

Innovation in the inventory era – digital transformation of the real estate industry in the Greater Bay Area

GBA Prop-tech White Paper
September 2022



Urban Land
Institute

EY 安永
Building a better
working world





Table of contents

1. Executive summary	5
2. About the report	7
Research background	7
Data sources	9
3. The concept of prop-tech and its ecosystem	12
The concept of prop-tech	12
The prop-tech investment market in Greater China	14
An overview of the prop-tech ecosystem	16
4. Real estate industry trends in the GBA	21
At the dawn of the inventory era, leading real estate companies are gearing up on technology innovation and digital capabilities	21
The main reasons for prop-tech application and digital transformation	26
5. Prop-tech and digital transformation readiness in the GBA	27
Prop-tech is on the agenda for strategic transformation	27
Nearly half of the GBA enterprises have entered the implementation stage for prop-tech	28
Corporate management optimization has become the mainstream application for GBA enterprises	29
GBA enterprises favor point solutions	30
Augment organizational capabilities for technology implementation	32
Technology will unleash the potential of enterprises and tap the hidden value of the industry	36
6. Key areas of technology innovation and digital transformation in the GBA	38
Smart planning and design	39
Smart construction	41
Smart buildings and space operation	44
Smart asset management	47



Table of contents

7. Future outlook and recommendations	50
Develop a systematic digital innovation strategy	50
Reshape the operating model to complement the innovation strategy	51
Establish a broad technology partnership ecosystem	53
8. About us	54
ULI and EY GBA	54

Executive summary

Prop-tech has become the main driving force for the latest real estate industry revolution and enterprise transformation. It has garnered significant interest as the real estate industry enters the era of inventory management. Under the dual pressures of China's tightening housing policy and rising operation costs, real estate enterprises must break new ground for growth, entailing new approaches in management and operation. Meanwhile, demands from epidemic control, remote work and the overall trends in data integration have catalyzed the rapid growth of prop-tech. This "new normal" has given the impetus for enterprises to undergo digital transformation.

The Greater Bay Area ("GBA") comprises the core cities including Hong Kong, Shenzhen and Guangzhou. It is one of the most developed areas in China, with established experience in leveraging development of the real estate industry to boost domestic demand. Rapid development of the real estate industry has resulted in large inventory, as such, management of existing inventory has become an industry-wide concern.

The GBA is envisioned to drive technology and innovation. Where new ideas emerge and technology develops, the GBA presents tremendous potential for the real estate sector with the increasing applicability of artificial intelligence (AI), Internet of Things (IoT), blockchain and other emerging technologies.

However, many enterprises have not fully grasped the potential and value of prop-tech. We present this white paper with the aim to explore how GBA enterprises may focus on prop-tech innovation and digital transformation as a practical means to respond to the challenges and opportunities of the day. The Urban Land Institute ("ULI") and Ernst & Young Transactions Ltd. ("EY GBA") have co-developed this white paper based on the feedback of 98 companies from our survey and interactive workshops. In addition, we have conducted 21 one-on-one interviews with company executives. The following content highlights the research outcome.

Prop-tech has become a hot topic within corporate management

79% of the surveyed companies stated that prop-tech is of high strategic importance to them, with 88% of the interviewed top management replying that prop-tech is pivotal. Horizontal analysis of the survey results has yielded the conclusion that, the more advanced a given company is in the use of prop-tech, the more pronounced role its senior management has in leading and driving such transformation.

Nearly half of the surveyed GBA companies have adopted at least one type of prop-tech; the mainstream application is asset and portfolio management tools

About 44% of the surveyed companies have adopted at least one prop-tech solution, while about 23% are in the early stage of evaluating or piloting solutions. Technological tools and solutions are gaining widespread industry acceptance but have not yet transitioned from early adoption to full incorporation by the market. Our survey shows that 60% of the interviewed companies have applied management tools, a reflection of the crucial role of technology in automating internal processes and optimizing asset and portfolio management. However, in the fields of construction and building management, the penetration rate of technology remains insufficient, showing that enterprises are not yet fully committed.

Integration of legacy and new systems and talent shortages are the main implementation challenges

Integration of legacy and new systems is the major challenge encountered when applying prop-tech. This challenge results from the lack of clear industry standards and integrated products in the market. The next major challenge is the shortage of prop-tech talent. Enterprises need more and more interdisciplinary talent with business, technology and project management backgrounds to participate in the industry transformation.



"Information and cybersecurity" and "Data management" are most valued by enterprises in the GBA

About 85% of the surveyed companies indicated that information and cybersecurity are crucial in prop-tech applications, while 78% of them consider data management capabilities to be of high importance. However, based on the self-assessment of organizational competencies and competitiveness, only about 40% (for information and cybersecurity) and 30% (for data management) of the companies believe that their organizational competencies are higher than the industry average. This shows that, in the process of digital transformation, enterprises in the GBA must look to enhance their soft capabilities and technical infrastructure in order to ensure successful implementation of prop-tech.

In the upcoming five years, AI, big data analytics and 5G will continue to impact the real estate revolution

The majority of the interviewed companies expect that AI, big data analytics and 5G will significantly impact the real estate industry in the next five years. As there is a rising trend in the prop-tech investment market in Greater China, AI and big data analytics have been the leading investments in recent years. In particular, AI has seen investment momentum over the past three years.

Most companies expect to utilize prop-tech to further improve operational efficiency and optimize business decisions

The surveyed companies express an upbeat attitude toward the impact of technology on the real estate industry. About 46% of the surveyed companies expect that emerging technologies will further improve operational efficiency, thereby raising the effectiveness of asset management. About 22% of them agree that big data analytics would enable more insightful business decisions through extensive market intelligence and user behavior analytics.

2 About the report

Research background

The urbanization process in China has peaked in recent years and slowed down as the real estate sector has shifted from development-oriented to inventory-oriented. In 2021, the State Council unveiled China's 14th Five-Year Plan for the Digital Economy, which promotes the full expansion of digital technology into all areas of economic, social and industrial development. The policy envisions the innovation and integration of digital technology and its versatile application in business, and pronounces the foundation for digitalization of the real estate industry.

Prop-tech as the main theme

The real estate industry plays a crucial role in China's national economy as it constitutes a large market share and involves many upstream and downstream enterprises. Digital transformation of the real estate industry is an important measure in the drive for national digital economy construction. 5G, AI, blockchain, big data analytics, digital twin and other emerging technologies are reaching all aspects of the real estate industry, facilitating cost reduction and enhancing company competitiveness. However, at this early stage, digital transformation is confronted with various problems including lack of a principled value system and unclear application of both technology and standards for prop-tech. As a result, most enterprises remain conservative toward adoption of prop-tech. This white paper addresses many aspects of prop-tech's ecosystem. By drawing upon the viewpoints of leading industry participants, we hope to bridge the gaps in industry understanding.

Focus on the GBA

According to the Global Innovation Index 2021 of the World Intellectual Property Organization (WIPO), among the top 100 technology city clusters across the globe, the Shenzhen - Guangzhou - Hong Kong cluster ranks second, right after the Tokyo - Yokohama region in Japan. The process of building a smart city in the GBA presents enormous opportunities for prop-tech. The imperative of quickly transforming traditional cities into thriving metropolises, and furthermore to fulfil the vision of the "one-hour living circle," bears significant promise for prop-tech application. In addition, talent working for high-tech industries in the GBA will demand high living standards in the area, thus encouraging the construction of new residential, working and leisure spaces. The same goes for enterprises, which will need spatial designs that are conducive to operational efficiency. The GBA will therefore rise as the prime location for testing prop-tech's applicability in the integration of space use and technology solutions.

