US CHINA
SERIES

China’s Data Centers

At a much earlier stage of development in the sector, China has nonetheless been growing its data center infrastructure at a rapid pace. A recent US-China Series discussion was centered around the country’s data centers and the market trends surrounding it, capital flows into this sector, and the upcoming disruptions to data center infrastructure. The discussion featured an old friend of US-China Series

Robert Ciemniak — Founder, Robotic Online Intelligence and Real Estate Foresight

Robert has been a supporter of US-China Series since its inception, and I can confidently say that Robert’s data on the Chinese Residential Property is as good as any I have seen. His insights into commercial and industrial projects are well sort after. It seems like a natural progression to take his data-driven approach to the Chinese commercial / industrial market's hottest segment, data centers.

We will discuss market trends, data center strategies, capital flows into the Chinese data center sector, environmental concerns and disruption of new technologies. We get into the details of the difference between the US and Chinese data center industries, entry barriers, and the dominant players.

The Chinese data center incumbents such as Chindata, 21 Vianet, and GSD are relatively small when compared to US peers but have been growing at a rapid pace. China’s data center market has tripled since 2015 and shows no signs of slowing down.

Robert and I spend considerable time discussing technology nationalism and data security concerns keeping the Chinese market dominated by local players. This has been a recurring theme where China continues to encourage the development of indigenous technologies where local incumbents will dominate and ensure Beijing's security requirements are maintained at all times.

Samm Sack’s of the Yale Law School coined the phrase “The Digital Iron Curtain,” a reference to an inward-looking China becoming more and more reliant on homegrown technologies. The storage of data could not be more central to this thinking, and hence the barriers to entry for foreign participants will grow over time, leaving the local data center providers to divvy up the spoils.

By **Paul Krake**, paul@viewfromthepeak.com.hk;
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China's Data Centers: An Overview

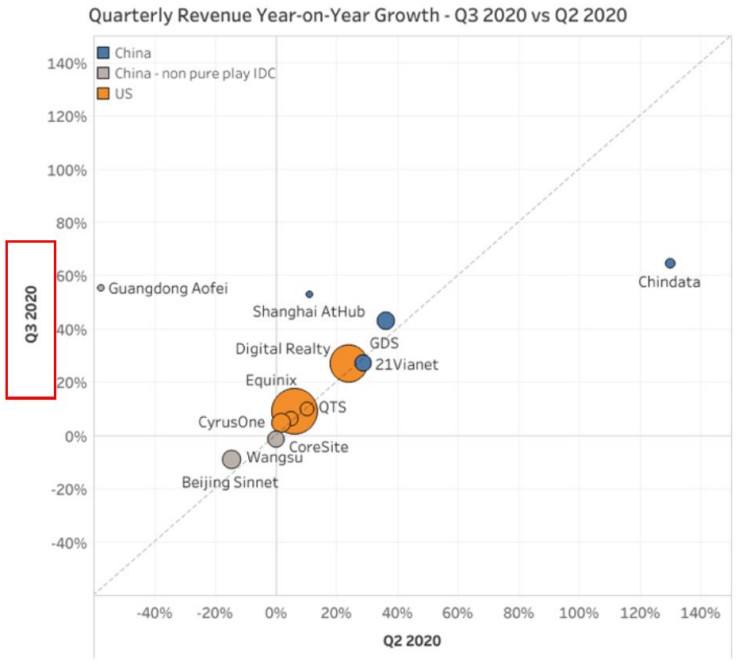
Robert Ciemniak: Data centers have been at the forefront of conversations for the past few years. From a real estate perspective, investors were looking for new sources of yield, as other sectors faced smaller margins and higher competition.

While data centers are a global phenomenon, China's path was marked by a new infrastructure push that took off last March, an idea that had come about at the end of 2018. The idea was that this infrastructure would underpin technologies from AI to 5G, autonomous vehicles, and e-commerce. Indeed, data generated from any domain needs to be housed, and China's push in various technological developments have created the demand for data storage.

