China and Taiwan R.O.C Handbook 2019

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Welcome to the Linesight China and Taiwan R.O.C Handbook 2019.

Each year, we bring together all the important indices and trends in construction to give you the most comprehensive industry overview possible.

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*Updated September 2019

REVIEW & OUTLOOK:

China Market Review

China construction review and outlook

China's economy grew by 6.6% last year, the slowest pace since 1990. This is expected to slow further to about 6.3% in 2019, with the country's trade dispute with the US affecting its domestic economy. China continues to shift away from manufacturing and infrastructure toward services.

The labour force is one of the most important factors that has contributed to the country's unparalleled economic development over the past number of decades. Initially benefitting from its ample supply of cheap labour, the country's demography and labour dynamics are now evolving with the slowdown of the economic growth.

China's economy grew by 6.6% last year, the slowest pace since 1990.

Minimum wages in China continue to grow, and last year, 20 out of the 31 regions in mainland China increased their minimum wages. The statistic shows the unemployment rate for China from 2012 to 2017, with projections up until 2023. In 2018, China's unemployment rate was recorded at about 4%. Consumer price inflation slowed to a six-month low of 1.9% year-on-year in December 2018 from 2.2% the previous month, and came in below the market consensus of 2.1% . The slowdown in inflation was mainly due to non-food prices, while food inflation stood at its lowest level in three months. For the currency, Chinese government will try their best to Chinese Yan stable.

Foreign direct investment (FDI) into China rose by 0.9% to ¥885.61 billion in 2018, which is equivalent to an increase of 3% percent to US$130.93 billion. Investment in the manufacturing sector accounted for 30.6% of total investment, and rose 20.1% from a year earlier. Within this sector, investment in high-tech manufacturing grew 35.1%. The biggest sources of foreign direct investment were as follows, with the biggest increases coming from Europe; Singapore (8.1% year-on-year), South Korea (24.1%), Japan (13.6%), the UK (150.1%), Germany (79.3%) and the US (7.7%).

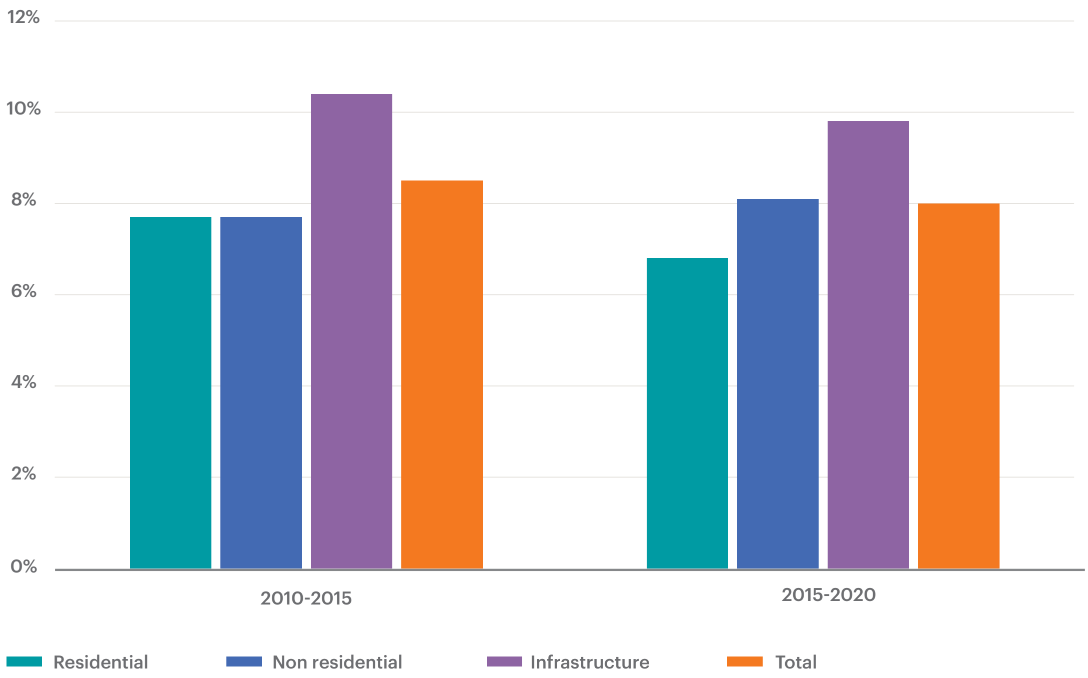
China's construction industry is estimated to grow by 5.9% and 6.1% in 2019 and 2020 respectively, driven by public sector projects, such as railway. Infrastructure investment remains a key driver of demand. However, China's fixed-asset investment growth has declined in 2018. As the US-China trade war starts to affect economic growth and market sentiment, there could, in turn, be a dampening of demand and prices for building materials. In addition, if China sticks to its initiative of deleveraging the whole economy, it will not have the ability to use increased investment to buffer any decrease in demand. Building materials generally still face overcapacity. The recovery in prices in 2017 and 2018 was primarily from rationalization of production between producers, for example, cement producers in China, without shutting down excess capacity. So far, the rationalization has been functioning well. However, if demand growth slows and the market turns, also resulting in a price drop, companies may not necessarily adhere to the rationalization plan and may start to raise production to increase cash flow. Therefore, overcapacity remains an overhang for the building materials industry in the region.

In summary, the Chinese economy is expected to face downward pressure in 2019, while the pace of growth gradually stabilizes.

China's construction industry is estimated to grow by 5.9% and 6.1% in 2019 and 2020 respectively, driven by public sector projects.

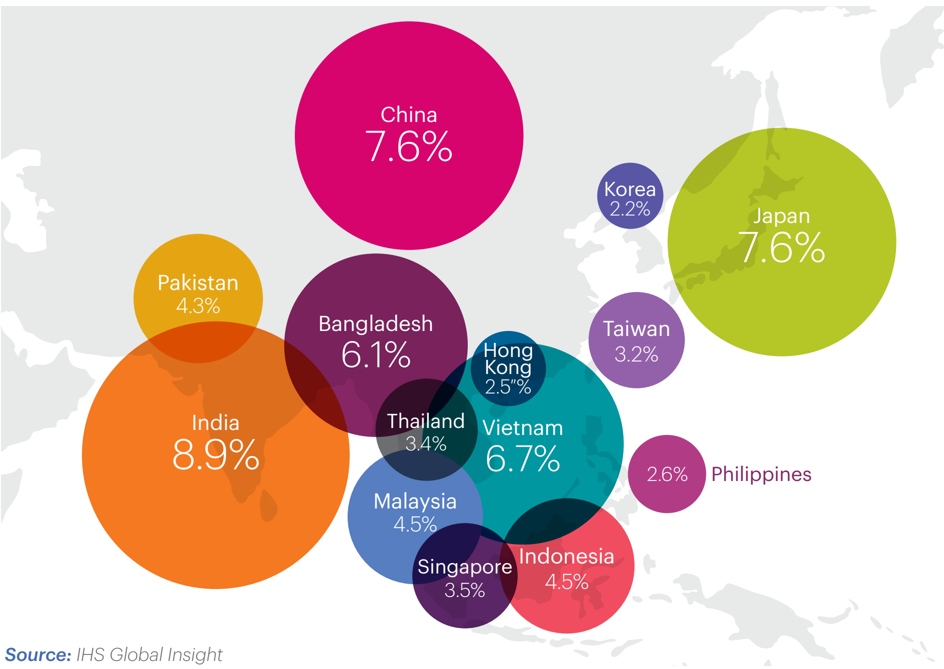
2. Macro indicators

2.1.



