extending over multiple locations within one city or region or even between adjacent countries. Note that incubators, accelerators, and parks can be multi-disciplinary in nature, catering for life sciences and other sectors (often high-tech sectors) alongside each other, whereas a life sciences cluster will have a clearer focus on life sciences.

The survey used for this report asked people for their view on the most productive types of location for life sciences. The answers were as follows:

1. Business park with some science/R&D facilities, 43 per cent;
2. Science park, 28 per cent;
3. Urban clusters, 14 per cent;
4. University space, 14 per cent.

The Asia Pacific survey highlights one key difference in the rankings compared with the results of the European survey. The Asia Pacific survey places business parks with some science/R&D facilities as the most productive location, whereas in Europe the survey placed urban clusters in prime position, supported by reference to the increasing crossover between life sciences and tech businesses and the emphasis placed on collaborative ecosystems. This difference may represent a slightly less mature market in Asia Pacific, with the growth in urban clusters still to come. Dedicated science parks were placed second in both surveys with a similar proportion of respondents.

When a university, teaching hospital, local authority, or government agency owns and leases LSRE, the objective is not primarily an investment objective, such as maximising the risk-adjusted return; the objective is more likely to be solving scientific problems, fostering a culture of collaborative innovation, or job creation.

Zhangjiang Science City, Shanghai, China

Zhangjiang Science City in the Pudong district of Shanghai, formerly known as Zhangjiang Hi-Tech Park, is China's answer to Silicon Valley. It was established in 1992 and is described as an industrial neighbourhood covering 455 hectares. It is home to over 18,000 enterprises, 53 regional headquarters of multinationals, and 828 high-tech businesses.[12] Zhangjiang metro area has a 2021 population of 1.3 million (up 2.18 per cent since 2020), while Shanghai has a population of 27.8 million.

The park has a focus on life sciences, software, semiconductors, and IT, providing in excess of 30 million square feet of office and R&D lab facilities. The scale of the Science City cluster and broad range of occupiers across different aspects of life sciences and technology facilitates a genuine opportunity for crossover between tech and life sciences to advance research and innovation. The park is made up of the following areas: the Technical Innovation Zone, the Hi-Tech Industry Zone, the Scientific Research and Education Zone, and the Residential Zone.

Science City strongly promotes entrepreneurship and innovation. It has 86 incubators hosting 2,600 SMEs.

The roll call of multinational corporates operating from the park is impressive. Major companies include life science firms GlaxoSmithKline, Roche, Eli Lilly, Pfizer, Novartis, GE, and AstraZeneca; technology firms include Alibaba, Hewlett-Packard, Lenovo, Intel, Infineon, and Microsoft; software firms include IBM, Citibank, eBay, Tata Consultancy Services, Infosys, and SAP AG; chemical companies include Wison Group, DSM, Henkel, Dow, Dupont, and Rohm and Haas; semiconductor firms include Semiconductor Manufacturing International Corporation (SMIC), Hua Hong NEC, Grace Semiconductor, Spreadtrum, and VeriSilicon. Other firms present include Asia-Pacific Software, Sony, Bearing Point, Kyocera, Cognizant,

A bird's-eye view of an industrial park in Putuo district in Shanghai which is operated by Zhangjiang National Innovation Demonstration Zone. (Photo/China Daily)

[12] Discover SHFTZ, Zhangjiang Science City, http://en.china-shftz.gov.cn/2020-04/01/c_263829.htm.

TCS China, Satyam, and Applied Materials. There are also a multitude of biotech firms, over a hundred of them domestically owned companies.

Academic links are provided by Shanghai University of Science and Technology as well as satellite campuses for Fudan University and Shanghai Jiao Tong University, Shanghai Advanced Research Institute of Chinese Academy of Sciences, and Shanghai University of Traditional Chinese Medicine. Specialist enterprises located in Science City include the National Shanghai Biomedical Science and Technology Industry Base, National Information Industry Base, National Integrated Circuit Industry Base, National Semiconductor Lighting Industry Base, National 863 Information Security Fruit Industrialization (Eastern) Base, National Software Industry Base, National Software Export Base, National Cultural Industry Model Base, and National Online Games and Animation Industry Development Base.

Its critical mass attracts high-level talent, with 370,000 employees – 6,200 with a PhD qualification and almost 50,000 with a master's degree.

Science City is operated by the Zhangjiang Hi-Tech Park Development Company (a state-owned enterprise – SOE). Ownership of the park is mixed – private developers/investors and owner occupiers.

The park is readily accessible from the inner and outer ring roads that serve the Shanghai metropolitan area. The park is also served by metro and tram services. It is located 13 kilometres from People's Square and 9 kilometres from The Bund. Airports are 21 kilometres (Shanghai Pudong International) and 25 kilometres (Hongqiao) distant.

Rents are RMB 10 to 20 (US$1.55 to US$3.10) per square foot per month (according to CBRE).

Spatial point of view

We now examine how the different life sciences settings work from a spatial perspective, using examples from the case studies woven into this report.

Incubators cater for start-up companies that are too small to need, or cannot afford to rent, dedicated office buildings or labs; therefore, incubators are dominated by shared space.

In Kanagawa Science Park in Japan, a building called the Innovation Centre Building is an incubator providing work and research rooms for start-ups and SMEs that are less than five years old. The managers of the park support entrepreneurs and researchers who are planning to start their own business and share their own experiences so that the start-ups and SMEs can achieve "early commercialisation".

Figure 32: Kanagawa Science Park

Source: http://www.pref.kanagawa.jp/osirase/0612/business/en/

Accelerators focus on existing businesses that have the potential to grow, and therefore their scale and layout are different from those of incubators. An accelerator may have buildings close to but separated from each other; it may also offer production facilities, unlike an incubator. For example, Melbourne's MedTech Actuator offers intensive mentorship, industry collaboration, and capital-raising support. A start-up can achieve in 15 months what can typically take three years or more, it is claimed, and will be ready to raise Series A funding, which will then lead into clinical trials, regulatory approvals, at-scale manufacturing, and market launch.[13] Its founding partners include the governments of Australia and Singapore together with industry giants like Boston Scientific, J&J, and Medtronic.

Parks cater to more established businesses, and their scale is a further step up from incubators and accelerators. Parks are not co-located with hospitals or universities, and they are generally found in suburban or out-of-town locations. Each business in a park can have its own dedicated building – this is another differentiating characteristic. Note that Kanagawa Science Park is small as parks go.

Biopolis, Singapore

Biopolis is a custom-built biomedical R&D hub at One-North, Buona Vista, Queenstown, Singapore. Covering 183 hectares of land, the hub is designed to benefit a range of disciplines. The development is situated adjacent to the National University of Singapore, the Institute of Technical Education, Singapore Polytechnic, the National University Hospital, the Singapore Science Park, and the Ministry of Education, ESSEC Business School, INSEAD, and Fusionopolis (an R&D centre dedicated to electronics and technology).