In light of this research background, ULI and EY GBA have co-developed this white paper, with the main themes on technology innovation and digital transformation of the real estate industry in the GBA. In this white paper we will address the current status and future opportunities of the prop-tech industry in the GBA. We hope that it will inform traditional real estate participants in their efforts to meet the needs of the inventory era by undergoing digital transformation.



Opinions, experience, self-assessment and recommendations

We collected online surveys and interactive workshop results from 98 companies, conducted 21 one-on-one interviews with senior management, and carried out leading case studies to understand the current status of prop-tech applications in the GBA. The research scope covers company strategy, technology application status, organizational capabilities and challenges of execution. Based on the key findings, we will unveil the overall situation in prop-tech application, identify the major areas of digital transformation and suggest potential improvement.

First-hand insights from business executives

To gain in-depth expert opinions on the digital, intelligent and sustainable development of the real estate sector, and to gather leading practice insights, we invited senior executives (including CEOs, CSOs, CFOs and regional general managers) to participate in one-on-one interviews. Our survey results show that emerging technologies provide superior experience to both operators and end users across the entire value chain. From construction and transaction to operation, business performance has been enhanced by upgrading existing operating models. Meanwhile, leadership plays a crucial role in accelerating digital transformation, implementing technology innovation strategies and unleashing the full potential of prop-tech. However, a capability gap exists among surveyed industry players.

A note of thanks to the interviewed companies for their collaboration and contribution

With the perspectives and insights of the interviewed executives, we mapped out the current status and future trends of prop-tech applications in the GBA. Real estate developers, technology companies and investors in the GBA are increasingly mindful of technology innovation and digital transformation as they outline their technology application blueprint. Their efforts will be key to a better industrial ecosystem in the future.



Data sources

Survey data from the questionnaire for 84 enterprises

The survey respondents mainly consist of middle to top management of enterprises headquartered in the GBA, or companies with significant business presence in the region. The survey collects insights from industry leaders on topics such as the level of maturity in industry prop-tech application and digitalization. Respondents had the opportunity to thoroughly consider issues in the strategic priority of prop-tech, its application and implementation methodology, their self-assessment of the company's competency level in key organizational capabilities and recommendations for the government. In this white paper, we will provide a comprehensive analysis of the survey.

In-depth qualitative interviews with 21 company executives

In addition, we conducted in-depth interviews to understand the industry leaders' experience in the application of emerging technology throughout the real estate value chain. In these conversations, we noticed that companies are actively adopting various technological solutions both by in-house development and collaboration with technology providers. Their goal is to improve operational efficiency and provide value-added services to end users. Furthermore, with a view to meet the policy goals of carbon peak and carbon neutrality, companies have extended efforts in energy management and renewable energy usage by procuring green building materials and investing in green construction technology. They are keen to meet the objectives of energy conservation, emissions standards and sustainability.

We will also present leading case analyses from local private, state-owned and multinational enterprises in the GBA and compare their experiences in prop-tech application. The case studies show the initial intentions and considerations, challenges and solutions to the strategic initiative.

Interactive online workshops

We organized online interactive workshops to collect the participants' views on prop-tech's value proposition. In these workshops we discussed prop-tech application challenges as well as technology-driven opportunities.

Proprietary database of prop-tech investment

As a supplement to the survey and interviews, EY's proprietary Embryonic Database was used for understanding the prop-tech investment market in Greater China (including Hong Kong and Macau) in the past 10 years. Statistics on the transaction frequency and value of prop-tech investment will be demonstrated in this report.



Our qualitative and quantitative analyses show the industry leaders' collective insights into the current and future development trends of prop-tech application in the GBA. Among them, 71%, 25% and 12% of the data come from surveys, executive interviews and interactive workshops respectively, a reflection of diversity in data sources.

The respondents are mainly GBA industry participants

58% of the respondents are from enterprises headquartered in the GBA. The rest of them have significant business presence in the region. They are participants in the key real estate value chain sectors of real estate investment, planning and design, and construction and operation. Their portfolios include commercial and residential real estate, office buildings, hotels, and industrial parks, etc.

More than half of the respondents hold mid-level to top management positions in their companies

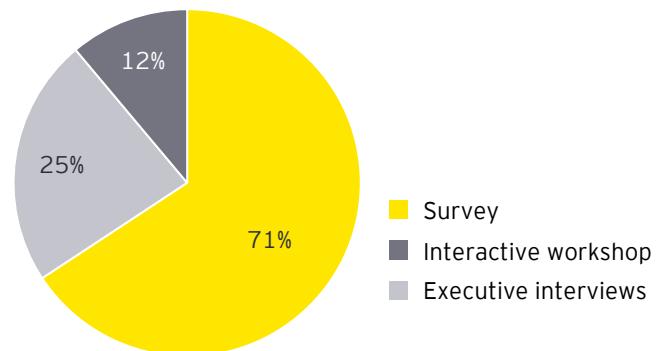
To maintain a strategic perspective in our study, 30% of our respondents are top management, and 32% are mid-level management. With years of experience, they have profound understanding of innovative technologies, real estate projects across the whole value chain, the execution of company strategy, the vision for digital transformation and end user requirements.

The respondents are mainly real estate investment professionals and developers

The study has a wide coverage of industry sectors, including investment and finance professionals, real estate developers, leading technology companies and start-ups, urban planning companies, consultants, government bodies and non-profit organizations, etc. Among them, 32% of the respondents are in investment and finance, 29% come from real estate development companies and 12% are from technology companies. The diversity of the respondents' background imparts a broad spectrum of views and richness of experience in this report.

Diversity in data sources

Distribution of data source



The respondents are mainly from investment and finance, real estate development and technology companies

Top three professional roles of respondents

32%
Investment & Finance Professionals

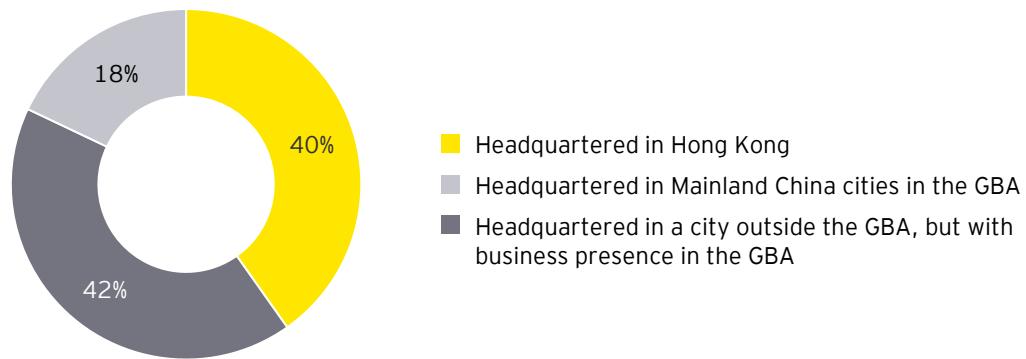
29%
Real Estate Developers

12%
Technology Companies



The interviewed companies are headquartered or have significant business presence in the GBA

Distribution of the headquarters of the interviewed companies



More than half of the respondents hold mid-level to top management positions in their companies