To understand the field of data centers, it's crucial to compare China's development with the US:

- Whereas data centers in the US have transferred ownership from telecoms to specialist providers, Chinese telecoms play a significant role on the supply side.
- China's internet growth has been largely consumer-driven, whereas the US is led by enterprise tech. The latter's example is also one in which many look for potential ways to boost China's growth in terms of digitizing enterprises.
- Regulatory barriers and licenses required to possess internet data centers makes foreign ownership of data infrastructure more complicated in China.

KEY **CARRIER-NEUTRAL** PLAYERS IN CHINA vs US



Source: Analysis by Real Estate Foresight based on data from public sources, company filings and disclosure.
The bubble size refers to the quarterly absolute revenue figures for Q3 2020.

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- While the US is more developed in this area, China's growth has been very intense. Our data shows that China's data center growth on a quarter-to-quarter basis would be the equivalent to year-on-year growth in the US, which is true especially among the big three of Chinese data center providers – Chindata, GDS, and Vianet.

On a global level, data centers' main driver is cloud computing, led by companies such as Amazon, Google, and Alibaba. Hence, it's interesting to understand the direction of cloud enterprises such as Alibaba Cloud and other actual clients of data centers, apart from major companies such as Alibaba and Tencent. What are especially noteworthy are internet companies such as ByteDance, as well as financial institutions, e-commerce, and state-owned enterprises, all of whom are undergoing digitization.

Tenants: Cloud is a key driver, but it is not the only one

Robert and the team at Real Estate Foresight compiled the following list of tenants for the major data center providers

Cloud Providers	Alibaba, Tencent, Kingsoft Cloud, Baidu, Huawei
Retail/ E-commerce	Meituan-Dianping , JD.com, Pinduoduo , Suning, VIP.com
Internet/ software	ByteDance, Sohu, Sina, Trip.com
Video/ Streaming	iQIYI, Youku, Bilibili, Douyu, Inke
Gaming	NetEase, Shanda Group, Perfect World, Ourgame, Linekong
Finance	Ping An Bank, China Everbright Bank, China Merchants Securities, Haitong Securities, ICBC
Media	CCTV, Workers' Daily, China Daily, Xinhua News, People's Daily
Manufacturing	Xiaomi, Oppo, Toyota, COFCO, Tesla
Government	China Meteorological Administration, Ministry of Education, Ministry of Finance, China Railway Corporation, China National Intellectual Property Administration

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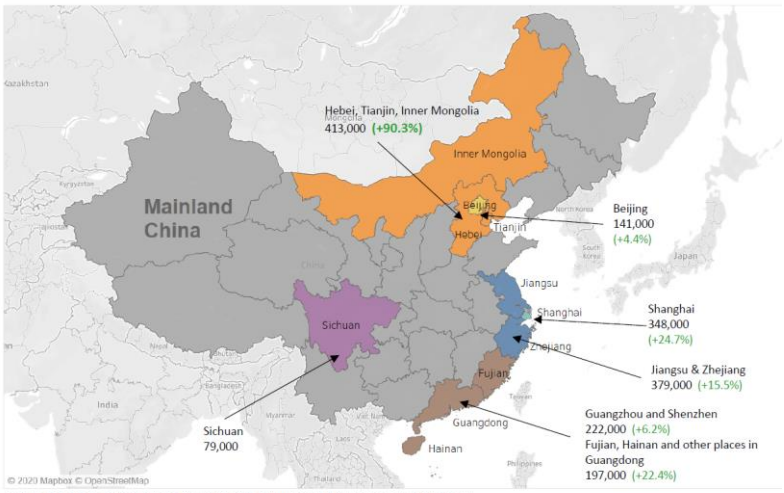
Data Centers and Geography

In terms of their geographical locations, data centers are spread out and can be classified into several categories:

- Centers located in or around tier-one cities such as Beijing and Shanghai have seen the most vigorous growth.
- Data centers also increasingly find themselves on the outer edges of these cities – Kunshan and Changshu in the case of Shanghai, for instance, or Langfang for Beijing — given the energy-intensive nature of data centers and power quotas in the country.
- More remote locations such as Inner Mongolia also play host to data centers. While latency over long distances is a consideration, the use of fiber makes it less of a concern. These locations are attractive in serving background data storage;
- Finally, emerging centers previously under-the-radar are also present in the example of cities such as Chongqing or Chengdu.