Biopolis is 30 minutes from the CBD by MRT subway and is served by a Singapore population of 3.5 million. Rental levels are between S$4.5 and S$5.5 (US$3.30 and US$4.00) per square foot per month (according to CBRE).

The Biopolis campus was created to provide space for biomedical research that could promote collaboration between private companies and public scientific or educational bodies. The focus is on innovation, drug discovery, clinical development, and medical technology. Biomedical sciences (BMS) account for 6 per cent of Singapore's GDP, and BMS manufacturing output in the country stands at more than S$23 billion (US$17.3 billion).

Phase 1 of Biopolis was undertaken by JTC Corporation (formerly Jurong Town Corporation), a government agency that champions sustainable industrial development. Subsequent phases have been developed by Ascendas REIT, Crescendas Group, Procter & Gamble, and Ho Bee Land.

In terms of the Biopolis development itself, phases 1 to 5 (completed from 2000 through 2013) provide 3.7 million square feet. The phase 1 complex (185,000 square metres) is a cluster of seven sky-bridge-connected buildings of eight to 13 storeys. Occupiers

[13] Medtech Actuator, https://medtechactuator.com/accelerator/.

are a mix of public and private-sector biomed research agencies. Phase 2, completed in 2006, added two seven-storey buildings (37,000 square metres) for research into neurology and immunology. Phase 3 completed in 2011 with two further buildings adding 41,500 square metres with provision for labs, R&D, offices, and retail operations. Phase 4 included an additional 46,000 square metres with improvements to lab design for clinical trial support, at a cost of about US$100 million, together with the 32,000-square-metre Singapore Innovation Centre owned by Procter & Gamble. The fifth phase comprises two towers providing 46,200 square metres to satisfy increased demand for biomed research. This phase also includes a 1,000-square-metre ready-made laboratory, known as Shell-Plus. Phase 6 is expected to complete in 2022 and will provide a further 35,000 square metres of business park space for biomed research together with 6,000 square metres for office and retail use. Two thousand square metres will be fitted out as semi or fully furnished labs to satisfy demand from biotech start-ups. Activity spaces, fitness corners, and a park with playground are also being incorporated to improve amenities.

The evolution of Biopolis can be charted in three phases:

Phase 1 2000–2005: The Creation – Sowing the Seeds

The first phase of Biopolis had three main objectives:

1. Creation of the physical infrastructure to conduct research;
2. Global headhunting of experts to lead the research institutions; and
3. Partnership with (and attraction of) foreign multinational companies.

Initially, US$1 billion was allocated to building Biopolis, as well as several new life science research institutes and providing co-funding for new R&D projects by global pharmaceutical businesses. Designed by Zaha Hadid, Biopolis was launched in 2003 and conceived to encourage cross-disciplinary collaboration and bridge the gap between academic and industry research.

Phase 2 2006–2010: Attraction Phase – Bringing in Scientists and Multinational Corporations

This phase focused on strengthening biomedical science capabilities to scale up scientific discoveries, with a focus on translation. In 2005 the national Translational and Clinical Research (TCR) programme was launched, jointly funded by the Ministry of Health, A*Star, and the National Research Foundation. This was supported by a substantial increase in public R&D budget allocation that funded, among others, the Academic Research Council and the establishment of Research Centres of Excellence. The new facilities at Biopolis were marketed successfully to private companies, attracting the likes of GlaxoSmithKline, Novartis, SingVax, and CombinatoRx.

Phase 3 2011–2015: The Consolidation – Industrial Alignment

In 2010 the decision was made to “industrially align” the biology research institutes of Biopolis. The MedTech Hub, a new innovative industrial park in a single building, was developed by the JTC Corporation during 2012–2013 to host medical technology manufacturing, a new direction added to the biomedical strategy alongside personal care, food, and nutrition. Spanning nine storeys and 38,900 square metres, the spaces are targeted at medical device manufacturers.

In 2014 the Singaporean government launched the Diagnostics Development (DxD) Hub, led by A*Star, one of four innovation clusters funded under Singapore's US$200 million Innovation Cluster Programme.

The attractive effect of the Singaporean biomedical cluster led to new activities from Roche, Novartis, GSK, Chugai, Procter & Gamble, ArKray, Flugidim, Nestlé, Danone Nutrica Research, and L'Oréal, among others.

By 2016, Biopolis hosted 53 companies and 5,600 employees. Singapore had attracted more than 50 manufacturing plants (nine of them producing biomedical products), established about 50 new research facilities, and located more than 30 regional headquarters of multinational companies in the field.

2016–2021: Reaping the Rewards – Continued Growth

From 2015 onwards, R&D investment in biomedical sciences levelled off, indicating a less active role for the Singaporean government in driving the biomedical cluster, perhaps an indication of the cluster's maturity. Nonetheless, the biomedical sector continued to grow despite some cuts to government funding from 2019.

> "Biopolis was conceived as part of a bold vision to establish the BMS as a key pillar of Singapore's economy. That vision has become a reality. Today, Biopolis is a thriving eco-system of public research institutions and corporate labs and a vibrant community of local and international biomedical scientists carrying out world-class R&D."
>
> — **BMS EXCO 2021**

One North Biopolis @ Singapore
http://tripfren.blogspot.com/2014/07/one-north-biopolis-singapore.html

In spatial terms, life sciences businesses that are in the start-up or scale-up phases benefit from being close to each other in settings that maximise the opportunity for collaboration ("collision density"). In contrast, mature life sciences businesses that are testing or manufacturing at scale have other requirements: space to expand, access to transport infrastructure, and (possibly) proximity to massive data processing power (see figure 3).

Another feature of some parks is the diversity of the occupier base which, may include tech businesses (broadly defined) to facilitate crossover and collaboration. Biopolis, in Singapore, was aimed at the knowledge economy, and it houses key growth sectors such as biomedical sciences, info-communications technology, and media. Its work/live/play/learn approach aims to provide a vibrant environment for innovative minds to congregate, collaborate, and create. Zhangjiang Science City hosts major names from the worlds of science (Novartis, Pfizer) and tech (IBM, Microsoft) while Macquarie Park in Sydney includes major pharmaceutical companies (Astra Zeneca, Johnson & Johnson, Procter & Gamble) and tech companies (Canon, Ericsson, Fujitsu, and Oracle).

"Long leases are not always common in Asia (with the exception of Australia)."

– **PwC and ULI, Emerging Trends in Real Estate 2021 (2020)**

Leases in Asia Pacific tend to be on the short side. In China, for example, leases of two or three years are common. In Japan, two-year renewable leases are popular, but longer-term arrangements are also possible. Length of lease may reflect the size of the space being let or the tenant's perceived strength of covenant, which in turn is related to the maturity of the tenant's business. Larger, more established companies have deep enough pockets to sign a more traditional office-type lease, but for the spin-outs and scale-up companies, it is all about flexibility.