Distribution of the respondents' management levels



3 The concept of prop-tech and its ecosystem

The concept of prop-tech

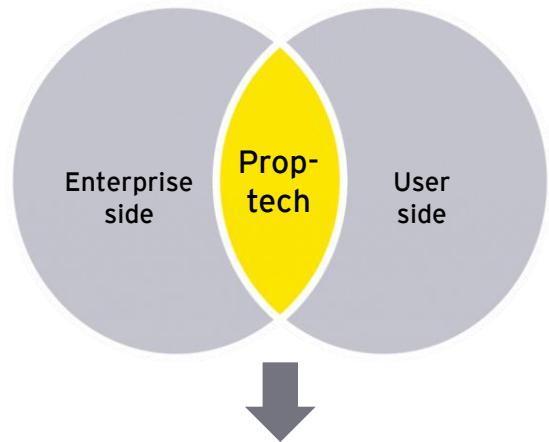
Urbanization and the rapid development of technologies have caused a sea change in people's lives and habits. What followed are changed expectations of living and working space. As an industry that touches every aspect of daily life, the real estate sector is positioned to engage in cross-industry integration with sectors such as finance, medicine, education and health care. Technological innovation is in demand for the creation of cross-industry synergy. In addition, information asymmetry and high carbon emissions have hindered high-quality industry development. Technology is the answer to the industry's development hurdles.

The prop-tech concept explored in this report encompasses two dimensions. The first dimension is the digitalization of the real estate ecosystem. From the perspective of the enterprise's value chain, it includes the digitalization of a series of business activities from land acquisition and development to real estate transaction and property services. It also involves the digitalization of the supply chain, which consists of the production and supply of building materials and other associated professional services.

The second dimension is the innovative development of software and hardware technology. Together they will propel the trend for industry-wide upgrades.

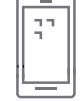
In terms of application, the core values of prop-tech include: creating value on the user side by harnessing the power of technology in the provision of value-added services; on the other hand, generating value on the enterprise side by enhancing digital capability within the enterprise, and meeting the requirements for space and private traffic operation.

Core values of prop-tech



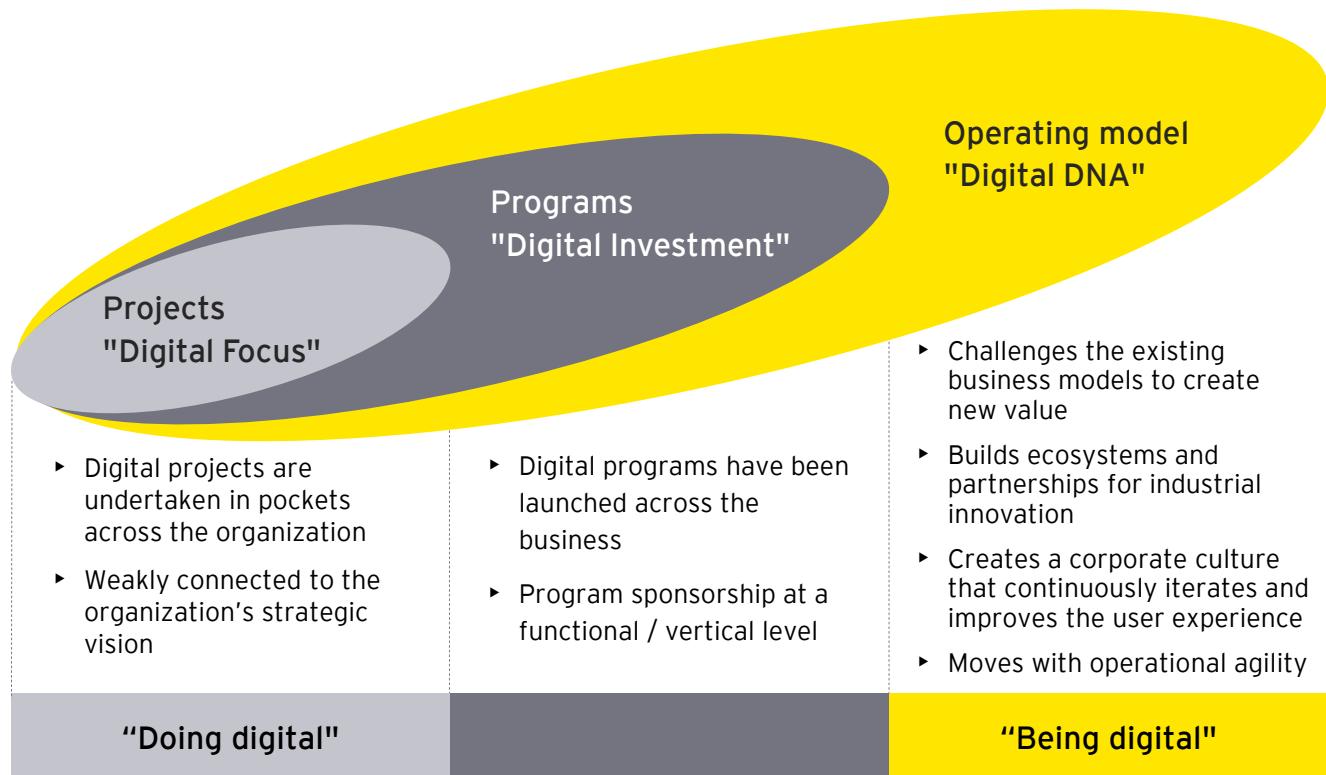
- ▶ Create value-added service scenarios
- ▶ Improve enterprise management capability

Trends in user space requirements

Flexibility	Experience	Connection	Innovation	Consistency	Personalization
 Sufficient flexibility in choosing when and where to work or study	 Space tailored to user experience with faster rates of response and solution	 Connect with people more closely and expand horizons at any time	 Exposure in innovative products and service, easy access to cutting-edge information and practices	 Consistent and seamless experience with products and services across online and offline platforms	 Customized solutions based on individual preferences in product and service delivery



From "doing" digital to "being" digital



Digital transformation ranges from IT modernization to digital optimization. It helps unlock workforce potential and accelerate new and better work practices within the organization. Being digital means understanding customers' behaviors and expectations, and developing solutions inside and outside of the business. Digital transformation is about:

- Being agile and creative in problem solving.
- Rethinking how to leverage new capabilities to improve customer services
- Being open-minded when evaluating work and operational practices
- Investing in new value spheres

The digital transformation discussed in this white paper will focus on the formation of "digital DNA" by turning strategy into operational execution, thereby creating new business value.

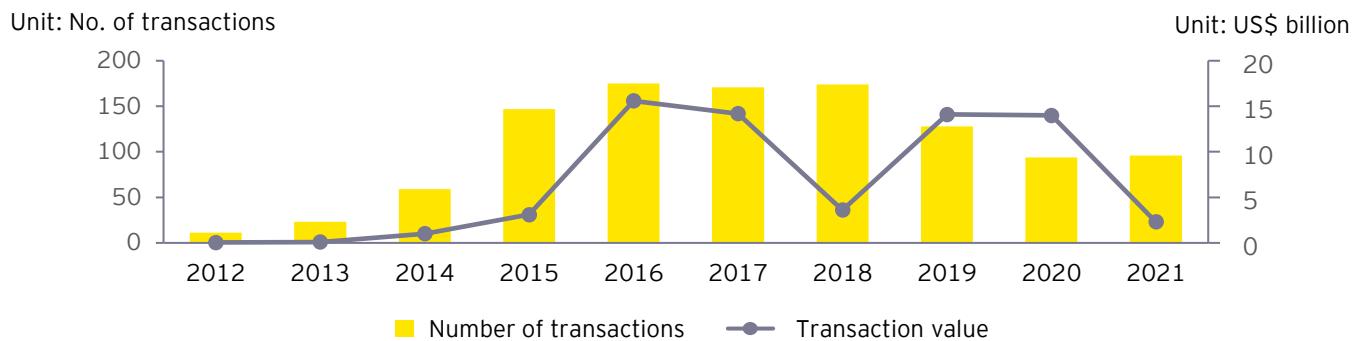
The prop-tech investment market in Greater China

The EY Embryonic database provides prop-tech investment data that reflects the current development of prop-tech and the market forecast for its future development. Moreover, an analysis of the place of investment can help determine the activeness of the relevant capital market and corporations in different regions.