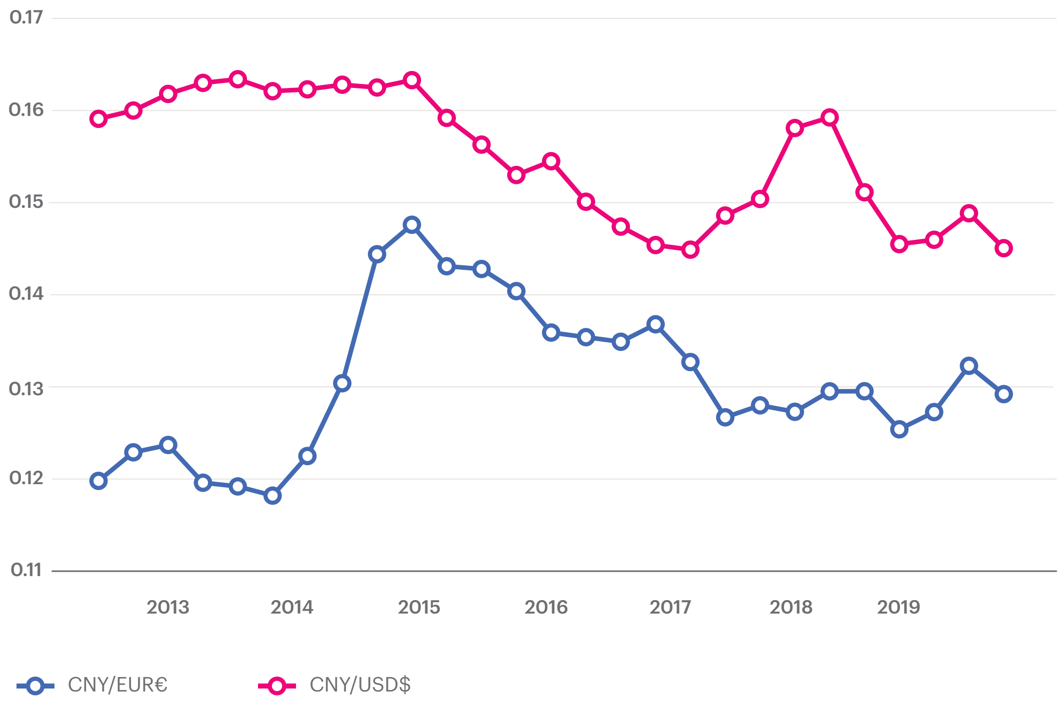
Source: *Global Construction Perspectives and Oxford Economics*

2.2. Construction spending growth



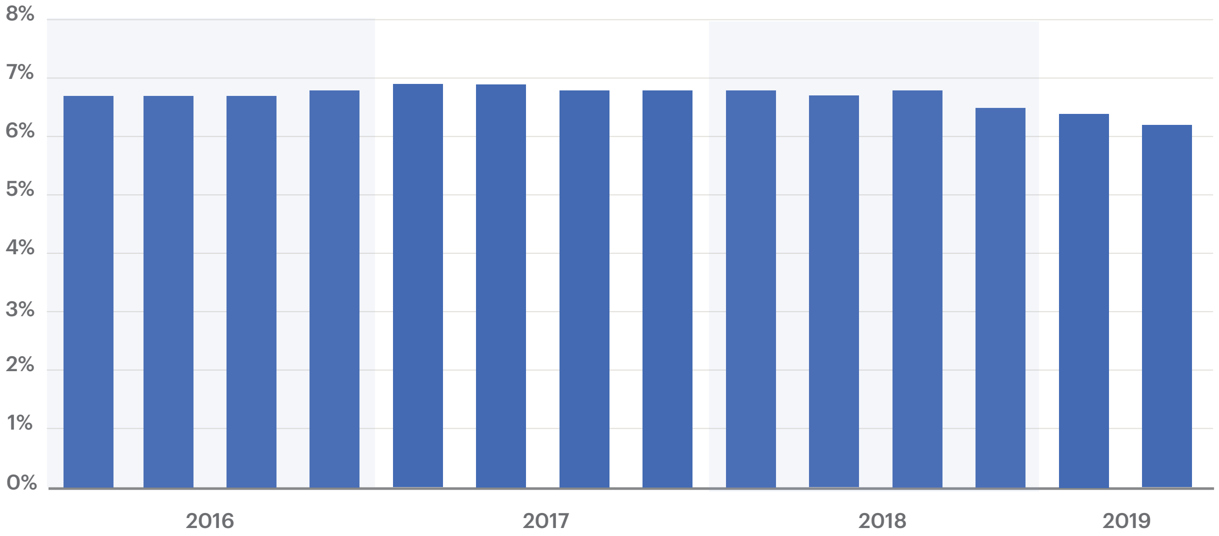
Source: *IHS Global Insight*

2.3. Currency exchange rates*



Source: *European Central Bank*

2.2. China GDP growth rate*



Source: *Trading Economics/National Bureau of Statistics China*

3. Linesight average Chinese construction costs 2019

Outlined below are the indicative construction costs for the varying sectors based on tenders received in the regions.

International construction cost comparisons – current at January 2019

	Shanghai		Beijing		Hong Kong		Chengdu		Guangzhou	
Description	**from** (US$/m²)	**to** (US$/m²)	**from** (US$/m²)	**to** (US$/m²)	**from** (US$/m²)	**to** (US$/m²)	**from** (US$/m²)	**to** (US$/m²)	**from** (US$/m²)	**to** (US$/m²)
Commercial offices										
City centre air conditioned										
Shell and core (medium – high rise)	1,064	1,521	1,084	1,554	2,927	3,808	971	1,287	971	1,320
Developer standard (medium – high rise)	1,238	1,729	1,244	1,995	3,667	4,408	1,118	1,628	1,156	1,552
Residential sector										
Developer standard apartments (medium standard)	699	891	696	874	3,017	3,976	582	762	611	762
Developer standard apartments (high standard)	1,191	1,431	1,176	1,449	4,217	5,646	779	1,032	812	993
Leisure										
Shopping centre	1,273	1,805	1,261	1,854	3,843	4,591	1,121	1,660	1,164	1,541
Hotel building (budget/3 star)	1,277	1,628	1,318	1,674	3,727	4,183	1,164	1,464	1,274	1,501
Hotel building (4/5 star)	1,879	2,518	1,925	2,548	4,192	5,057	1,827	2,328	1,856	2,246
Education										
Primary level (up to 3 stories, no air conditioning)	584	895	586	903	2,102	2,632	493	732	502	768
Car park										
Multi storey	370	532	424	494	1,285	1,581	322	418	353	449
Double level basement	716	1,093	708	981	2,397	3,157	563	932	558	937

Note: *Assume coverage/scope as per corresponding handbook items*

Source: *Linesight*

4. Main contractors and design firms

4.1. Top 15 main contractors

2018 rank	Construction company	Revenue $ bn
1	China Communications Construction Group Ltd.	75,383
2	China State Construction Engineering Corp.	145,046
3	Power Construction Corp	45,662
4	China Railway Construction Corp.	102,237
5	China Railway Group Ltd	131,556
6	China Energy Corp Ltd	26,599
7	China National Machinery Industry Corp	6,005
8	China Petroleum Engineering Co	8,314
9	China Metallurgical Group Corp.	30,099
10	China National Chemical Eng'g Group Corp. Ltd	9,148
11	Sinopec Engineering Group	5,362
12	Citic Construction Co Ltd.	2,138
13	Qingjian Group Co. Ltd	8,898
14	Harbin Electric International Co Ltd	1,627
15	TBEA Co. Ltd	4,864

Note: *2018 rank based on 2017 contracting revenue.*
Source: *Engineering News Record*

4.2. Top 15 design firms

2018 rank	Design firm	Revenue $ bn
1	China Power Engineering Consulting Group Co. Ltd.	1,217
2	China Energy Corp Ltd	890
3	China Communications Construction Group Ltd.-	449
4	JSTI Group	355
5	China Petroleum Engineering Co	276
6	AEDAS -	205
7	Sinopec Engineering Group - Arcplus Group PLC	200
8	China Chengda Engineering Co Ltd	191
9	China National Machinery Industry Corp	184
10	China Railway Group Ltd	123
11	China Tianchen Engineering Corp	105
12	China Railway Group Ltd	61
13	Arcplus Group Plc	54
14	China Aluminum International Eng'g Corp Ltd	43
15	Changjiang Inst of Survey, Planning and Design	41

Note: *2018 rank is based on 2017 revenue.*
Source: *Engineering News Record*

5. Taiwan R.O.C Market Review

The Taiwanese Directorate General of Budget, Accounting and Statistics (GDBAS) announced that it had reduced the 2018 GDP growth outlook from 2.69% to 2.66%, and the growth forecast for 2019 has also been reduced from 2.55% to 2.41%. Taiwan expects to maintain this moderate level of growth to 2023, based on external demand for manufactured goods.

The domestic economy is facing a further slowdown as a direct result of the Sino-US trade war, but benefits are still being felt from wage increases in 2018. Taiwanese high-tech manufacturers based in China who have been affected by the Sino-US trade sanctions have been offered an incentive to move manufacturing facilities to Taiwan. This, along with revised land ownership policies within industrial parks, will incentivise owners to utilise idle industrial land. Investors who fail to build relative facilities within the fixed three-year term from purchase of the plot will incur fines and be forced to sell the land. Unemployment has reduced to 3.7% and is forecast to hold at that level. The Central Bank has again held the interest rate this year at 1.375%, where it has remained unchanged since 2016.