In Singapore, for example, smaller spaces may be let for two to three years whereas larger spaces may be let for five to six years. Two to three years is also a popular lease length in Korea.

Australia is the exception: long leases of eight to 10 years with one or two options to renew are not unusual in that market.

According to the ULI Asia Pacific survey, the predominant arrangement is a lease with traditional rent (that is, a fixed amount with mark-to-market or inflation-related reviews) only. Hybrid leases featuring base rent plus a share of profit or base rent plus a share of revenue are uncommon.

Kendall Square, Boston, USA

Kendall Square is in Cambridge, Massachusetts. It covers an area of about 314 hectares (776 acres) adjacent to MIT, close to Harvard University, and faces downtown Boston. It is internationally connected by Logan International Airport. The East Cambridge/Kendall Square area provides close to 1.1 million square metres (12 million sq. ft.) of office and lab space. Major real estate owners include Alexandria, Blackstone, BioMed Realty, Brookfield, Boston Properties, and King Street Properties.

Kendall Square is often described as "the smartest square mile on the planet" and forms part of the world's premier life sciences supercluster of Greater Boston. The success of the life sciences cluster around Cambridge has attracted top companies and employees, driving population growth and tenant demand. The Greater Boston area has a population of 4.9 million. In addition to MIT and Harvard University, the academic talent pool is drawn from Boston University, Tufts University, Lesley University, and Hult International Business School. In addition, there are six major hospitals, including Boston Medical Centre,

Massachusetts General Hospital, and the Dana-Farber Cancer Institute. Kendall Square employs 60,000.

Milestones on the evolution of Kendall Square include the selection of Boston Properties, in 1978, to develop a 140,000-square-metre (1.5 million sq. ft.) "Golden Triangle" mixed-use district. In 1982, Biogen established its headquarters in Kendall Square, and the Whitehead Institute was founded as a major centre for genomics and the Human Genome Project. The year 2000 saw the launch of Cambridge Innovation Centres by Tim Rowe, now claiming to house more start-ups than any other building on earth. While the original focus of the area was biotech, including cancer research, the spectrum of science, tech, and supporting services is now far broader. The last 20 years have seen an impressive range of science and tech companies move into the area, including Google, Microsoft, Pfizer, Moderna, and Apple.

The whole ecosystem is very well supported by VC and private equity funding from the likes of MPM, Atlas Venture, Polaris, and Interwest, plus real estate giants such as Blackstone, who can provide equity and real estate solutions.

Asking lab rents cover a wide spectrum depending on the location. East Cambridge/Kendall Square rents are around US$105 per square foot (per annum triple-net), while West Cambridge/Alewife Square rents are US$78 per square foot per annum. In the maturing Seaport area, rents are US$88 per square foot per annum but fall to a range of US$47 to US$55 per square foot per annum in the more peripheral 128 North and West areas. Demand pressure is forcing tenants to migrate to more suburban areas where investors and developers are refurbishing appropriate existing office space. Somerville and Watertown are two locations benefiting from conversions and ground-up development, with new growth markets like Newton and Weston catching up with more established core markets.

Future plans to relieve pressure on the Kendall Square area include a further migration to the Seaport area which has the potential for significant growth and where Ginkgo Bioworks and Vertex are already key tenants.

Kendall Square, Boston.

In life sciences there is extra focus on who pays for the fit-out. On the one hand, VC-backed tenants have funding but no steady cash flow, so they might pay for fit-out in exchange for lower rent; established players, on the other hand, may prefer to pay higher rent and contribute less to the fit-out to reduce upfront costs. Some investors are happy to contribute towards plant and equipment as it makes for "stickier" tenants.

Regarding tenant improvements, fit-outs for life sciences companies can be complex and expensive. A property owner will work closely with the tenant to ensure the space is properly designed and in compliance with all relevant laws. For owners and investors converting office to life sciences space on a smaller scale, understanding their leasing risk and downside protection is important, since some life sciences start-ups can be unsuccessful.

Chapter 3 discussed how demographic trends and other indicators point to sustained, strong growth for the life sciences industry, which can potentially make life sciences properties an attractive proposition for investors and developers. The investment background is also favourable, given the ongoing strong interest in real estate as an asset class in today's low-interest-rate environment and a lack of core product at attractive prices in the traditional sectors. The life sciences sector has also been more resilient, in terms of income, than others during 2020 and 2021 (lab work cannot be done at home). The life sciences industry has been in the spotlight for much of the last 18 months as government officials and the public monitor virus mutations, infection rates and vaccine roll-out programmes and the impact on recovering economies. Successful management of the COVID-19 virus involves the resilient supply chain of research and innovation, clinical trials, and manufacturing. Life sciences real estate could therefore provide investors with two benefits: yield and the diversification benefits of an anti-cyclical play.

The various disciplines in life sciences and the respective space needs of this diverse set of companies will demand industry knowledge, specialised real estate expertise, and local market knowledge. Even with the proper skill set, however, investors and developers will need to be forward-looking to provide state-of-the-art, flexible-use space that not only fosters collaboration and innovation, but also can accommodate tenants' evolving requirements (see Institutional Real Estate 2020).

In Asia Pacific, despite the predicted continued growth, the life sciences sector is not yet understood well by the real estate industry or recognised as a distinct investment sector. This is partly because of lack of transparency or, as one participant in our roundtables noted:

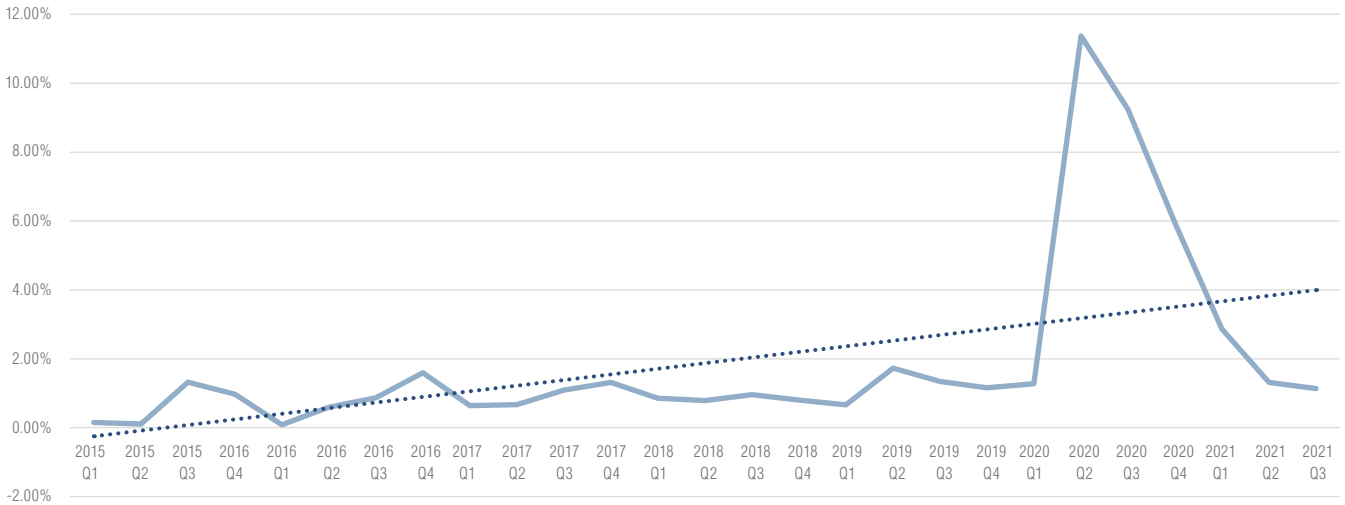
> "The Asia market is still too small to get access to clear data."
>
> — **Global real estate investor**

Investor trends

Investment data is hard to come by in Asia Pacific. At present, no forum or centralised data hub exists where a diverse group of owners could, if they wished to, share data, and as a result it is very challenging to get a clear picture of the total LSRE investment market in Asia Pacific.