Concentration of Data Centers in Select Provinces in China (2019) by Number of Cabinets



Source: Based on data from Ministry of Industry and Information Technology
Note: no data reported for the major data center region in Gui'an / Guizhou

Based on data disclosed, the most significant growth was seen in the Beijing area, and in the case of Inner Mongolia, located around 200 kilometers away from Beijing, geographically, it is quite close.

Understanding Data Center Strategies

To understand the different players behind data centers and their strategies, it's helpful to keep in mind the following criteria:

- Providers are either purchasing industrial land and developing everything themselves, or they are leasing space from others and providing data center services. The scope of

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such services – such as IT, cloud, or other value-added services – are also questions to keep in mind.
- Some centers' business models may be built to serve large clients such as Alibaba and Tencent, while others are constructed to serve multiple players.
- Geographic location, as outlined previously, is also an essential factor, as well as understanding the other differing metrics used to measure data centers: sheer space in square meters, cost of electricity, as well as participants of the market who often are involved in complex, multi-party relationships

The data center rental market has been seen as relatively stable, with steady growth and investments. Capital has been flowing in, where Blackstone and Bain Capital had investments in Vianet and Chindata, respectively, early on. Private equity is one side as well, where funds invest in developers of specific projects, some of which are large scale, others are local deals.

All in all, around 50 significant companies in China are connected to data centers, excluding government entities and telecoms, of which 30 are listed. However, for the most part, these companies are also in other businesses, from system integration and television networks to the steel industry.

Disruption to Data Center Technology

Technologically-driven data centers are prone to disruption from technology, though its extent remains unknown. This could occur in the context of a greater need for energy efficiency and concern for electricity consumption. Examples include experimental undersea data centers carried out by Microsoft. The expansion of data centers is often more so underpinned by technological revolution rather than physical expansion in space in the way that real estate does. Powerful computing chips, for instance, could increase the efficiency of space used for data storage.

Some key takeaways:

- In the China-specific context, the push for new data infrastructure is critical, as it is often seen as the 21st century's version of manufacturing.
- While local players are emerging, the barriers to entry for foreigners are very high. At the same time, a number of viable strategies could be pursued in the form highlighted above – through differing levels of asset involvement, sector, etc.
- Finding the demand-supply balance is important, but it is difficult to gauge potential oversupply. Data center developments could benefit other sectors, such as the residential property market because the existence of infrastructure and investment lends itself to development.

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Data Centers: Investment Composition

Discuss the proportion of data centers built and used as investment vehicles by both domestic and international investors, versus dedicated use of centers from Chinese tech companies such as Baidu, Tencent, and Alibaba.

Robert Ciemniak: In China, the exact distribution between cloud companies building their own data centers and space provided by individual data centers is unclear, though, in the US, that seems to be roughly equal.

Among individual cloud companies, Kingsoft Cloud mostly utilizes data centers built by other firms. This is a problematic area to track since phrases such as "our" data centers can involve different levels of involvement and management on a case-by-case basis. Yet, given the growth in data center providers and the growth of large cloud companies, it can be said that the latter pursues the external strategy of utilizing external data centers.

Chinese Data Centers and The World

Can Chinese data centers expand their business abroad, or US providers enter the Chinese market? Discuss the role of techno-nationalism in limiting companies to their domestic markets.

Robert Ciemniak: The restrictions limiting foreign ownership of data centers in China are very clear. While individuals could participate in the market through variable interest entities or other investment platforms, these data centers are not directly accessible to foreign management. Amazon had to sell its data centers several years ago, and US companies essentially partner with Chinese companies such as Vianet or Beijing Sinnet to deliver services. While the economic opportunities exist, the technical legal structure is complicated.

Do top service providers such as Inspur or H3C have global footprints, and how do their cloud businesses conflict with the Chinese government?

Robert Ciemniak: In general, infrastructure goes where cloud providers such as Alibaba go; the same holds true for US cloud providers who serve US firms' expansion in other places. Undoubtedly, Chinese companies are expanding in Southeast Asia, a natural destination as e-commerce and cloud services enter that market. Similarly, companies such as Zoom and ByteDance and their data infrastructures also serve as interesting case studies.