In the past 10 years, the frequency and value for prop-tech investments have increased, despite the pullback after peaking in 2018

Between 2012 and 2021, excluding investments with undisclosed transaction values, about 1,100 prop-tech transaction events occurred in Greater China, with a cumulative transaction value of about US\$67.9 billion. It is worth noting that the single investment amount before 2019 was at the US\$10 million level, and by 2019 and 2020, the single investment amount exceeded the US\$100 million threshold. Beginning in 2021, the prop-tech investment market started to cool down.

Prop-tech investment in Greater China from 2012 to 2021



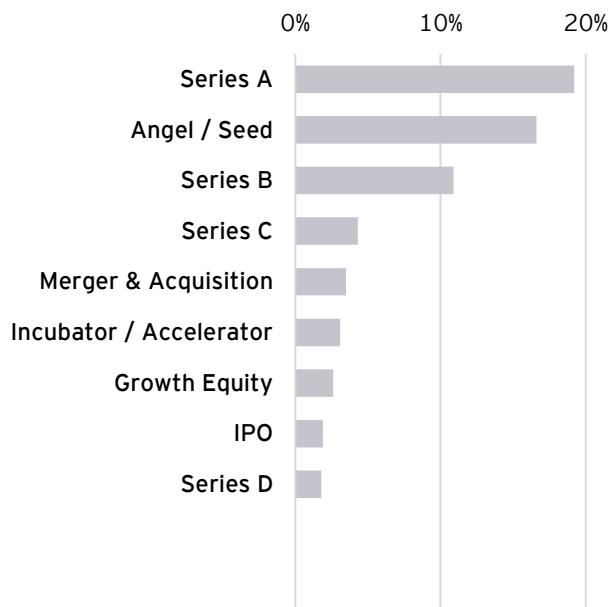
Source: EY Embryonic

Transactions in the past five years have dominated the market, and the investment stage has shifted from the early to middle stage

Over the past decade, based on the disclosed 782 investment types, prop-tech transactions have, since 2017, accounted for 60% of total transactions. Series A round and angel / seed round have accounted for 19.2% and 16.6% of the total number of transactions respectively. This market reception can be explained by the fact that prop-tech companies are priced reasonably, with a relatively low investment threshold for investors at the early stage.

Before 2015, the cumulative proportions of angel / seed and Series A rounds of investment were gradually rising, reaching a maximum of 20.6% and 36.4% respectively. After 2015, the number of early-stage financing events progressively dropped to a level of no higher than 20%. At the same time, financing steadily increased from 7.9% for Series B and 1.7% for Series C in 2015 to 10.9% and 4.3% in 2021 respectively. The prop-tech investment type is gradually shifting from the early to the middle stage.

Top prop-tech investment types (Unit: %) (2012 to 2021)



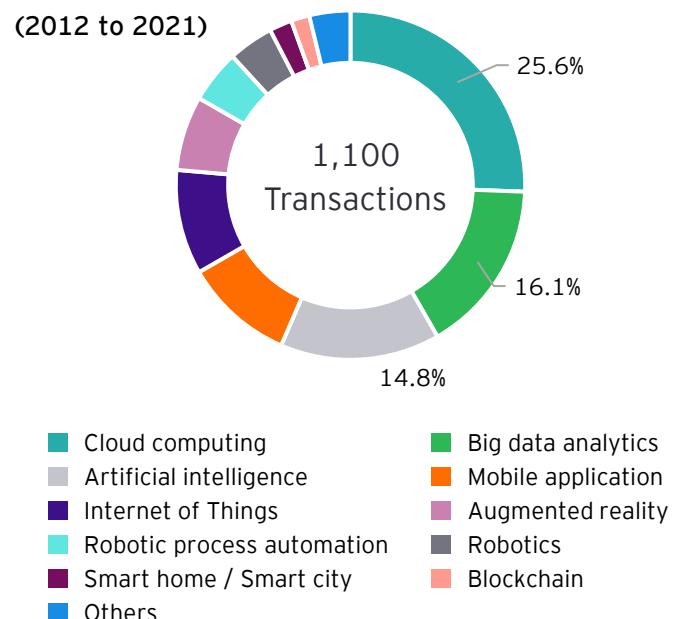
Source: EY Embryonic



Investors are most inclined to invest in cloud computing and big data analytics, and the number of transactions in AI has risen at the fastest pace

In the past decade, investors have traded actively in different prop-tech areas. The number of investment transactions in cloud computing companies accounted for 25.6% of total transactions, topping the investment in all technological fields. In the past five years, with the broad application of big data analytics and AI in the entire real estate chain, the percentage of investment transactions in such fields has accounted for more than 10%. It is noteworthy that since 2018, investment in the AI-related prop-tech area has gained momentum, constituting about 18% of new investment events in the past three years, second only to cloud computing. This phenomenon might have resulted from the accelerated development of AI technology in recent years.

Cumulative proportion of invested prop-tech areas
(Unit: %)
(2012 to 2021)

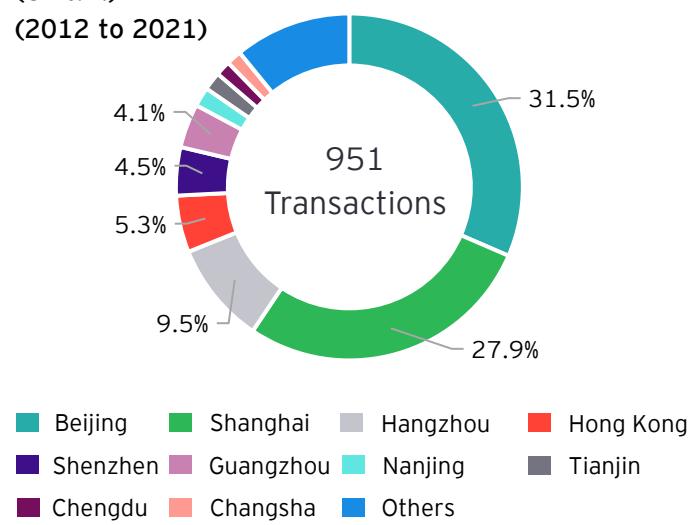


Source: EY Embryonic

The Beijing and Shanghai markets have exhibited the most enthusiasm for prop-tech, while the GBA cities as a whole rank third

Based on the data of 951 disclosed prop-tech investments, over the past decade, the number of investments that occurred in Beijing ranks first, accounting for 31.5% of the total number of transactions. This is followed by Shanghai, accounting for 27.9%. The GBA cities occupy third place in the top six cities. Prop-tech investments in Hong Kong, Shenzhen and Guangzhou take up around 13.9% in total, where Hong Kong and Shenzhen have the highest number of transactions, accounting for about 5.3% and 4.5% of total investment events respectively. Beijing and Shanghai are leading in the number of prop-tech investments possibly because Beijing and Shanghai are home to more mature entrepreneurial ecosystems and active venture capital markets. Furthermore, with its considerable number of state-owned enterprises, the Beijing market has ready access to venture capital.