However, a handful of sources are available. One of these is Real Capital Analytics, who have gathered details on 137 deals over the six-year period from third quarter 2015 to third quarter 2021. Life sciences real estate is still a niche part of overall real estate investment in Asia Pacific, as figure 33 illustrates, accounting for a small percentage of average quarterly volumes when the other sectors (apartment, hotel, industrial, office, and retail) are included. Nevertheless, the growth trajectory is strongly upwards and, if it continues, life sciences could become a material part of the overall market.

Figure 33: Life sciences investment in Asia Pacific as a percentage of total real estate investment



Source: Real Capital Analytics, 2021.

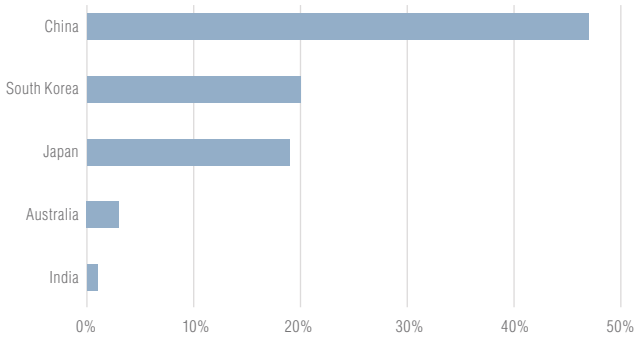
"We like, we want it, it's just a case of finding the product."

— Global real estate investor

Top destinations and sources of capital

Figure 34 shows the top five destinations for investment in Asia Pacific LSRE over the period Q3 2015 to Q3 2021. The top three countries, together, account for 85.8 per cent of total volumes. In order, these are China, South Korea, and Japan. The other countries, ranked from fourth to last by investment volume, are Australia and India (which are shown in figure 34) followed by Singapore, Malaysia, and New Zealand (which are not). There has been movement from year to year over that period: for example, South Korea has been ranked ahead of Japan in 2017 and 2021 but behind Japan in 2018, 2019, and 2020.

Figure 34: Top destinations for investment in Asia Pacific LSRE

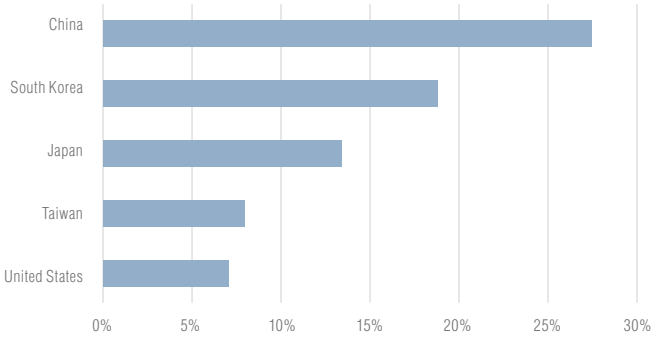


Source: Real Capital Analytics, 2021.

As figure 35 demonstrates, the main countries of origin for investors in Asia Pacific LSRE are China, South Korea, and Japan. These countries account for 59.7 per cent of total investment. The next five, ranked from fourth to eighth are Taiwan, United States, Hong Kong, Germany, and Australia.

There has been considerable movement from year to year, just as there has been with investment destinations. For example, in 2015 the American investors outspent all others, whereas one year later it was the Chinese investors on top.

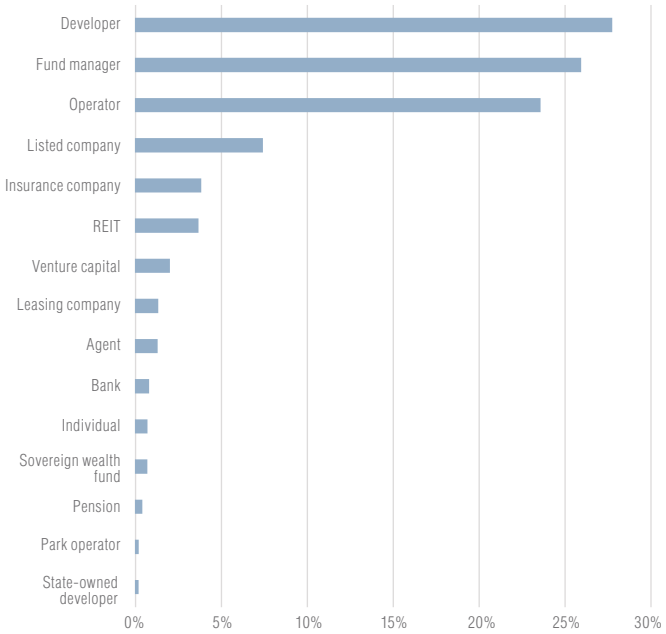
Figure 35: Investor origin



Source: Real Capital Analytics, 2021.

The principal buyers are developers (27.7 per cent), fund managers (25.9 per cent), and operators (23.6 per cent), who together account for 77.2 per cent (figure 36). The remaining 22.8 per cent is attributed to a wide variety of entities including insurance companies, pension schemes, banks, private investors, REITs, and sovereign wealth funds. Four-fifths of those who transacted between Q3 2015 and Q3 2021 did one deal only, which suggests that the market is quite fragmented. Only nine market participants have been both a buyer and a seller over that period and only one of those has been a seller more than once and a buyer more than once.

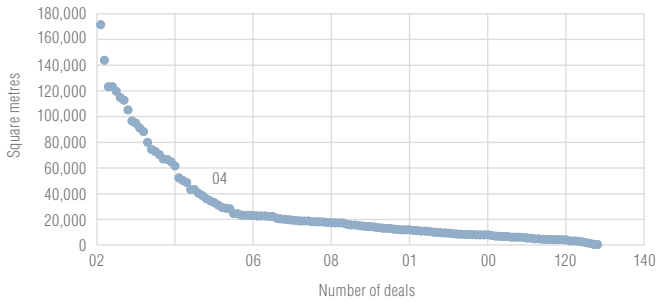
Figure 36: Buyers of LSRE, Q3 2015 to Q3 2021



Source: Real Capital Analytics, 2021.