In terms of local political factors, local elections held 24th November 2018 marked a shock defeat for the ruling Democratic Progressive Party (DPP) to the Kuomintang (KMT), who won 13 jurisdictions compared with the DPP's six. Mayor Ko was re-elected in Taipei City. The Government is likely to find it difficult to continue to get support for its current domestic economic policy before the national elections in 2020, and if national elections follow suit, the party will lose its legislative majority. Taiwan's relations with mainland China remain unchanged under the DPP, but could improve after the 2020 polls, assuming KMT return to power.

According to TIER (Taiwan Institute of Economic Research), one of the country's leading economic think tanks, the sub-index for the local construction industry fell from 94.72 in December to 93.59 in January, with the construction market appearing stagnant, as many projects were pending ahead of the Lunar New Year holiday that started in early February '19. The construction industry is expected to improve over the next six months. The Government is planning to expand public construction as well as state-owned enterprises investment; therefore, the overall fixed capital formation for the year of 2019 will certainly have higher growth compared to 2018. TIER forecasts the relevant growth rate standing at 4.40%, with private investment growing by 3.12%.

The current Government has released NT$72.7 billion to the 'Forward-looking Infrastructure Development Program' to develop national infrastructure The program includes eight categories; railway projects to provide safe and fast transportation, water environments to build resilience against climate change, green energy infrastructure to foster environmental sustainability, digital infrastructure to create a smart and connected nation, urban and rural projects to balance regional development, childcare facilities to reverse declining birth rate trends, infrastructure to ensure food safety, and human resources infrastructure to nurture talent and boost employment.

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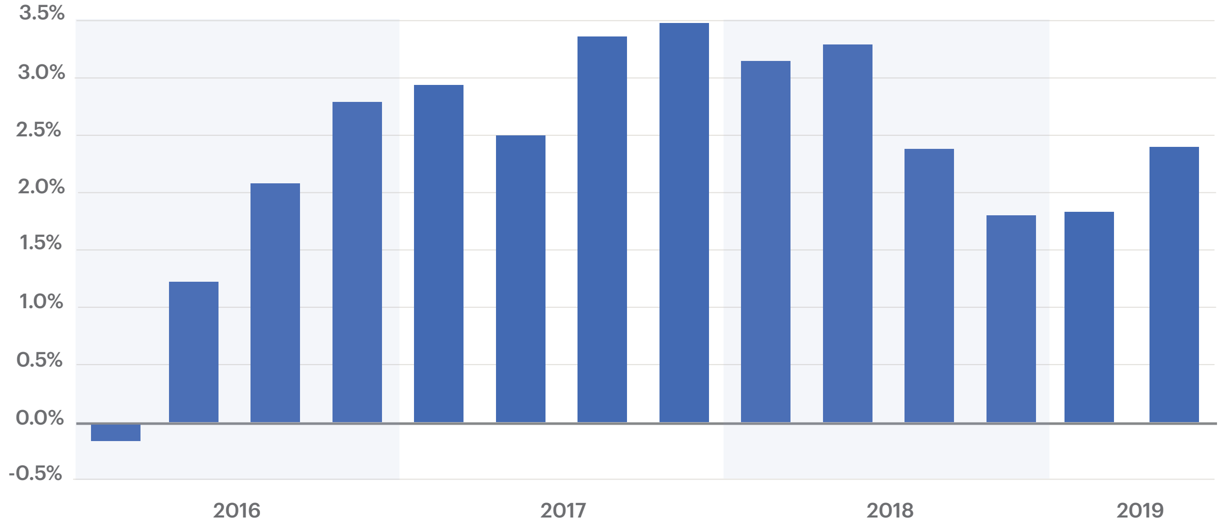
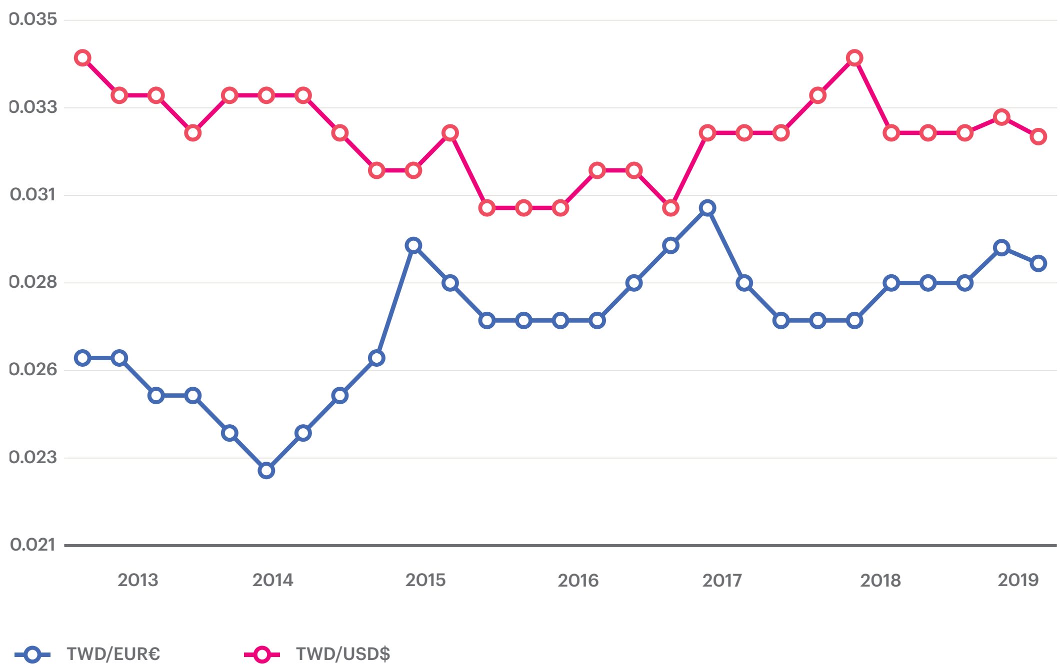
6. Macro indicators

6.1. Taiwan R.O.C GDP growth rate*



Source: *Trading Economics/National Bureau of Statistics China*

6.2. Currency exchange rates*



Source: *European Central Bank*

7. Linesight average Taiwanese construction costs 2019

Description	Taiwan from (US$/m²)	Taiwan to (US$/m²)
Commercial		
City centre air conditioned	2,700	3,150
Shell and Core medium-high rise	2,350	2,800
Residential		
Developer standard medium standard	1,950	2,400
Developer standard high standard	2,300	2,600
Leisure		
Hotel building (budget/3*)	2,500	2,800
Hotel Building (4/5*)	2,800	3,100
Shopping Centre	3,750	4,000
Education		
Primary level (up to 3 stories, no air conditioning)	1,300	1,500
Car park		
Multi storey	850	1,300
Double level basement	1,400	2,000

Note: *Assume coverage/scope as per corresponding handbook items*
Source: *Linesight*

REVIEW & OUTLOOK:

Global Insights

Global Market Review

Trade dispute between the world's two largest economies has the global economy holding its breath in anticipation of the outcome.

Although the deadline has recently been extended, the potential outcome in the current US-China trade dispute continues to cast a shadow over global economic prospects. The IMF has reduced its global growth projection for 2019 by 0.2 percentage points since its projection in October 2018. When asked what had changed since October at the World Economic Forum Annual meeting in Davos, Christine Lagarde (Managing Director of the IMF) responded that it is the level of risk and the acceleration of the pace at which risks are materialising.

The reduction to 3.5% growth in 2019, is largely due to weaker performances in Europe and Asia, specifically relating to trade tariffs between the US and China, and Brexit. However, as Lagarde points out, it is still growth, albeit a little more modest than previously predicted.

US set to break record despite slowdown

The strong performance of the US economy is expected to continue in 2019. The financial results for 2018 were delayed due to the partial government shut down in January, however figures show that significant growth in the first three quarters were balanced by a significant slow-down in the fourth quarter.

Commentators are expressing the view that the beneficial impact of tax reforms introduced by the Trump administrations are fading. Nevertheless, the economy is in a strong position and the Federal Reserve has indicated that it intends to implement moderate rate hikes in 2019 and 2020, in order to keep the economy from overheating amid rising inflation and a rapid decline in unemployment. If the current expansion in the US economy continues past July 2019, it will have broken the previous record of a decade of expansion, which was set by the tech boom in the 1990s.