Number of investment events in prop-tech by city
(Unit: %)
(2012 to 2021)

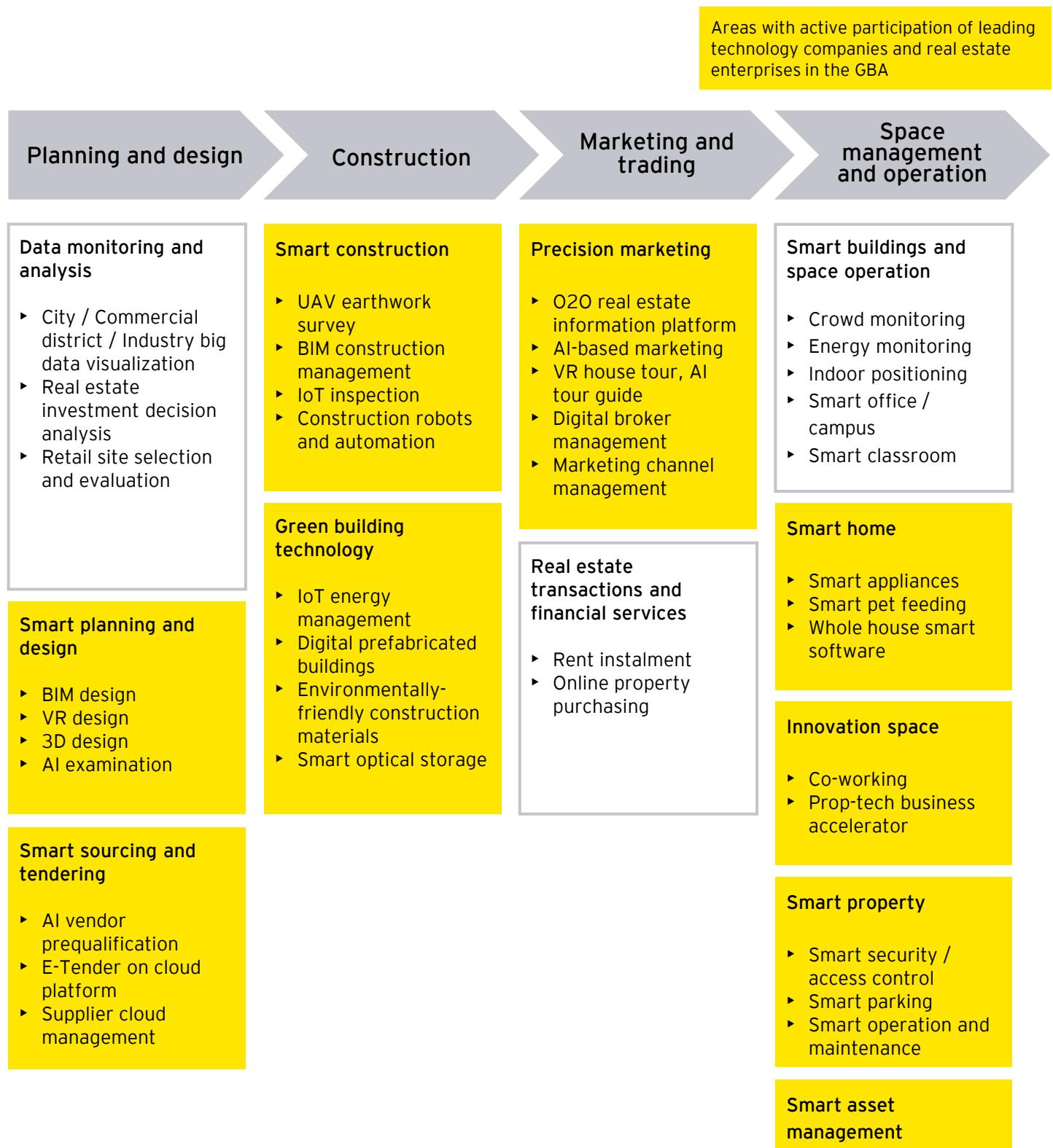


Source: EY Embryonic



An overview of the prop-tech ecosystem

The value chain for China's prop-tech (only representative segments are included)





To show the development status of the prop-tech industry in different regions, we have compiled a list of representative business segments of the prop-tech industry in China based on the industry's value chain. In addition, we have summarized the active markets for leading real estate companies and technology giants in the GBA by desktop research and interviews. With these studies we have drawn the following industry observations:

The Chinese market is influenced by the government's express disapproval of real estate speculation. Its focus is on technology-driven residential and physical attributes

The Chinese government exercises strict control over real estate financial leveraging. The People's Bank of China and the China Banking Regulatory Commission have issued several policies on real estate enterprise financing (summarized in the table below) to step up supervision over the real estate market, and de-financialize and de-leverage the real estate industry in the era of real estate inventory market.

Date of issue	Legal document	Relevant provisions
March 2021	Notice Regarding Preventing the Flow of Loans for Business Purposes into the Real Estate Field in Violation of Rules	Strengthen loan review: Banking institutions shall effectively strengthen the examination of borrower qualifications, credit needs and management of loan term, etc.; real estate agencies shall not provide or cooperate with other institutions to provide consultation and services on financial products such as housing mortgage business loans, and shall not induce buyers to use funds for business purposes in violation of rules.
March 2021	Outline of the 14th Five-Year Plan for National Economic and Social Development and Vision 2035 of the People's Republic of China	Uphold the principle of "housing is for living and not for speculation": We will ensure access to housing, keep a jobs-housing balance, maintain stability in land and housing prices and expectations, strengthen financial regulation of the real estate industry, support reasonable demand for owner-occupied housing, and curb speculative and investment-related demand for housing.
December 2020	Notice of Establishing Rules for the Management of Concentration of Real Estate Loans of Banking Financial Institutions	Restrict the ratio of real estate loans: The People's Bank of China and the China Banking and Insurance Regulatory Commission shall, according to the asset size and types of banking financial institutions, manage the concentration of real estate loans by tiers and determine the upper limits of the ratio of real estate loans and the ratio of individual housing loans (the ratio refers to the ratio of real estate/individual loans balance to all RMB loans balance).



China's prop-tech value chain is diversified, especially in the upstream industry, where various segments have emerged

As they experience the impact of the decline in sales profits and national macroeconomic policies, real estate professionals must constantly explore smart solutions to improve business performance. At the same time, new market players have emerged. Together these factors have caused further diversification in the value chain of China's prop-tech industry, especially in the early stage of real estate project development. Being positioned at the early stage of development projects, the fields of smart sourcing and tendering, as well as green building technology, have active markets. Relying on a wealth of experience, leading real estate companies have established an intelligent procurement and tendering platform, formulated supplier evaluation standards, explored the integration of supply chain resources and achieved higher cooperation efficiency and benefits. In addition, many companies support the "carbon peak and carbon neutrality" policy by using green building technologies such as new materials, new energy and prefabricated buildings, leading the effort in aligning real estate digital transformation with sustainable development. The 14th Five-Year Plan for Building Energy Efficiency and Green Building Development issued by the Ministry of Housing and Urban-Rural Development in March this year clearly states that by 2025, green building standards will be fully implemented with the focus on promoting ultra-low energy consumption building projects, strengthening the construction of building power systems and broadening the application of environmentally-friendly building materials. These policies will encourage the use of more green building technology products. As such, related market players will emerge in the future.