Most transactions involve assets that are smaller than 60,000 square metres (figure 37). There were only 20 instances of larger assets changing hands over the six-year period and, in five of those cases, the asset was described as a “park”.

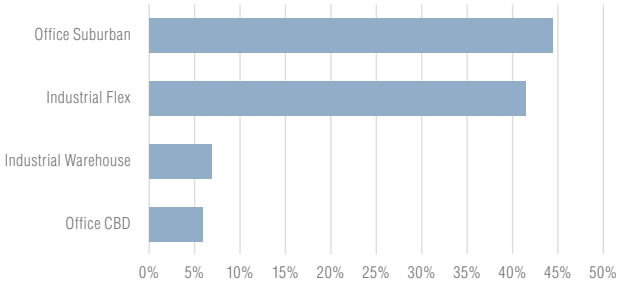
Figure 37: Size of deals



Source: Real Capital Analytics, 2021.

Figure 38 indicates that suburban office is the dominant property type among LSRE investment deals in Asia Pacific, accounting for 45 per cent of the total.

Figure 38: Investment volumes by type of property



Source: Real Capital Analytics, 2021.

Pricing of deals

In terms of the pricing of deals, it is very challenging to get reliable data on cap rates (yields) in this market. Less than 10 per cent of the deals in the Real Capital Analytics database have an attached cap rate, and the rates are spread all the way from 3.6 per cent to 9.0 per cent.

Such a wide variety suggests that the investors cover the full risk spectrum from core to opportunistic. It may also reflect the fact, noted previously, that some owners have objectives for their real estate that are not investment objectives. There is no clear correlation between cap rate and the monetary value of the deal or between cap rate and asset size (in square metres).

Scale and property type

In the ULI Asia Pacific member survey conducted in August 2021, participants showed a clear preference for scale. When asked about their preferred scale of investment, they answered as follows:

- Mixed-use life science campus (36.8 per cent);
- Entire science park or similar large scale (31.6 per cent); and
- Major blocks exceeding 10,000 square metres in size (15.8 per cent).

"Companies want to position themselves close to similar and complementary businesses."

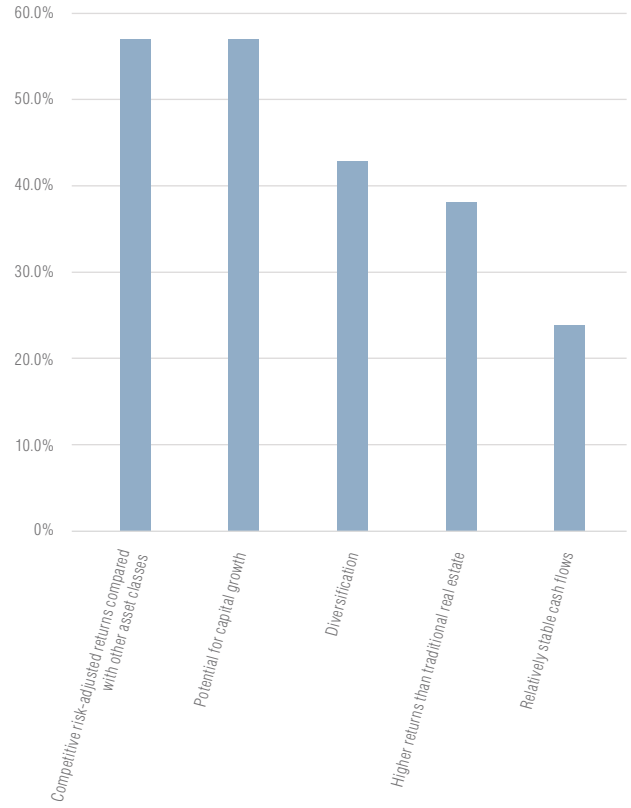
– **Asia Pacific investor**

Institutions and REITs are typically looking for a lot size of US$50 million, though in Australia, with its more limited market, the lot size might be closer to US$35 million. Larger assets tend to be multi-let because larger operators who might let 100 per cent of a building are more often owner-occupiers.

Investment purpose

Competitive risk-adjusted returns and the potential for capital growth are the two main reasons for investing in Asia Pacific LSRE, according to the ULI member survey conducted in August 2021.

Figure 39: Investment purpose



Source: Didobi-ULI survey, August 2021.

If investment in Asia Pacific life sciences real estate is to follow the same path as in the United States, more transparency is needed. Transparency around rental levels, yields, vacancy rates, and valuations would give confidence to investors and would also encourage speculative development. There seems to be no shortage of capital, but without data a "leap of faith" is required; or to put it another way, the key is finding the right opportunity and overcoming nervousness among investors.

Different routes to investing in life sciences real estate

Investment in the life sciences sector across the Asia Pacific region will require a flexible approach. CBRE Australia's recent report *A new era of life sciences growth* (2021c), highlights four potential approaches:

1. Sale and leaseback

Firms keen on sale-and-leasebacks to improve balance sheets

Companies want to dispose of assets following M&A or recycle capital for R&D

Most viable in Japan and Australia; emerging opportunities in South Korea

2. Asset conversion

Aged light industrial properties can be converted to laboratories or cold storage

May not be suitable for operations requiring advanced specifications

Viable in markets with limited supply such as Hong Kong SAR and Japan

3. Public/private partnership

Newly planned science parks that need to raise capital for development

Prominent government role means partnership is the preferred format in several markets

Viable in India, Singapore, and China

4. Asset development

Developers can obtain land from the government for R&D facilities

Participate in build-to-suit facilities with pharmaceuticals companies

Viable in most markets provided land is available

Route 2: repurposing existing buildings for life sciences

There are some overlaps between high-tech sector environments and traditional urban industrial and office developments; they also have many distinct needs which real estate and urban development have to respond to. LSRE in an urban setting poses the challenge of repurposing existing stock.

Retail buildings are one possibility as they tend to have delivery access, goods storage areas, plant space, and high floor-to-ceiling heights. Industrial buildings can also lend themselves well to repurposing because of adaptability and cheap build. One could put a new box within an existing box in an industrial building, and this is probably cheaper and faster than repurposing an office building, where one might need to install new plant on the roof.

As working practices change and landlords reconsider the highest and best use of their office stock, pivoting towards the life sciences may be attractive. A vibrant city centre can help attract and retain top talent. Planning restrictions or zoning need to be borne in mind because a change of use will likely require planning or re-zoning permission and could prove to be prohibitively expensive; however, the degree of change needed may reduce over time if data science plays a bigger role and lab work a smaller role going forward, as many predict.

Survey and interview responses – key differences between Europe and Asia Pacific

Q: For investors, what are the main differences between traditional real estate and LSRE?

Europeans more likely to say “floor ceiling heights”, Asians more likely to say “cold storage”

Q: In LSRE, which leasing model is prevalent?