The US appears to be on track for this by avoiding overheating and financial imbalances - the classic causes of recessions. President Trump is determined to follow through on his campaign promise to end unfair practices with trading partners - late in 2018 he reached agreement on the replacement of the NAFTA, now known as the USMCA (United States-Mexico-Canada Agreement). Earlier in 2018, he turned his attention to China, citing unfair trade practices and theft of intellectual property. China then made a counterattack, and hence we have a trade war on our hands.

China to increase public spending

The Chinese economy, the second largest in the world, is expected to slow down further in 2019. The Government had been implementing a plan to reduce debt and risky lending. However, in response to the trade war, they are switching policy and tending towards a stimulus package of more fiscal spending, reducing the amount of money the bank needs to hold in reserve at the central bank and thus freeing up money for additional lending; building a resilient domestic market and stabilising economic growth and monetary easing in order to enhance growth.

Europe still in flux

In Europe, uncertainty around Brexit still dominates. Business investment and domestic consumption in the UK is likely to remain subdued while the issue of Brexit is unresolved. A no-deal Brexit will likely cause a serious economic shock, while leaving the EU with a deal could result in a boost in investment and consumer sentiment, which has been subdued for the last number of years. Germany, the largest economy in the eurozone, is dealing with a softening of private consumption, and introduction of new automobile fuel emission standards have resulted in a weak industrial production.

Meanwhile, France is dealing with 'Gilet Jaunes' or the 'Yellow Vest' movement, and after 10 weeks the protests are finally showing signs of receding. However, what was previously viewed as an unorganised movement is morphing and changing, and the final shape it takes could be of political concern. In Italy, weak domestic demand and higher borrowing costs together with concerns about sovereign and financial risks have dampened domestic demand.

Ireland is set to see continued strong growth, which will shield it somewhat from the slowdown in the global economy. However, labour shortages, pressure on public services and rising prices caused by this strong growth present major challenges for Government and businesses alike. The outlook is overshadowed by the prospect of a hard Brexit, which would negatively impact on Ireland's growth, with rural Ireland being particularly impacted.

The GCC continues to diversify

Oil prices have been volatile thanks to swings in supply, and OPEC has agreed to cut production with a view to returning prices to US$70 a barrel later in 2019. However, the GCC economy continues to improve, with a period of increasing interest rates and the prospect of stable oil prices. In particular, Saudi Arabia continues with its diversification plans as part of its 'Vision 2030' plan. And while the geopolitical situation remains a concern, improved economic dynamics are offsetting these concerns.

The governments continue their drive to reduce the economies' dependency on oil prices, and thus we have seen a trend of mergers and acquisitions, particularly in the banking sector. These M&As are seen as an opportunity to improve economies of scale and scope, and to improve market share in the global markets.

The governments are also focusing on continuing to attract foreign direct investment, which is stimulating economic growth and boosting investor confidence in the region. The UAE has made some significant investments in technology, and in particular renewable energy, with the ambition to have 44% of its energy requirements provided through renewable resources by 2050.

Its investment in infrastructure continues, as it prepares for Expo 2020, which is providing a stimulus for the regional construction industry. While FDI investment in the UAE is expected to significantly increase with recent investment law provisions, relaxation of visa rules and other business-friendly reforms also appear poised to both attract qualified foreign workers. However, Egypt is expected to be the region's top performer in 2019, followed by Iraq. Iran will contract again in 2019 as US sanctions continue.

In Israel domestic demand should continue to support economic growth this year. Private consumption will likely benefit from a lower tax burden and still-favourable financial conditions. New gas and oil-related projects are expected to boost fixed investment growth. On the other hand, regional tensions remain a key downside risk and cloud the outlook.

The Chinese economy, the second largest in the world, is expected to slow down further in 2019.

Asia Pacific remains robust

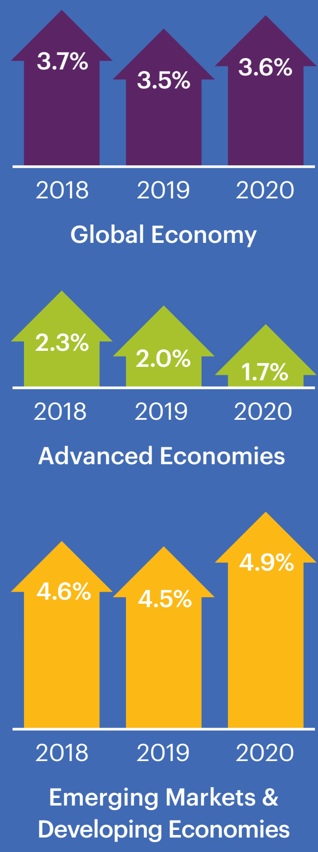
A recent press release by the Singapore's Ministry of Trade and Investment noted that its economy is, like many other global economies, expected to slow in 2019. The manufacturing sector, in particular electronics and precision engineering, is experiencing difficulties due to weakening global demand for semiconductors and associated equipment. While other sectors, such as wholesale trade, transportation and storage finance and insurance are expecting to moderate in growth, in line with the global economy. The information and communications, health and social services sectors are expected to remain resilient due to demand for IT and digital solutions. The construction industry is expected to see a pick-up after three consecutive years of contraction. Politically, there is speculation that general elections will be held this year to take advantage of the still-strong domestic growth and heightened public morale following bicentennial commemorations.

Remarkably, the Australian economy has gone 27 years without a recession. While there are risks to the economy, it is expected that business investment, rising exports of commodities and Government spending will likely offset the contracting housing sector, subdued consumer spending and devastating drought.

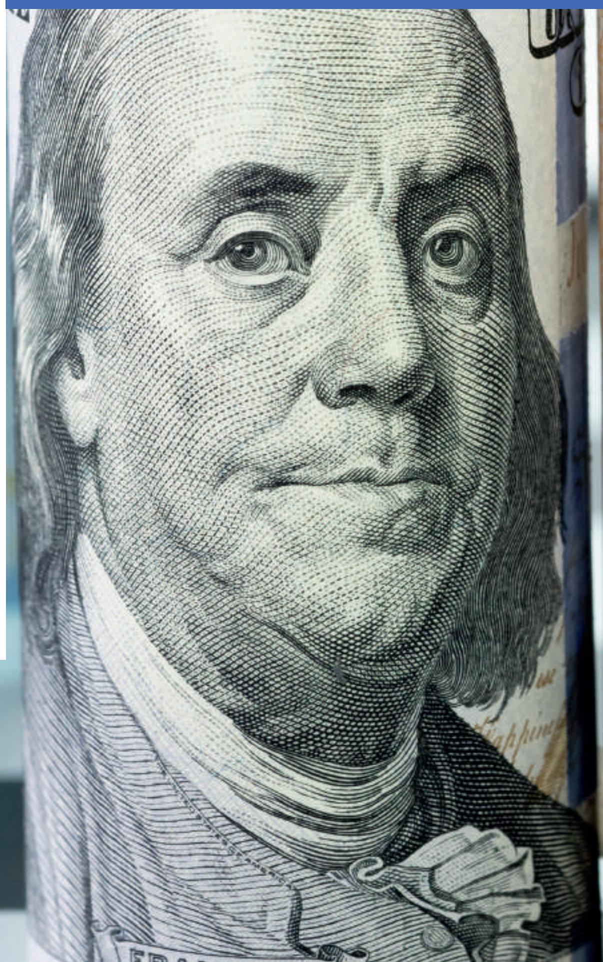
Employment growth is strong, as the Australians consistently add more jobs than needed to accommodate the growth of the working-age population, resulting in reduced unemployment rates and participation rates increasing to the highest level on record. In addition to increased production capacity from LNG plants, the Australian resource sector is also seeing increased activity from the Chinese in response to the US tariffs, in iron ore and coal particularly, though this cannot be relied upon in the longer term. Thus, growth in 2019 should be moderate.

Kim Hegarty
Associate Director

Growth projections



Source: *International Monetary Fund*




毛泽东

GLOBAL INSIGHT

How is sustainability impacting the built environment?

Sustainability is the process of maintaining change in a balanced environment, in which the use of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony, and enhance both current and future potential to meet human needs and aspirations.

For many in the field, sustainability is defined in terms of three interconnected domains or pillars: environment, economy and society. Economy and society are constrained by environmental limits.