The Chinese market for prop-tech is fragmented, with both technology and real estate companies as suppliers. Product integration and standardization await improvements

The Chinese prop-tech market is still in the early stage of development, and the market is relatively fragmented. Throughout China's prop-tech value chain, both the leading or start-up technology companies and real estate developers are involved. From early planning and design, construction, to later marketing and trading, followed by space management and operation, many firms are players in these segments. Technology companies in the fields of real estate data monitoring and analysis, smart planning and design, smart construction or precision marketing are active players in the market, owing to the continuous improvement and maturity of AI, big data analytics, and cloud computing technologies.

Leading real estate companies play an obvious leading role, especially in the planning, design and construction stages. A possible explanation for this is that product development in these fields depends on a large volume of project data, a solid foundation of industry knowledge and investment in certain hardware assets (construction robots, etc.). As a result, they have won the favor of real estate giants and receive financing from them.

As to the fields of marketing and trading, space management and operation stages, technology companies are more likely to stand out with their innate advantage in all things digital.

It must be noted that an industry standard has not yet been established. To illustrate, there is no consensus on the appropriate speed in maintenance response for smart homes. It is the same with construction robots, and this will hinder the development of related industries. In July 2020, the Office of the Central Cyberspace Affairs Commission, the Ministry of Industry and Information Technology and other departments issued the Guidelines for the Construction of a National New Generation AI Standards System,



pointing out that by 2023, an AI standards system will be initially established, with the focus on development of data, algorithms, systems, services and other key and urgently-needed standards. On the other hand, the prop-tech industry has not yet formed an effective linkage for its upstream and downstream segments. Similarly, representative integrated products have not yet appeared. Comprehensive high-quality technology products integrating BIM technology application, intelligent construction, green construction and intelligent operation are rare.

New ideas and technologies are closely integrated in the GBA, leading to the emergence of new market segments and broad applications of technology

As it benefits from the GBA's policy incentive for technology and innovation, the prop-tech industry in the GBA has great prospects for business. It is also worth noting that new market segments, such as prop-tech innovation accelerators, have emerged in the GBA, creating a new link in the prop-tech ecosystem by providing acceleration services for potential prop-tech companies. In addition, industry participants in the GBA continue to expand the application of new technologies in the real estate industry by technological innovation. For example, a technology company in the GBA has developed a blockchain-based real estate transaction system, which solves the problems of long transaction cycles, lack of trust among parties to the transaction and information fragmentation.

In addition, many companies are exploring integration of the upstream and downstream segments and collaborative management of the real estate industry. With AI, big data analytics and BIM technology, they have built an intelligent design and management platform covering the entire industry cycle to assist with real estate pre-investment decision-making and post-investment management.



Leading real estate companies in the GBA have a high degree of participation in technological innovation and digital transformation

Many leading real estate companies have set up their headquarters in the GBA. They are actively developing real estate projects, providing a wealth of potential markets and application scenarios for implementing prop-tech. In addition, the leading real estate companies have participated in all aspects of the prop-tech value chain by setting up prop-tech business segments or subsidiaries, thereby promoting prop-tech innovation and digital transformation. A leading real estate developer in the GBA names digital transformation as the focus of its company strategy. It further formulates an implementation path to guide business innovation and strategy implementation based on its current business situation. The scope of reform includes: upgrading the overall management system of the company's business and functions to provide management support for digital transformation; promoting technological innovation and using technologies such as prefabricated design, BIM system and green energy supply to support the entire process from design to construction; emphasizing the intelligent operation of space and creating a high-tech business space to serve multi-dimensional application scenarios and meet diverse needs; and finally achieving business innovation and value creation through data collection and analysis. During this process, the company gradually commercializes its accumulated experience, and then launches competitive market products and services in the market.

The GBA's visions of smart city, digital economy, smart manufacturing and sustainable development may all find practical fulfilment in the real estate industry. From design and construction to operation, the government's preferential policies serve both as the guidance and catalyst in the transformation of the real estate industry. In the process of building smart cities in the GBA, the drive to rapidly transform traditional cities into sophisticated metropolises will present favorable opportunities for prop-tech applications.

Real estate industry trends in the GBA

At the dawn of the inventory era, leading real estate companies are gearing up on technology innovation and digital capabilities

Innovation on property operation is key to success in the inventory market era

Subject to macroeconomic control policies in recent years, real estate market demand in the GBA has been tamed. The COVID-19 pandemic has caused market volatility. Taking the office building market as an example, the annual average monthly rent of Grade A office buildings in Hong Kong, Guangzhou and Shenzhen has shown a volatile downward trend. The volume of new Grade A office buildings is also decreasing each year. This phenomenon reflects the dynamic changes in market supply and demand, at the same time indicating the trend of real property market restructuring in the GBA as the demand for traditional Grade A office buildings is shifting toward other types of working space.

On the other hand, A-share listed real estate companies headquartered in the GBA have shown a declining income growth rate in their property development business¹. The growth rate of the companies' core profits is significantly lower than revenue growth, showing that slow growth has become an industry norm. The real estate inventory market has witnessed increasingly fierce competition in the sales market. Therefore, real estate companies must focus on effective operation and management, at the same time breaking new ground for profit growth, in order to score competitive advantage and continue to develop.

Hong Kong, Shenzhen, Guangzhou and other core cities in the GBA are the earliest beneficiaries of China's policy incentive to drive domestic demand by leveraging the real estate industry. In China's development agenda, the real estate industry was a top and expedited priority in the earliest days. The result was large inventory that awaits proper operation.

The keys to real estate operation are space and flow. Space is concerned with the provision of a proper environment for habitation, work and leisure. Flow represents customers, and is concerned with how data can improve the quality of existing services and create new value-added services. Leading real estate companies are keen to introduce business innovation and transformation due to market pressure and company development needs.

¹ Income from property development business refers to income other than that derived from property management and leasing. Income from sales of commercial housing, construction sites and auxiliary facilities as well as agent construction, etc. is, properly considered, income from property development business.



Leading real estate companies implement prop-tech strategies in four main ways

From our study of the leading real estate companies' practices in technology innovation and digital transformation, we have summarized below the four major implementation methodologies for prop-tech strategies ranked by the extent of capital investment:

(1) Direct procurement and strategic alliances

For the application of mature technology, real estate companies usually adopt strategic alliances with technology or internet companies to achieve rapid technology implementation in a win-win situation: real estate developers adopt advanced technology solutions to solve digital pain points, while technology providers can implement and test their new digital products in various business scenarios to expand their brand impact.

(2) Self-development or co-inventing

Real estate companies tend to adopt self-developing or co-inventing methodologies when they have high customization requirements, or if their IT department has strong technical capability. Companies can gradually build up in-house experience and create commercialization opportunities.

► **Self-development:** A GBA real estate developer established an innovative engineering management mechanism to improve on-site construction safety and quality. To ensure smooth implementation of the new mechanism, the company has self-developed a digital engineering platform to practice intelligent engineering management. The system helps identify hidden dangers in a timely manner, provides better visibility into construction management and flags any existing risk.

► **Co-inventing:** To embrace the trend of smart construction, a GBA real estate company has worked with research institutes and technology companies to co-invent a digital construction management system based on advanced edge computing technology. The system helps industrialize the research outcome from research institutes and achieves all-round monitoring and management of construction sites.