Europeans more likely to say “open market”, Asians more likely to say “long term”

Q: Which are the key drivers of growth in life sciences?

Europeans more likely to emphasise “talent”, Asians more likely to emphasise “ageing population” or “health expenditure”

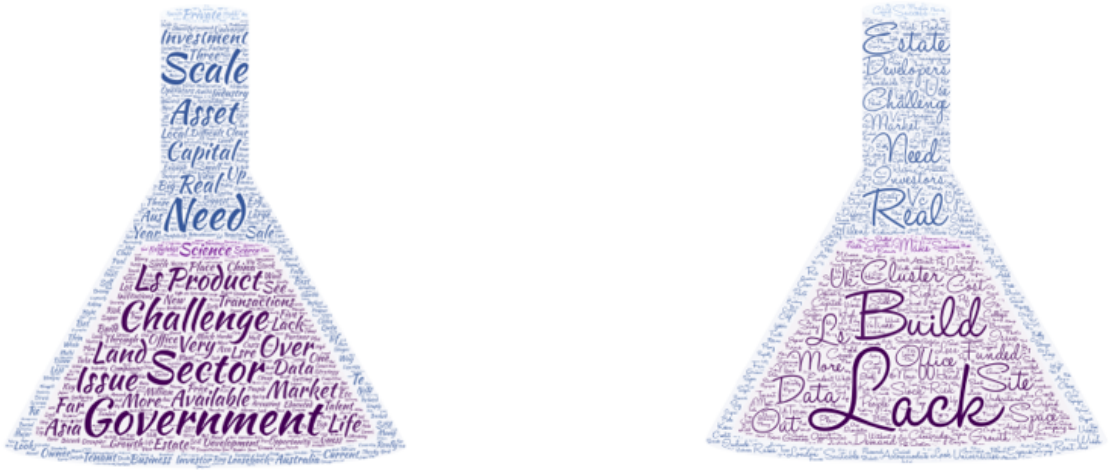
Q: Which are the key location factors that drive LSRE growth?

Europeans more likely to say, “lab space”, Asians more likely to say “healthcare operators”

Q: In your firm, what do you consider the greatest challenge in life sciences real estate?

Europeans more likely to say “lack of suitable sites” or “lack of data”, Asians more likely to say “government”

Figure 40: Greatest challenges in life sciences real estate



Sources: Interviews carried out for ULI in Asia Pacific and Europe.

Q: Which type of locations are you most interested in?

Europeans more likely to mention specific cities and urban clusters, Asians more likely to say "[where] private ownership allowed" and business parks

Q: What do you see as the barriers to attracting more capital?

Europeans more likely to say "lack of understanding", Asians more likely to say "lack of product"

Comparative cost analysis

Whilst every effort has been made to source comparative costs data to show relative costs associated with new-build traditional offices versus new-build life sciences office/lab space, this research has drawn a blank. A number of specialist cost consultants and major brokers were approached for data. Although information is available for the main commercial and residential sectors, no cost information for the life sciences segment appears to be in the public domain. Anecdotally, we were informed that one major agency was having to commission bespoke work on costs.

Drawing on building specifications that emerged from the Asia Pacific case studies, analysis of the U.S. market, and some cost information provided for the Europe report, we provide some very high-level estimates below.

The cost of a life sciences building is to a large extent driven by the tenants' requirements for:

- Building management system (BMS) capability;
- Column spacing of ideally 11 feet;
- Efficient heating, ventilation and air conditioning (HVAC);
- Electrical service that provides twice the power of a typical office building;
- Exhaust systems to provide environmental safety and cleanliness;
- Floor ducts to accommodate high voltage, low voltage, and IT wiring;
- Floor vibration stability to accommodate use of sensitive microscopy equipment;
- Floor-to-ceiling height clearance to accommodate special equipment used in research;
- Floor-to-roof loads capable of supporting 100 pounds per square foot;
- Freight elevators in addition to passenger elevators;
- Low voltage (LV) switchboard capacity;
- Lower heating and cooling deviation for tighter environmental control;
- Different grades of water;
- Standby power generator to protect systems, ongoing research and sensitive products;
- Strong floors to bear weight of lab equipment (design load capacity of 500 kg/m^2);
- Sufficient loading dock and utility yard space to receive, store, distribute, and dispose of hazardous materials;
- Wastewater treatment.

New build: data from the UK[14] suggests that the cost premium for new-build shell and core Category A office/lab hybrid space in central London is in excess of 20 per cent over new class A offices. For labs, tenant requirements will often include additional items such as lab benching. There are multiple variations of this, depending upon the nature/maturity of the tenant – everything from plug-and-play desks with all services being brought in and covered as a service charge to the tenant, to more mature tenants who know what they want, with the developer only providing shell and core and the rest being the tenant's responsibility.

In London, depending upon the "primeness" of the location, the rental premium achievable for office/lab space over core office space could exceed the cost premium substantially because of the supply/demand dynamics in a CBD urban environment.

[14] Medtech Actuator, https://medtechactuator.com/accelerator/.

Conversions: the office conversion route will likely offer cost savings over new build, but there are many issues and challenges in undertaking this route, including planning and the specific features required by life sciences tenants as listed above. It is an area that demands a detailed knowledge of tenant requirements both now and in future, to accommodate growth and life-cycle changes in requirements. In the United States, it is estimated that the investment to convert buildings to lab space and offer tenant improvements can total more than US$300 per square foot (Kirk 2021).

To put that indicative conversion cost in perspective, the annual rent for life science space in a mature market such as Boston can exceed US$100 per square foot. As noted earlier, East Cambridge/Kendall Square rents are around US$105 per square foot.

Each Asia Pacific market will be different, with new development often targeted at suburban and out-of-city locations where the demand-side rental pressure may be less evident. Investors and developers will need to foster a detailed understanding of local markets to minimise risk and maximise potential reward.

6. CONCLUSIONS AND RECOMMENDATIONS

At a time when investment in the life sciences sector has been boosted by (hopefully) a one-off global pandemic, a genuine opportunity exists for the real estate industry to engage in and benefit from a structurally growing sector that has government, private sector, and society support.

In addition to COVID-19, a number of structural growth drivers and broader sector trends further spur the growth of the life sciences sector, which requires suitable real estate. The growth of the sector presents an investment opportunity for those who are willing to get fully acquainted with the sector's nuances, which range from the specific requirements of life sciences buildings (including wet labs and dry labs) to the layout of life sciences locations (such as incubators, accelerators, and parks).

Understanding what makes a successful life sciences ecosystem, as illustrated by the case studies, is key to success. The trend towards urbanisation seen in some of the North American and European cities is less evident in the Asia Pacific region. The preference remains with purpose-built parks, precincts, and suburban locations. However, it is an area to watch going forward.

The report has highlighted throughout the societal and demographic factors that drive further growth of the life sciences sector as well as the broader trends that will enable further growth and help shape the life sciences sector (see figure 41).