From a national security perspective that limits US firms from transferring data from China to the US, does that create a nationalistic or inward-looking data storage approach?

Robert Ciemniak: Indeed, there are issues surrounding this type of data, but quantitatively speaking, sensitive data forms a tiny portion of the overall market. However, it is a significant possibility posed to foreign investors.

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Merging Business Models

Do you foresee a merger of business models over time, or will the industry as it has involved in China remain distinctly Chinese?

Robert Ciemniak: Such mergers would depend on the specific sector. In the case of state-owned telecoms, their significance in infrastructure means it is hard to imagine a scenario in which they would play a lesser role, and the same holds for the largest operational data centers and other government-related entities. But convergence could take place in the private sector, as it has done so in the US and worldwide. While there could be a slowdown in the expansion of data centers — as it has happened in the US — given a focus on greater efficiency, the same has not taken place in China. This transition would be something to look for, as constraints around electricity use and carbon targets could shift the focus to optimization rather than expansion.

Energy and Environmental Considerations

Could environmental concerns limit the expansion of data centers within China, or would the same concerns accelerate innovations around optimization?

Robert Ciemniak: As an optimist, I see environmental concerns as a driver of innovation. Global data has shown that internet traffic and data centers have grown multifold over the past few years, while electricity use stayed flat. The same may happen in China. Almost all government mandates from the local and provincial levels contain power usage effectiveness (PUE) targets decreasing, which is a key factor that authorities pay attention to.

How important are latency issues in determining the location of data centers, and what are the different costs associated with different locations?

Robert Ciemniak: It depends on the industry. Latency may matter for applications such as video streaming, e-commerce transactions, and sensitive financial services. Since 2018, the Ministry of Information and Industry Technology has been releasing guidelines for setting up infrastructure that preserves a certain latency level.

When it comes to pricing, there is little difference between more remote locations such as Inner Mongolia versus the suburbs of Beijing, but the costs of such centers are contingent on electricity costs, and local government subsidies can influence that. Policy considerations may mean that local authorities may want to subsidize costs to attract data centers, and so a natural segmentation occurs with multiple locations featuring different characteristics.

What is the distribution of different data center models, and is it dependent on geography?

Robert Ciemniak: In some examples that have been made public, such as GDS Holdings, data center locations tend to be on either the edges of towns or lower-tier cities. In general, large data

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centers servicing large tend to be outside tier-one cities, and they tend not to be in remote places such as Inner Mongolia.

On the other hand, smaller or colocations tend to be in city centers, such as smaller financial services firms co-locating with other firms. Overall though, the quantitative distribution of these places remains a question.

Supply-Demand for Data Centers

Given the opaqueness of pricing and different methodologies that firms use, how can forward supply-demand dynamics be quantified, and what is the prospect of potential oversupply?

Robert Ciemniak: I would say that there appears to be an oversupply in the last few years, at least according to aggregate figures. However, there are also signs that demand far outpaces supply in specific sub-segments and projects — this could be characterized as a typical China phenomenon, similar to that of the residential market. Like other sectors, inefficiency may exist among specific projects. At the moment, the evidence suggests that some market segments may be struggling while others, in targeted sectors, are expanding at a rapid clip.

Government incentives for data centers helps explain the justification for building big data centers with low utilization rates. Indeed, government subsidies take on a longer-term outlook for the potential economic returns of data centers; and while some would keep track of the growth of Alibaba and similar companies as primary drivers of growth.

Conclusion

Despite the profound economic and societal differences between the United States and China, some of the innovation themes are universal. While the globe will be a battleground for technology standards, indigenous technology sectors will dominate ubiquitous technologies such as 5G and cloud. Data centers will be one space where overriding concerns about data security will ensure that foreign engagement will be nothing but token, if at all. While the EU-China Comprehensive Agreement on Investment mentions cloud and data centers, practically it is impossible to see how Chinese firms don't dominate the Chinese data center landscape.

Chindata, GDS, and Vianet will continue to grow and provide exposure and yield to real estate investors hungry for yield and struggling to find it in more saturated commercial and industrial sectors. If consistent growth is an investing priority, Chinese data centers should provide it.

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