Sustainable building (aka green construction or green building) refers to both a structure and the application of processes that are environmentally responsible and resource-efficient through a building's life cycle. This extends from planning to design, construction, operation, maintenance, renovation and demolition.

There are several associated built environment goals; to design future projects to minimize energy and water consumption, as well as wastewater production; incorporate sustainable design principles into capital investment decisions; base capital investment decisions on life cycle cost, including the cost of known future expenditures.

Positive impacts

Sustainability in buildings refers to their ability to be environmentally responsible throughout their life cycle, from planning and design through to operation and maintenance.

It is based on energy use, water use, indoor environmental quality, material selection and the building's effect on the site, while also addressing the impact on human health and the environment. It does this by:

1. Reducing waste, pollution and degradation of the environment
2. Efficiently using energy and water, along with other resources
3. Protecting occupant health and productivity

Ultimately, and intuitively, a greener and more efficient design and operation has less impact on the environment, as well as minimizing harmful effects on human health and the environment.

Beyond new developments, existing buildings need to be upgraded to be more energy efficient and use renewable energy sources to lower greenhouse gas emission.

The economic and social benefits associated with green building, as listed below, are also significant.

Economic benefits:

- Reducing operating costs
- Improving occupants' productivity
- Creating market for green products

Social benefits:

- Improving quality of life
- Minimizing strain on local environment
- Improving occupants' health and comfort
- Promote a better planet
- Sustain environment without disrupting natural habitat

LEED and WELL certification:

LEED is the most widely used green building rating system in the world, with a LEED-certified building offering considerable cost savings to owners, in terms of maintenance costs over the building's life cycle. LEED sustainability standards for design have now become a part of architectural design on a standard level, leading to the next level of occupant wellbeing, with the new WELL Building Standards.

WELL is a performance-based system for measuring, certifying and monitoring features of the built environment that impact human health and well-being through seven concepts: air, water, nourishment, light, fitness, comfort and mind. The below seven concepts are pillars upon which sustainability relates to the human side of a building:

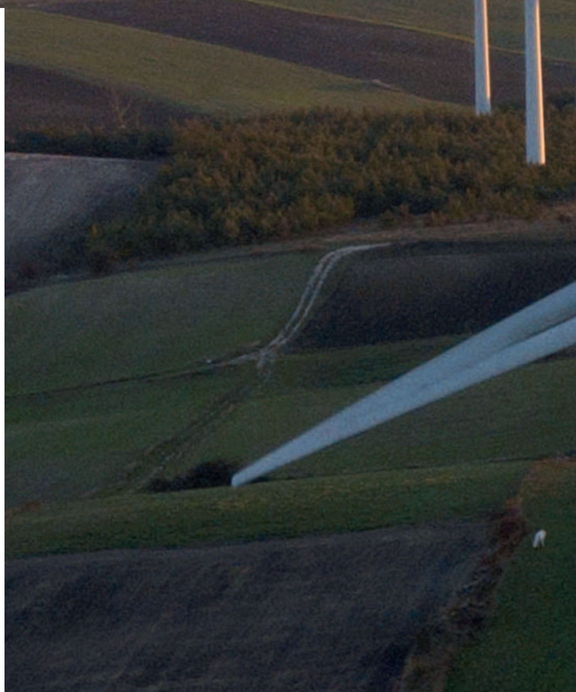
- Air - achieve optimal indoor air quality to support the health and well-being of building occupants. This promotes strategies to remove airborne contaminants, and promote pollution prevention and air purification.

- Water - optimize the quality of water available to building occupants and promote accessibility. This encourages strategies to ensure water is safe, clean and easily accessible through filtration, treatment and strategic placement.

- Nourishment - encourage healthier eating habits and food cultures that lead to better health. This includes availability and promotion of healthy food choices.

- Light - minimize disruptions to the circadian rhythms of building occupants, enhance productivity, and improve physical energy and mood levels. This is done by implementing strategies for better illumination, by providing criteria for window performance and design, light output and control, and appropriate visual activity.

Sustainability in buildings refers to their ability to be environmentally responsible throughout their life cycle, from planning and design through to operation and maintenance.



- Fitness - encourage integration of physical activity into the everyday life of building occupants bu utilizing building design, accommodating fitness regiments, and providing the space and opportunity for an active lifestyle.

- Comfort - design of an environment that is distraction free, productive, and comfortable for the occupants, by promoting strategies to meet accessibility design standards, providing comfortable furnishings and workstations, controlling acoustics and thermal conditions, and reducing known discomforts.

- Mind - support the mental and emotional health and well-being of the occupants, by providing regular feedback and knowledge to them about their indoor environment. This is done through design elements, relaxation spaces, and health treatment and benefits

In addition, innovation is a key consideration, in terms of promoting the continuous advancement of WELL and allowing project teams to achieve higher certification levels. There are five innovation features that each count as an optimization for any of the project types.

In summary, the age-old adage that the smallest changes can make a big impact rings true in the case of sustainability – the seemingly small measures implemented in green building processes are making all the difference. However, the importance of education, training, and the encouragement of occupant to implement best management practices for optimal sustainability cannot be underestimated.

Frances Graham,
Project Director

WELL is a performance-based system for measuring, certifying and monitoring features of the built environment that impact human health and well-being through seven concepts: air, water, nourishment, light, fitness, comfort and mind.

GLOBAL INSIGHT

How capital projects are responding to Life Sciences market trends

Global healthcare spending continues to increase dramatically and is projected to reach in excess of US$10 trillion by 2022.

This investment is driven in large part by the global increase in life expectancy, improved access to medicines and the growth of non-communicable diseases - most prominently cancer, heart disease and diabetes.

Contrary to popular perception, the Life Sciences sector covers a lot more than just pharmaceuticals. Beyond the top-tier pharmaceutical firms we all hear about, the core Life Sciences subsectors include medicine manufacturing, electromedical apparatus manufacturing, medical equipment and supplies manufacturing, and biological and chemical research and development.

In this diverse and highly-specialised group, one thing these businesses have in common is major capital requirements. Here are five trends that are shaping today's Life Sciences sector — and how they're affecting associated capital projects.

Cost is key

The life sciences industry as a whole continues to experience mounting pricing pressures, increasing access to drugs globally, growth in new innovations and therapies, and uncertain trade policies.

These forces are causing the industry to become more cost-focused. This increased focus is particularly evident in the industry's capital investments, which tend to be much more targeted than they were just a few years ago. For instance, the rush to build more factories has been replaced by a more patient approach, wherein companies are waiting until they have a new product that has gone through all phases of clinical trials and all levels of regulation before they commit to building a new facility.

Outsourcing non-core responsibilities

The outsourcing of key responsibilities is also becoming more common. For example, many life sciences companies have capital projects planned all over the world, meaning they will be spending a tremendous amount of capital over the next few years. However, these companies are simultaneously re-thinking their role in project delivery, choosing to focus more on the core operations of researching, manufacturing and selling their products. So, while their construction is increasing in number and size of projects their staffing is actually going down. This trend is most obviously manifested in the smaller in-house engineering and construction staffs we see today.

That doesn't mean that life sciences companies are eliminating their in-house capital management personnel entirely. Rather, many companies are moving to a hybrid execution model, leveraging a combination of internal and external resources. Overall though, the trend is clearly towards outsourcing project management responsibilities.

Expanding regulations

Regulations in the manufacturing of pharmaceutical products will continue to rise, as global regulators share information across borders and the entire industry relentlessly pursues product safety.

People are ingesting what is being manufactured, and the facility, its equipment, products and even the air quality in the rooms have got to be safe. Meeting these requirements means going through extensive testing and documentation. The process of commissioning and qualifying a facility to demonstrate safety and compliance to governmental regulatory agencies is already time- and resource-intensive, and as regulations continue to increase, so will this phase of a project.

New drugs and biologics

Another trend is heavy investment on behalf of many pharmaceutical companies in the research, development and manufacturing of biologics and other new cancer drugs.

Spending on new cancer drugs alone is expected to grow by more than 50% over the next few years, and the production of biologics, in particular — drugs that are derived in some way from living organisms, and have revolutionized the treatment of many cancers and chronic conditions such as multiple sclerosis, arthritis and rheumatoid arthritis, Crohn's disease and other auto-immune diseases — is expected to skyrocket over the coming several years.

Companies are waiting until they have a new product that has gone through all phases of clinical trials and all levels of regulation before they commit to building a new facility.

However, biologics and cancer treatments are expensive and time-consuming to research, test and produce, often taking many years and billions of dollars of investment before they hit the market.