(3) Strategic investment and incubation

To embrace immature emerging markets or expand business coverage, real estate companies might choose to establish internal innovation investment funds by establishing a suite of technology acceleration or incubation mechanisms and offering business scenarios for product piloting. For instance, a leading real estate company in the GBA invested in an intelligent IoT technology company based on its intelligent life strategy. Both parties are committed to building a smart real estate and smart home ecosystem. The technology company provides smart home IoT systems for the residential projects of the real estate company to improve residents' living comfort and convenience. In addition, some leading real estate companies cultivate technology-driven innovative companies by setting up incubator spaces. Not only do they increase revenue by providing space services, but they also identify potential investment targets and establish a broader partner ecosystem. As a result, they will promote the digital transformation of the real estate industry by facilitating collaborative efforts among innovative technology companies, real estate enterprises, investors and governments.



(4) Establishing wholly-owned or joint venture subsidiaries

For those opportunity markets that are highly synergistic with company strategies, some real estate companies chose to set up subsidiaries to operate independent business segments. By setting up wholly-owned subsidiaries, a real estate company can integrate the high-quality resources of the parent company and respond to the group's top-level strategic deployment; or otherwise set up joint ventures with other companies to achieve resource complementarity and integration.

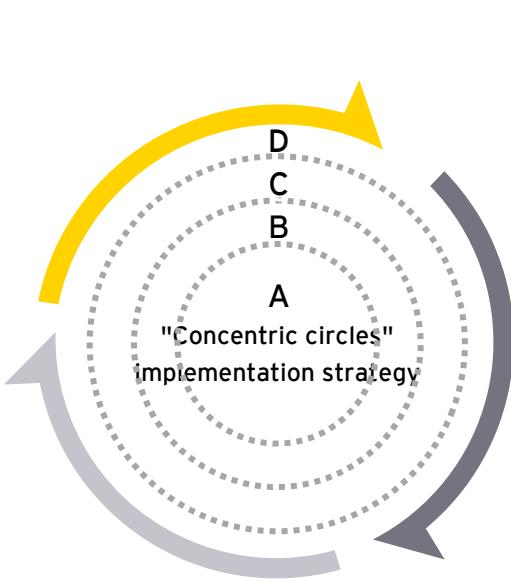
- ▶ **Wholly-owned:** A GBA real estate developer is optimistic about the prospects of robotics technology application in the future real estate industry, so it sets up a wholly-owned subsidiary in robot construction. This subsidiary specializes in robot R&D, manufacturing and the BIM-based intelligent construction collaboration platform. The company's robots use AI measurement algorithms and image processing technology to reduce errors caused by manual measurement. They also maneuver complex construction tasks to improve construction efficiency and replace repetitive work that would otherwise be labor-intensive.

- ▶ **Joint venture:** To empower its property operations business, a GBA real estate operator has set up a joint venture with a leading video IoT and data operations service provider. The joint venture develops security technology through hardware deployment and is building a digital control center that connects to public security to enhance real-time building surveillance and security alerts.



In response to digital transformation in the industry, a leading real estate company has established “concentric circles,” a differentiated technology implementation strategy based on business synergy and cost considerations. Through collaboration, the real estate company brings social, brand and investment empowerment to partner companies. As shown in the figure below, the concentric circles demonstrate how different implementation methods vary from high to low synergy with the company business.

Case study: A leading real estate company developed a differentiated prop-tech implementation strategy based on business synergy and cost considerations



Inner circle: high business synergy
Outer circle: low business synergy

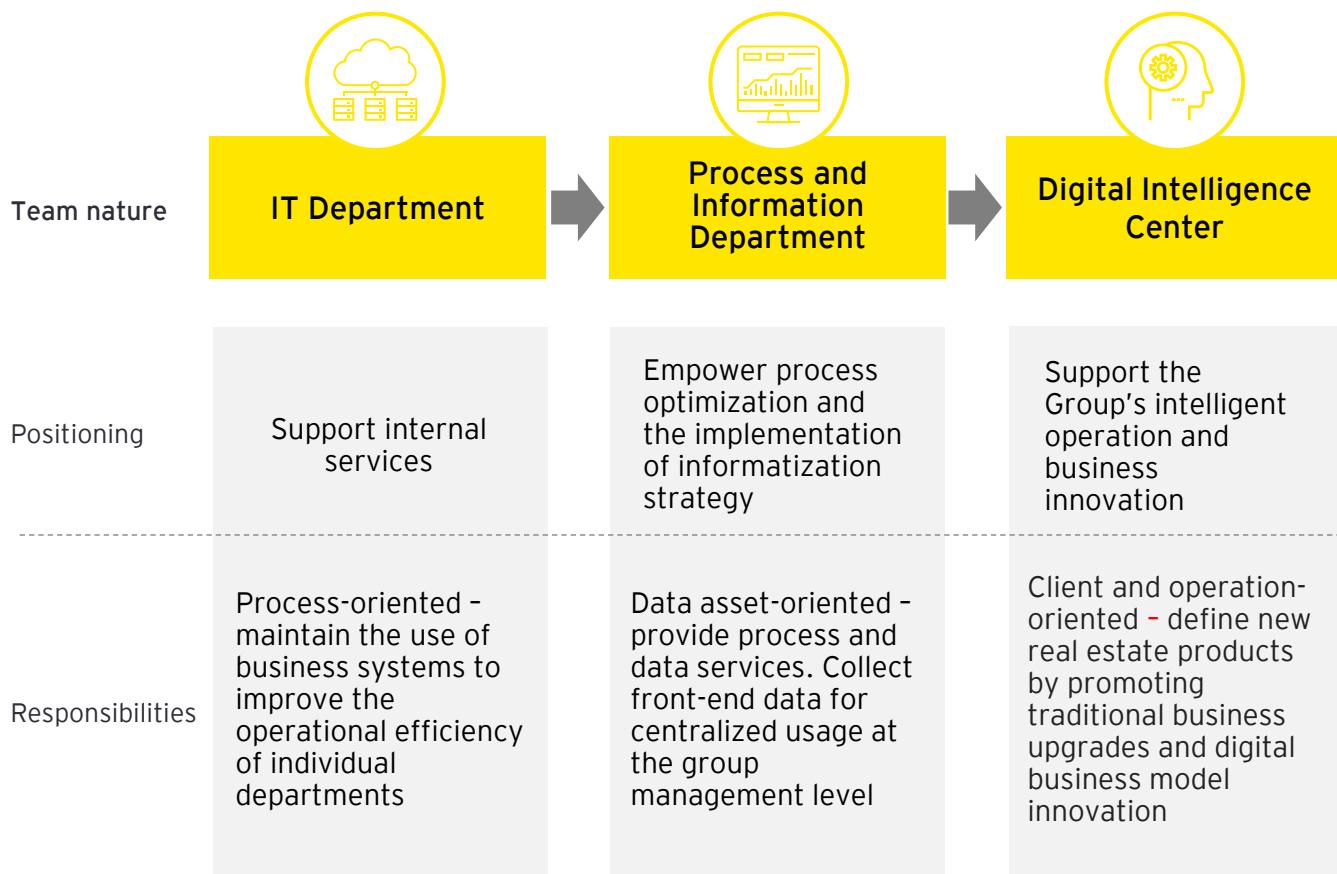
- A** **Establishing a subsidiary:** Through independently operated subsidiaries, the real estate company embraces new market opportunities with readiness and efficiency.
- B** **Strategic investment:** Invest in innovative technology companies that are synergistic with the company's top-level strategy.
- C** **Innovative technology incubation and acceleration:** Build a collaborative ecosystem that forms a close relationship with start-up technology companies.
- D** **Procurement and strategic cooperation:** Undergo direct technical solution procurement with IoT companies or companies that have mature technologies based on cost and adaptability considerations.