Figure 41: Macro and micro drivers and trends in the life sciences sector

Sector	Drivers	Trends	Macro
	• Demographics – ageing • Lifestyle diseases • Health care spending • Coronavirus pandemic	• Technology • Urbanisation • War for talent • Sustainability	
Country	• Government policy • Government funding • Academia and universities • Competitiveness • Tax and legal framework		
City/location	• Affordable office and living space • Urban environment attractiveness and amenities • Triple/quadruple/quintuple helix • Venture capital and corporate research and development funding		**Micro**

Source: ULI.

Figure 42: Asia Pacific life sciences real estate sector weaknesses and opportunities

Weaknesses	Opportunities
Lack of data and transparency	Impact of COVID-19
Lack of product for occupiers	Funding availability and diversity of sources
Lack of investment stock	More life sciences activity = more data and transparency
Lack of understanding within investor/developer community	Policy priority
Lack of operational expertise	Accelerating impact of technology in the life sciences sector
Government control (in some territories) over land and buildings	Reshoring of R&D and manufacturing

Source: Didobi.

The qualitative research for this report identified six key weaknesses and opportunities for Asia Pacific LSRE, as detailed in figure 42.

The report reviews the main trends impacting the life sciences sector in Asia Pacific and how the drivers and dynamics are affecting the demand for life sciences (LSRE).

The learning curve is steep, and business case data is not as readily available to investors as it is in the more established real estate sectors such as offices, retail, and industrial; however, experience from the more mature U.S. market indicates that the effort will be rewarded.

Recommendations

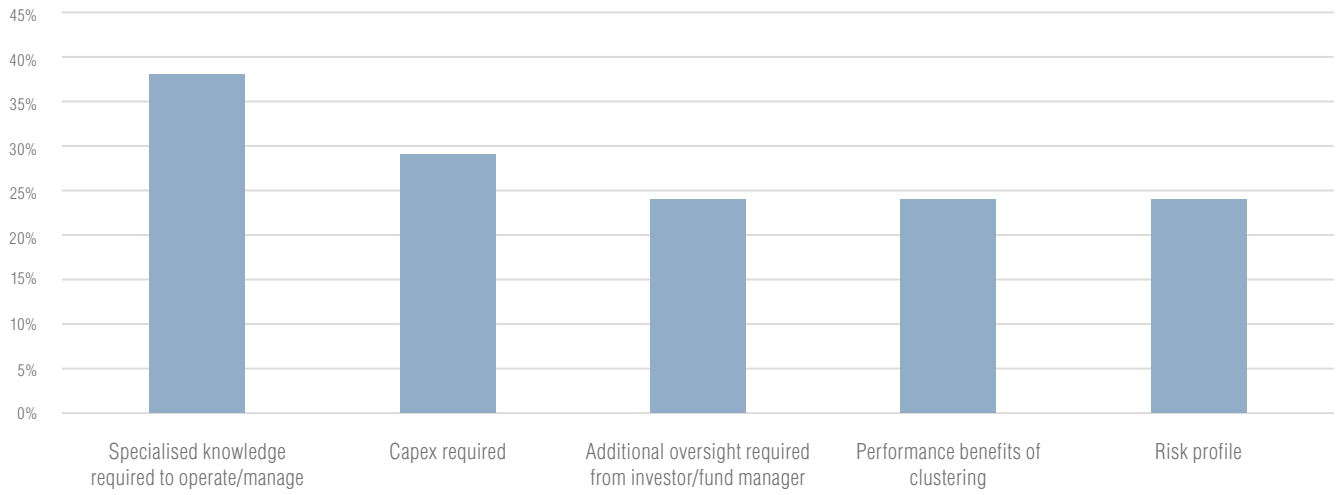
The opportunity exists now, more than ever before, to create the transparency a maturing real estate market requires by agreeing on common definitions and creating knowledge of demand, supply, costs, rents, ownership, and lease terms through structured data that is verified and maintained. To tap into the opportunities the life sciences sector provides from a structural growth and diversification perspective in Asia Pacific, the real estate industry needs to act in the following key ways, helping overcome the barriers to the sector.

- **Overcome the lack of reliable data.** Investment research companies should collect and incorporate medical offices and laboratory space in their reporting from investors and developers, according to pre-agreed, common definitions. Encourage real estate players and investors to publish rental rates and ownership/management for health care properties, offices, and labs. Having this data would give investors confidence and attract capital by removing a lot of the assumptions as to risk and return.

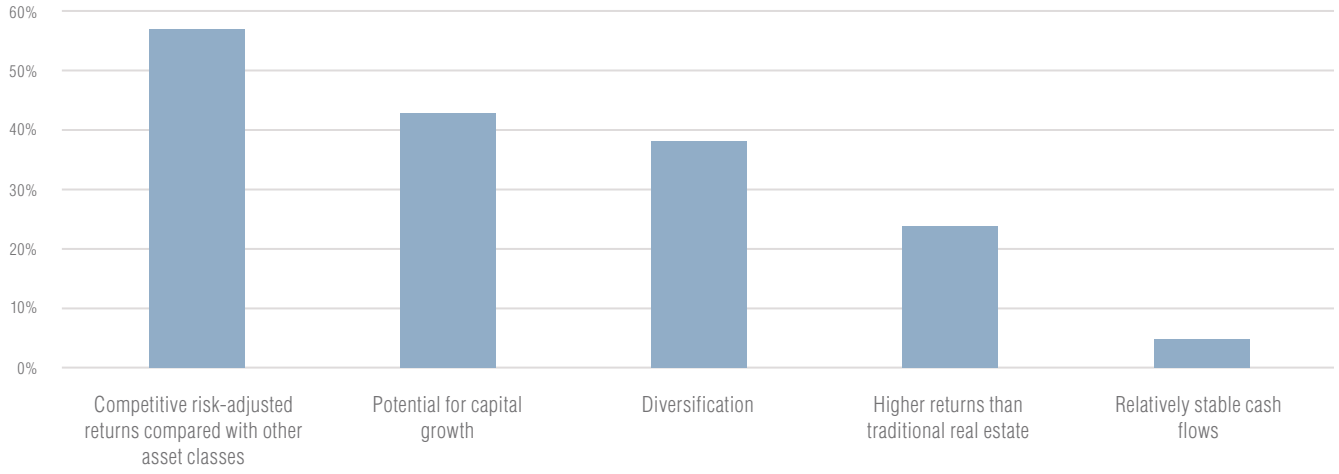
- **Be prepared to work closely with government,** both national and local. Real estate developers and investors need to cooperate with government when it comes to strategic vision, location, workplace, building layout, target tenants and rental terms.
- **Factor in mega-trends in LSRE decision-making.** Real estate investors need to track global mega-trends such as housing affordability, ageing populations, competitiveness, and reliance on technology as part of life sciences investment decision-making.
- **Work towards a shared definition of LSRE** and associated key terms. This definition should address the nature of the investment and also the question of proportion: If 49 per cent of a multi-let building is let to non–life sciences tenants, can that building be labelled as LSRE? Lack of a shared definition could hinder capital flows, in particular cross-border capital flows.
- **Work with major life sciences tenants to better understand their needs** and develop appropriate facilities. The needs of a life sciences tenant are varied and complex, while their financial status ranges from early stage and/or fast-growing life sciences companies to major global conglomerates. The types of space vary from office, lobbies, and meeting rooms to wet labs, dry labs, cold rooms (walk in and built in), and medical facilities. The one-size-fits-all approach will not work. This can create a unique and challenging set of factors for a landlord to transverse in designing, developing, and leasing space to life sciences customers.