Industry consolidation

Mergers and acquisitions continue to dominate headlines in the Life Sciences sector, with big pharma hunting for the next generation of medicines against declining returns on R&D. There has already been a large amount of consolidation in the industry, and experts are projecting that the larger mergers are likely to settle down. Consolidation among mid-sized manufacturers, however, especially among companies looking to take the lead in next-generation therapies or acquire producers that complement the company's core, will be the trend.

The life sciences industry continues to adapt and evolve to market conditions, a growing global population, increased regulations, stiff competition and various cost pressures. In this complex and dynamic industry, capital projects are a microcosm of healthcare's broader challenges.

Nigel Barnes, Director

Jeff Peragallo, Director

Mergers and acquisitions continue to dominate headlines in the Life Sciences sector, with big pharma hunting for the next generation of medicines against declining returns on R&D.

GLOBAL INSIGHT

How to build a data centre and keep the lights on

Data centres have gone from being almost hardly noticed to one of the most important pieces of infrastructure in the global digital economy. They host everything from financial records to Netflix movies.

As a result, data centres have become a multibillion-dollar industry, precisely because their role is so important. Designing, building and supporting data centres requires strategic planning and careful construction in order to keep clients' mission-critical data secure and available 24/7 - regardless of what it is.

There are many factors which must be addressed when designing and building a data centre. For starters, it's all about power - finding it and managing it.

Finding the power

Data centres require an incredible amount of electricity to operate and this electricity often requires the direct intervention of regional utilities in order to work. Energy infrastructure needs to be shifted, power lines need to be run and redundancies need to be established. The most secure data centres have two separate feeds from utilities, so that if something happens to one of the lines — like an unexpected squirrel attack — the centre doesn't immediately lose all of its functionality.

Coordinating that takes a lot of effort and often the clout of a large corporation in order to get anywhere. But even the big players need to check the policies of utilities and local governments in any area in which they are planning on building a data centre; they do this to ensure they will be able to establish those inputs. Because without that redundancy, data centres can be vulnerable to power outages that could result in not only the loss of critical customer data but also any negative impact on the brand of the data centre owner.

The price and availability of that power are also incredibly important considerations because a data centre is going to be a large draw at all times. With a significant amount of power going into computing, and even more going into cooling computers down, it's no surprise that data centres are using more than 1.8% of the power of the entire United States. Again, companies planning data centres need to work with local governments and utilities for subsidies and deals that can make that energy easier to afford.

Keeping the lights on

Much of the support infrastructure in data centres is focused on making sure that their power cannot be interrupted. Uninterruptible Power Supplies (UPS) -powerful batteries that can provide power almost instantaneously- are critical for this effort.

They ensure that during an emergency any power loss is returned in milliseconds, instead of seconds or minutes that could result in the loss of data or functionality for thousands of computer systems. But most UPS systems don't serve as back-up power for long. In other words, they simply don't have the kind of power storage capacity that it takes to power a data centre for more than a matter of minutes. In order to keep data centres fully running without utility power, data centre operators usually turn to large diesel-powered generators, stocked with 24-48 hour of fuel at all times.

All of this redundancy is required because of the incredible amount of energy that data centres use. But the other key factor in a data centre's success is the efficiency with which that energy is used. That starts with the organisational strategy used for cooling.

Staying cool

Data centres are carefully planned structures. Every square foot needs to contribute to the wider goals of powerful and efficient computing.

You can't just slam server racks together because their placement needs to fit in with the cooling system used to prevent overheating.

Data centres run hot, and today's advances in High-Performance Computing (HPC) mean that they are using as much as five times more energy than they used to. This makes a cooling solution one of the most important decisions that a data centre operator has to make.

By far the most common data centre cooling method involves airflow, using HVAC systems to control and lower the temperature as efficiently as possible.

In order to keep data centres fully running without utility power, data centre operators usually turn to large diesel-powered generators, stocked with 24-48 hour of fuel at all times.

Rise of liquid cooling

While liquid cooling has historically been the domain of enterprise mainframes and academic supercomputers, it is being deployed more and more in data centres. More demanding workloads driven by mobile, social media, AI and the IoT are leading to increased power demands. As such, data centre managers are scrambling to find more efficient alternatives to air-based cooling systems.

The liquid cooling approach can be hundreds of times more efficient and use significantly less power than typical HVAC cooling systems. But the data centre market is still waiting for some missing pieces of the puzzle, including industry standards for liquid-cooling solutions and an easy way for air-cooling data centres to make the transition without having to manage two cooling systems at once. Still, as the growing need for more efficient cooling shows no signs of slowing, liquid cooling will likely become the norm in years to come.

Building a data centre is about executing an extremely complex plan, with input from experts in wide-ranging fields. Firms thinking about building their own data centre should consult with experts who have dealt with their specific difficulties before to ensure that all of these core areas can be built without incident.

Modern data centres are planned down to the last wire on Building Information Management (BIM) applications and similar software, so that the outcome is as guaranteed as possible before the first wall is erected. Data centres are key arteries of the digital economy, funneling the data of the modern economy between consumers, companies, governments and citizens. That takes a lot of energy!

Eoin Byrne,
Associate

> **The data centre market is still waiting for some missing pieces of the puzzle, including industry standards for liquid-cooling solutions andan easy way for air-cooling data centres to make the transition without having to manage two cooling systems at once.**

GLOBAL INSIGHT

Workplaces of the future

The commercial environment has been transformed from the office-based workplace of the past to the more open and collaborative space we see today. And now, we are beginning to see another transformation.

According to Gensler, the workplace of the future requires a profound change in how design supports its varied forms, meaning the design industry will have to set aside its old ways to look at the working environment holistically.

There are significant changes happening in the workplace, with a younger workforce, surge in innovation-driven businesses, global transition towards working across geographic and demographic markets, and economic and cultural shifts are becoming the new norm.

The new generation of workers is looking for work spaces suited to conversation among a few people, and for a balance between focus and the need to interact. There is a need now for the office workspace to be reshaped to interact with the community, and for smarter spaces that attract young, creative people.

Redefining standards in space utilisation

Soaring real estate costs are driving higher density and greater utilisation of space. Many large companies are now forming global standards of office spaces, that are essentially a kit of parts to be adapted to different locations, such as tech hubs, easily configured offices, open-bench workstation neighbourhoods, and open network team areas.

According to the Ted Moudis & Associates 2018 workplace report, the square footage per person is staying the same; however, the number of offices has decreased, and the number of alternative seating continues to rise.

A strong focus on amenities and well-being

Companies are placing more value on creating alternative space for focus, meetings and amenities for employees. There is an increasing amount of space being dedicated to mental and physical well-being for their staff. This amenities focus is driving activity in the workplace and encouraging movement throughout the space. The Internet of Things is allowing integration and accessibility of technologies across multiple platforms, to facilitate agility.

Design that supports mental and physical restorative opportunities throughout the day to improve morale and increase productivity is a must. Companies are now more focused on creating spaces that reflect the brand and philosophy of the company.

Working from home

Working from home is a perennial debate - some companies embrace it and some abhor it. In 2013, Yahoo banned employees from working from home, stating "some of the best decisions and insights come from the hallway and cafeteria discussions, meeting new people, and impromptu team meetings". Speed and quality are often sacrificed when we work from home. Richard Branson from Virgin responded, "it was a backward step in an age when remote working is easier and more effective than ever". Google noted that as few as possible people work remotely, noting that "there is something magical about sharing meals, spending time together and noodling ideas".

Working from home is more common among full-time workers over 55, and those with dependent children. It encourages employees' work/life balance cutting down on commuting time. Although there is the fear that not being seen in the office may cut down on promotion opportunities, pay increases and lower performance evaluations. And so, the debate goes on, with no clear winner. Although, with the pressure on higher density, the greater utilisation of space and AI innovation, perhaps the pro-working-from-home lobby may win out in the end.

Private space versus open-space interactivity

The pursuit of efficiency is leading firms which were office-heavy to opt for a more shared, open, team-based workspace, and with paper disappearing, libraries, records and administrative functions are being consolidated to reduce the footprint. Support spaces are being consolidated to allow more space for amenities. Activity-based work environments provide new amenities and a wider range of workspace types, while reducing the total area of occupancy. The forecast is that there will be an increase in semi-enclosed and small focus rooms, less executive suites, an increase in USF (usable square footage) per work seat in activity-based work environments, and an increase in both employer and building-provided amenity and wellness spaces.