APPENDIX 1: TOP FIVE SURVEY FINDINGS

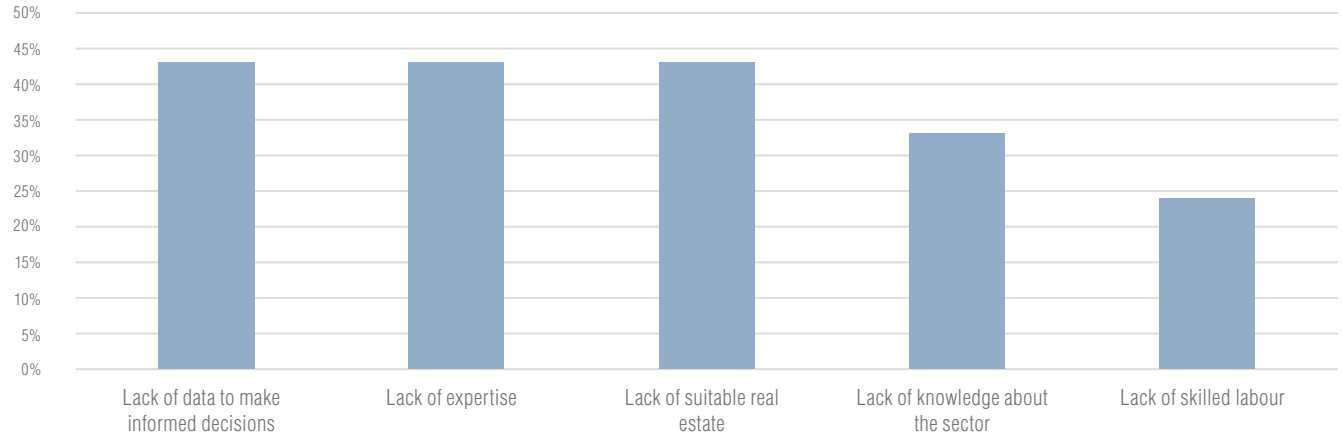
For investors, advisers, and lenders, what are the main differences between traditional real estate and life sciences real estate?



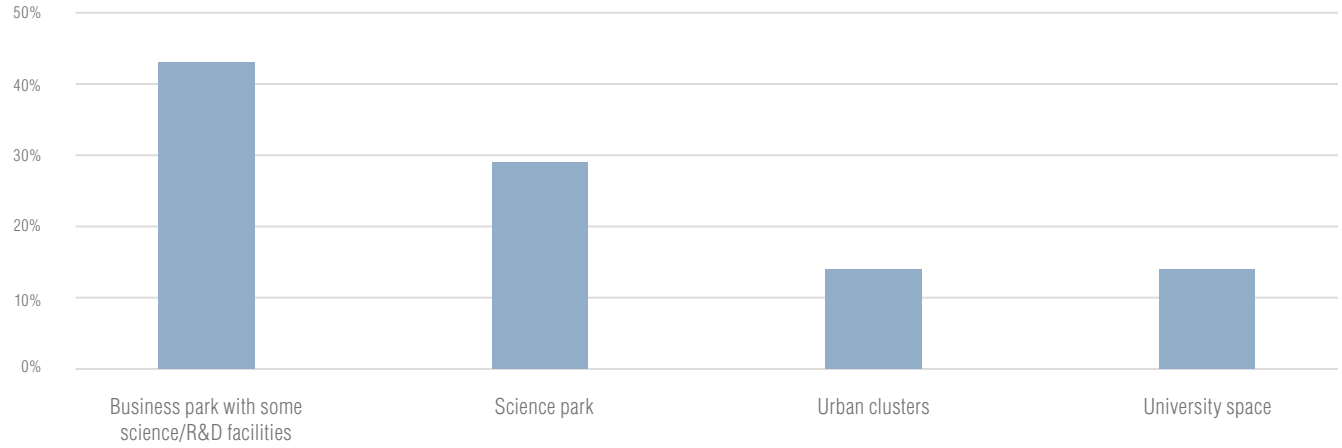
If you invest in life sciences real estate, what is your investment purpose?



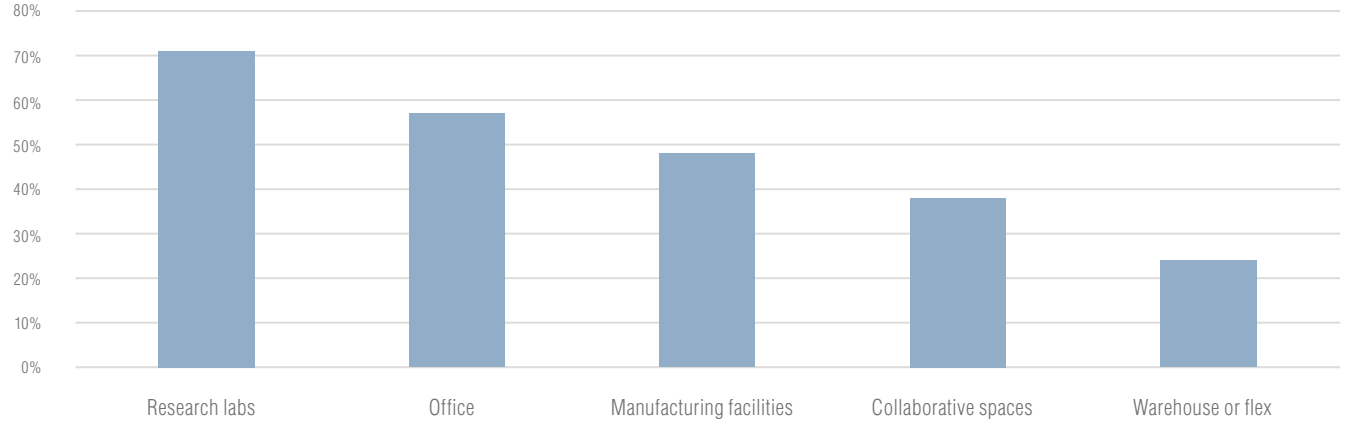
In your firm, what do you consider the greatest challenge in life sciences real estate?



In your view, which are the most productive types of location for life sciences?



Which types of real estate are of interest to you?



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