According to the Ted Moudis & Associates 2018 workplace report, the square footage per person is staying the same; however, the number of offices has decreased, and the number of alternative seating continues to rise.

More visibility and transparency with open perimeters, transparent walls and low partitions are the new norm, providing a more inviting and connected environment. Informal collaboration spaces and alternative settings are helping to provide privacy zones in place of private offices.

Employees are sitting in open spaces with greater choices of where and how to work, including benching and sit-to-stand desks. On the other hand, there is a growing number of people and companies who are now thinking that the old days of the private office was not so wrong after all, allowing the closing of the door to avoid interruptions. Open office space has taken that decision away from people, and even with headphones, it is tough to avoid distractions.

Ultimately, people are different. They come in at different times, have diverse requirements, socialise at different times and have their most productive hours at different times. So, what is the solution?

There are several ways of making the environment fit all tastes, with WorkDesign Magazine proposing the following key considerations for the workplace of the future:

- Flexibility is paramount
- Technology is the ultimate enabler
- Everything is connected, with fast, smart and integrated networks
- Personalization is prioritised
- Environmental threats necessitate change – Buildings & transportation need to reduce impact on environment and change to adapt to global landscape.

In summary, the workplaces of the future are a work in progress, with no shortage of ideas. It will be a rollercoaster ride to see what the future holds, but it is an exciting time to be involved in the commercial fit-out world.

Damien Coffey,
Director

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What we do

Our services are tailored for your project, delivering maximum efficiency from inception to completion. We specialise in key areas, to provide faster project delivery, greater cost efficiency and maximum value.

Project Management
Delivering project success through strategic planning and stringent controls.

Cost Management
Ensuring better value for money at every stage of the construction process.

Program Management
Managing a network of projects simultaneously in order to deliver program success.

Project Controls
Controlling every aspect of a project to ensure maximum performance and long-term success.

Procurement
Adopting the most appropriate strategy to suit both public and private sectors.

Supply Chain Management
Providing efficient logistic strategies to streamline the delivery of equipment and services.

Health and Safety
Assuring compliance, and providing design teams and clients with expert advice and independent review.

Consultancy
Providing professional, hands-on advice and guidance throughout every stage of your project.

Planning and Scheduling
Controlling every aspect of a project to ensure maximum performance leads to long-term success.

Our values

Over the years we have developed a way of working that ensures quality and consistency in how we operate. Our five core values inform what we do and how we do it:

Partnership

We are focused on our clients' goals and work closely with them to achieve the best possible results. We believe in collaboration. When we share our experiences and combine our expertise, we can achieve great things.

Progress

We believe in always moving things forward and finding better ways of working. We're not just focused on what we do but also on what we can achieve. We are driven by success – for our clients, our partners and each other.

Integrity

We are fair, open and ethical in everything we do. We challenge things we believe to be wrong and are open to being challenged by others. We take pride in the quality, accuracy and independence of our work.

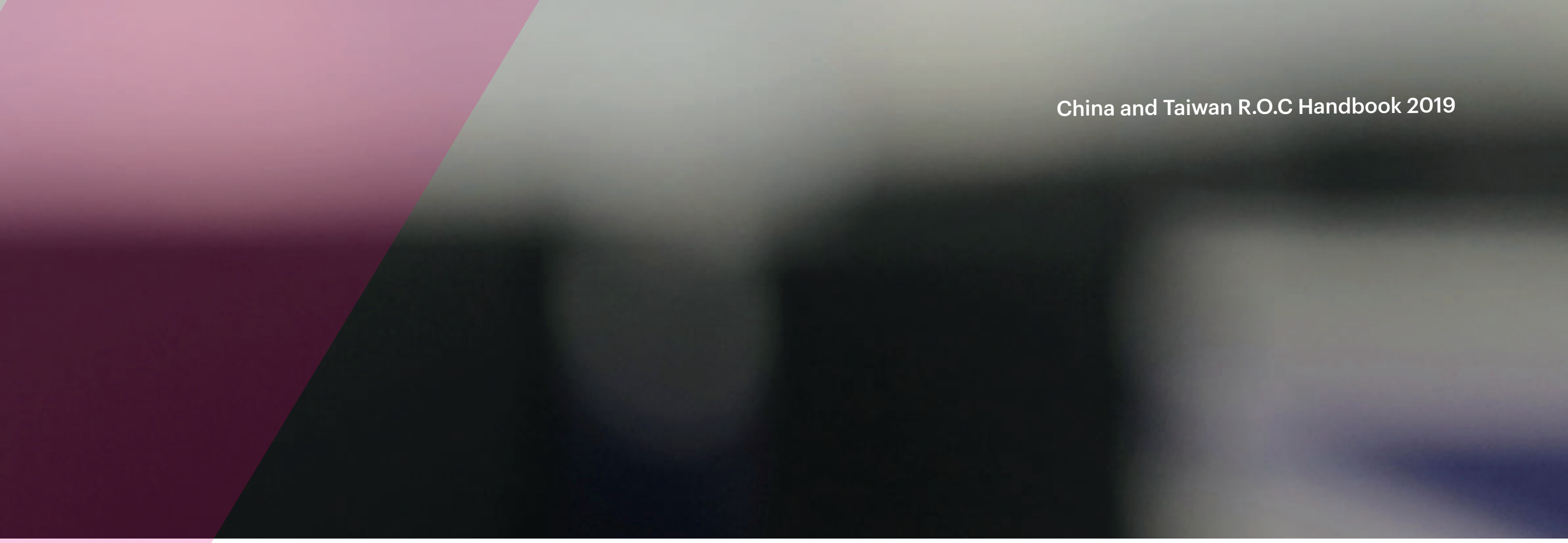
Resourcefulness

We work around the world, in diverse sectors and for clients with distinct ambitions. This requires us to act effectively and creatively in new and complicated situations. We rely on our individual and collective abilities to resolve any challenges we may face.

Long-term view

We believe in working sustainably, and so we build enduring relationships with our clients and partners. We work together in a way that is respectful and considerate of each other and the wider society in which we live.

Our culture



Our **bold ambition, honesty** and **confidence to deliver,** together with our commitment to cultivating **meaningful relationships** is what sets us apart.

Our distinctive culture has always played a key role in our success. As a business we want to be intentional in maintaining and working within the principles of our distinctive culture.

Own and empower

We have a highly developed sense of responsibility for identifying problems, finding solutions and executing with excellence. As individuals and teams, we are free (and encouraged) to exercise our judgement to reach our goals.

Connect for good

We are team players, collaborating globally and locally to deliver exceptional results. We encourage and nurture relational rather than transactional business relationships, continuously building a totally inclusive working environment.

Embrace clarity

Our emphasis is on direct communication - our preference is always face-to-face, or to pick up the phone. We express ourselves clearly, honestly and effectively in our communication. We are pro-active in inviting and providing actionable feedback.

Lead by example

We believe in mentoring as a way to strengthen and develop ourselves and provide the resources, environment and flexibility required. We practice 'reverse mentoring' between junior and senior employees - every single person in Linesight has something to teach.

Bold ambition

We continuously develop our global team, with a shared drive and ambition to deliver exceptional results. We believe success is winning unreserved recommendations for exceptional work and impact. We always work with an eye on the future, whilst delivering on our commitments and objectives.

2018 A year in review

JANUARY

We launched our Purpose Built Student Accommodation (PBSA) Report at a private symposium in Dublin.

FEBRUARY

Patrick Ryan, Managing Director USA East Region, joined the panel at the Enterprise Ireland Leadership 4 Growth Programme, at the Consulate General of Ireland in New York.

MARCH

Celebrating International Women's Day across the globe. Our colleagues in Dubai showing their creative side!

JULY

Paul Brady took part in the Etape Du Tour, an annual amateur race on one stage of the Tour de France.

AUGUST

Richard Joyce, Managing Director, Linesight Ireland, celebrated 30 years in Linesight!

SEPTEMBER

14 members of the Linesight team from around the globe took on the formidable 700km Paris2Nice cycle, in aid of the Irish Youth Foundation.

APRIL

Shay Dahan, Director of our Israel operations, ran 500km across Israel in eight days to raise funds for Krembo Wings, a youth movement for children with special needs.

MAY

Des O'Broin became the fifth member of the Linesight team to be appointed President of the Society of Chartered Surveyors Ireland (SCSI).

JUNE

The appointment of our new Country Director for India coincides with the opening of our new office in Mumbai.

OCTOBER

Linesight teams from Dublin, New York and Singapore took on the Run in the Dark challenge in aid of the Mark Pollock Trust.

NOVEMBER

We marked the launch of our Build-to-rent (BTR) research report, with a breakfast briefing in Dublin that drew in over 70 high-profile industry stakeholders.

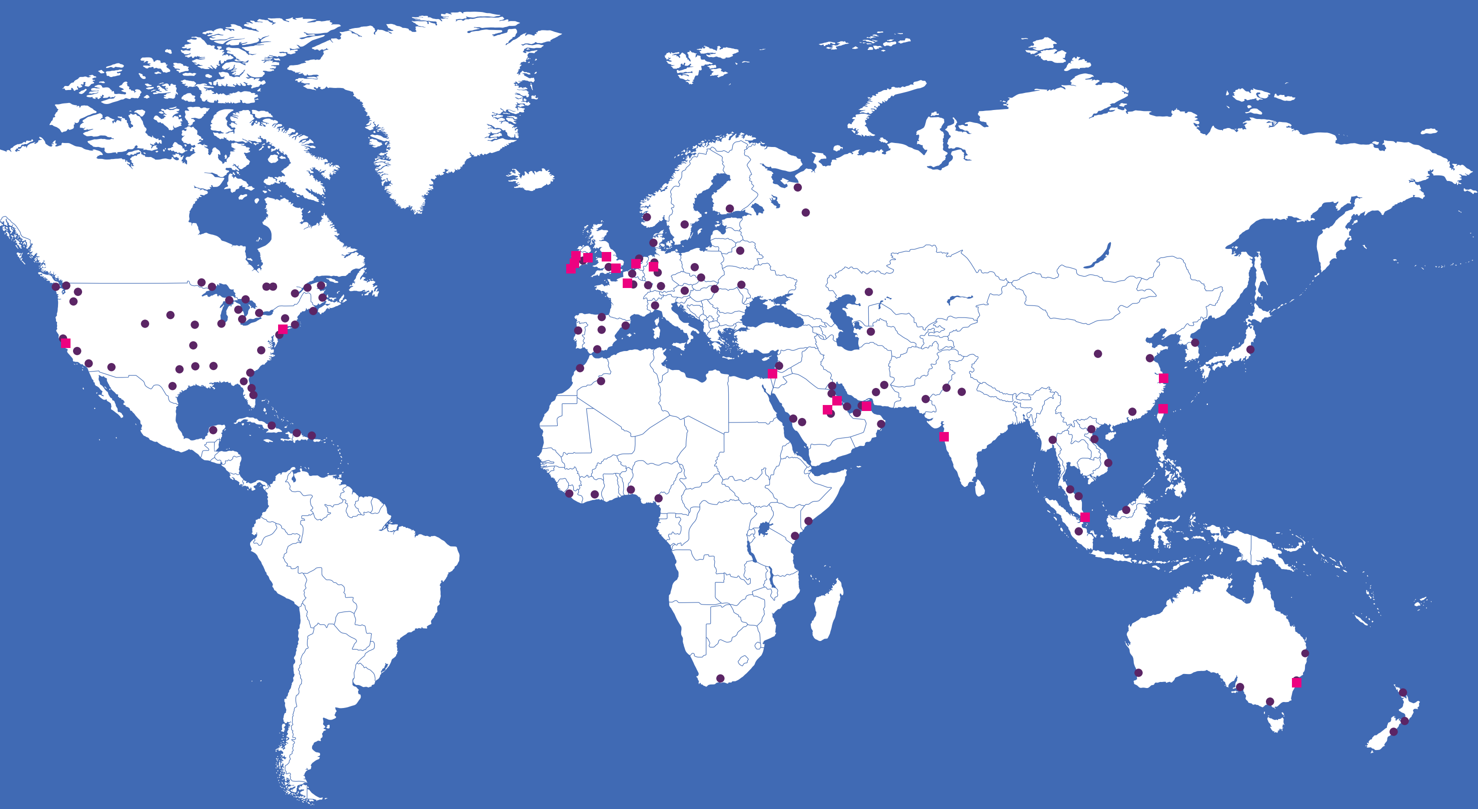
DECEMBER

A number of our colleagues celebrated passing the APC to become Chartered Quantity Surveyors.

Working with you wherever you are

With staff located across Europe, MENA, Asia Pacific and the USA, our reach is truly global. We have delivered projects in over 40 countries and are always exploring new areas of opportunity. We offer first-class consultancy on major projects across 13 specialist sectors, and we have developed a broad portfolio of innovative projects in every region.

- Commercial Development
- Commercial Fit-Out
- Data Centres
- Education
- Food and Beverage
- Healthcare
- High-Tech Industrial
- Hospitality
- Life Sciences
- Residential
- Retail
- Student Accommodation
- Transportation and Infrastructure



Our offices

Asia Pacific

Singapore
150 Cecil Street
#05-01
Singapore 069543
T: +65 6801 4540

Shanghai
Unit 819 8F Building 2
No 1196 Century Avenue
Shanghai 200120 PRC
T: +86 21 6043 3695

Taipei
11F-5 No 162 Sec 4
Zhongxiao E Rd Da'an Dist
Taipei City,
106 Taiwan (ROC)
T: +886 906 179382

Sydney
Level 5
131 Macquarie Street
Sydney NSW 2000
T: +61 2 8278 9500

Mumbai
Unit No 902
Maithili Signet
Sector 30A Vashi
Navi Mumbai 400705
T: +91 22 49766744

North America

New York
286 Madison Avenue
Suite 602
NY 10017
T: +1 646 802 9900

San Francisco
582 Market Street
Hobart Building
San Francisco
CA 94104
T: +1 415 343 2434

MENA

Bahrain
Building No 655
Road 3614
Al Seef Area
T: +973 17 746 892

Dubai
6th Floor
1 Lake Plaza Tower
PO Box 11497 Dubai
T: +971 4 432 3831

Riyadh
5th Floor Office 503
Olaya Street
Riyadh 11517
T: +966 11 460 4006

Europe

London
2nd Floor
27-29 Cursitor Street
London EC4A 1LT
T: +44 203 875 1770

Manchester
Peter House
Oxford Street
Manchester M1 5AN
T: +44 161 618 1811

Paris
9/11 Allée de l'Arche
Paris La Défense
92671 Paris
T: +33 1 70 92 37 91

Dusseldorf
4th Floor
Konigsallee 92A
40212 Dusseldorf
T: +49 211 5403 9615

The Hague
11th Floor
Koningin Julianaplein 10
2595 AA The Hague
T: +317 08 918 467

Tel Aviv
12 Abba Hillel Street
Ayalon House
Ramat-Gan 5250606
T: +972 3 754 1289

Ireland

Dublin
Hoban House
Haddington Road
Dublin 4
T: +353 1 661 4711

Cork
VHI House
70 South Mall
Cork
T: +353 21 4274 474

Limerick
Linesight House
6 Hartstonge Street
Limerick
T: +353 61 493 515

Galway
Block 10
Galway Technology Park
Parkmore Galway
T: +353 91 734 005

20 offices

150+ project locations

Acknowledgements

A special thank you to all those involved in this year's publication.

Editorial Team

Derry Scully, Naomi Carroll, Niall Doran and Claire O'Broin.

Contributors

Nigel Barnes is Director of Life Sciences EMEA at Linesight. Based in London, Nigel has over 30 years' experience in capital project execution, from inception to start up, for both the client and consulting sectors for large bluechip process manufacturing companies.

Eoin Byrne is an Associate at Linesight, providing cost management services in the data centre sector. Based in Sacramento, Eoin is a Chartered Surveyor with over nine years' professional experience in construction cost and project management.

Damien Coffey is a Director of Project Management at Linesight. Based in San Francisco, Damien has over 35 years' experience across a variety of sectors working on a diverse range of projects, including data centres, mixed-use and leisure developments.

Frances Graham is a Project Director at Linesight. Based in New York, Frances has over 35 years' experience in the architecture and construction industry. With significant experience in the Retail sector, she holds the LEED AP Interior Design and Construction credential, as well as being well-versed on WELL.

Kim Hegarty is an Associate Director at Linesight, providing cost management services across a variety of sectors. Based in Dublin, Kim is a Chartered Surveyor with over 25 years' industry experience with particular experience in commercial projects, both shell and core, and fit-out.

Jeff Peragallo is Director of Life Sciences USA at Linesight. Based in New York, he has over 30 years' experience in the Life Sciences sector with a unique blend of technical knowledge and commercial Life Sciences experience.

Linesight