Source: EY interview



Leading real estate companies have established teams to escort the implementation of technology strategies. Based on the experience of a leading developer in the GBA, its IT department has undergone digital and intelligent transformation in tandem with the evolution of the company's digital strategy.

Case study: To complement the needs of technology strategy implementation, the IT team of a leading GBA real estate developer has undergone several positioning upgrades



Source: EY interview



The main reasons for prop-tech application and digital transformation

As we have learned from our survey results and the qualitative interviews with company executives, more and more companies are using technology innovation and digital transformation to refine their operations and diversify development. The following are the underlying motivations.

► To improve efficiency and reduce costs

Due to the macroeconomic policies governing the real estate sector and the traditional business model of "market expansion by pre-emptive investments," the real estate supply chain has been under stress in recent years. Currently, real estate companies are feeling a profit crunch. Rising costs and declining revenues are the culprits: the financing costs of real estate enterprises have increased significantly due to the impact of financial deleveraging; on the other hand, housing prices have been severely regulated, reining in the previous uptrend. In addition, the uncertainty of national policies has caused liquidity pressure and thus more uncertainties to the real estate industry. To be able to sustain long-term and healthy development, real estate companies must rely on digital transformation to revitalize their inventory resources. In the long run, refined operations and a move from land acquisition will be the approach to sustainable project management.

Massive real estate data and project management work require operators to improve the efficiency in decision-making. In this age of data, the diversification of information and data sources has had a profound effect on all aspects of the value chain. In addition to traditional industry data, such as customer information, property information and transaction data, current industry data include internet browsing traces, search keywords and mobile phone location information. The diversity and complexity of data have created demand for algorithms and machine learning technologies to help real estate companies make better use of them, to estimate property values more accurately and to make more informed investment decisions.

► To improve user experience

The rise of the middle class and purchasing power have led to varied user needs. Growth of China's national economy has boosted overall consumption levels. During the inventory era, user experience is a key concern in the real estate industry. Expectations of diversified, customized user experience with the aid of intelligent technology have become the new industry benchmarks. Digital technology will enhance user experience from the operation perspective. It will support the new cycle of stable industry development in the inventory era.

Therefore, the real estate industry will be mindful of the "user-centric" development model. At present, most real estate companies are operating multiple business segments. The multi-business model has enabled real estate companies to accumulate troves of client data. However, the majority of client data from different businesses are not synchronized and shared. Data integration will be a means to turn these data into assets, especially with accurate client data analysis and better cross-segment synergy for service, product and operation.

► For sustainable development

National policy promotes industry-wide low-carbon development. With the national "dual carbon" policy, there is emphasis on green ecological civilization and sustainable development in Guangdong, Hong Kong and Macau. The real estate industry's efforts to meet environmental objectives are crucial in achieving the country's low-carbon goals. As a major carbon emitting industry, the real estate industry must reduce its carbon footprint. With digital technology, real estate companies will ride this new trend of sustainable development.

Prop-tech and digital transformation readiness in the GBA

Prop-tech is on the agenda for strategic transformation

Which management level of the enterprises is discussing prop-tech?

To understand the GBA real estate enterprises' perception of prop-tech, we researched what management level is driving the prop-tech agenda. We grouped respondents into the primary categories of senior management, middle management, junior management and employees.

Prop-tech is a hot topic for middle and top management

In this survey, respondents across industries generally recognize the importance of prop-tech as a company strategy, with approximately 79% of the companies surveyed considering the adoption of prop-tech to be of high strategic importance. Prop-tech issues have also permeated all organizational levels, drawing widespread attention from both senior management and employees that are implementing digital transformation of the company.

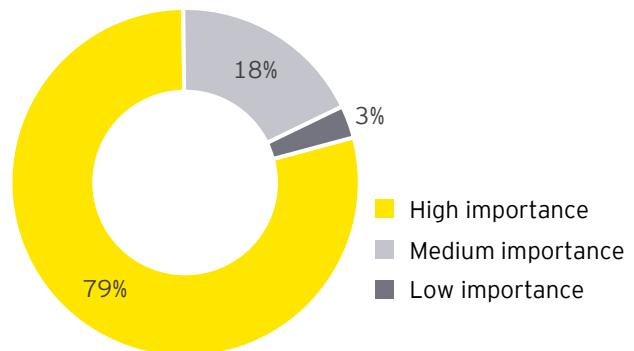
Except for a small number of companies that do not consider prop-tech to be important strategically, most companies have included prop-tech in their future strategic plan, regardless of whether they are pioneers of digital transformation or not.

Corporate senior management thinks that prop-tech applications are critical

Among the top management of all the companies surveyed, 88% of the top management emphasize prop-tech, and they are pivotal in the promotion of prop-tech. Engagement by top management will create a digital culture for the company. There will be a recognition of prop-tech for its strategic value. Overall, the company pays more attention to the synthesis of technology and business, rather than focusing on the technology itself.

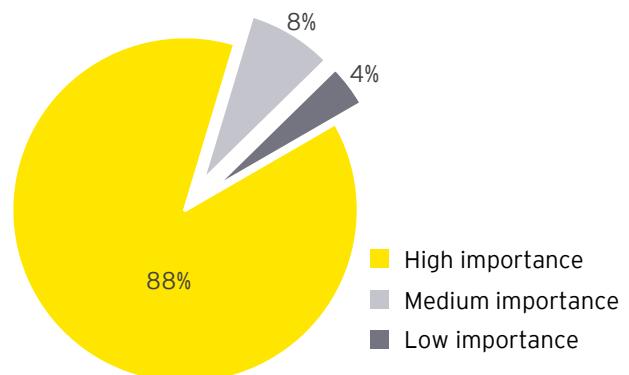
Companies generally see prop-tech as being of high strategic importance

How important is it for your company to make the adoption of prop-tech a strategic priority?



Corporate executives pay special attention to prop-tech

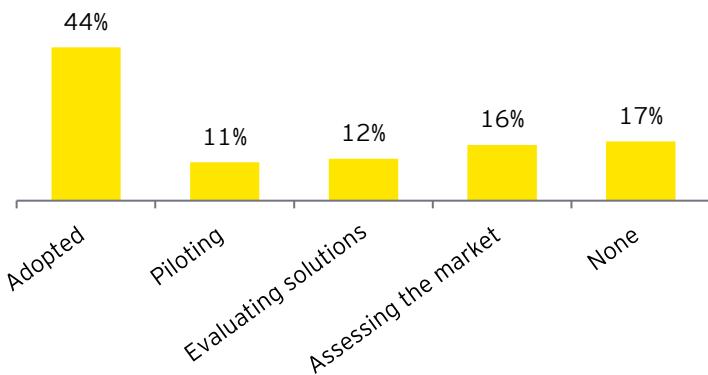
Does senior management view prop-tech as the company's strategic focus?



Nearly half of the GBA enterprises have entered the implementation stage for prop-tech

Nearly half of the surveyed companies have adopted at least one prop-tech

Where is your company in terms of prop-tech maturity?



Adopted

- ▶ Already adopted or implemented at least one prop-tech solution

Piloting

- ▶ Use of prop-tech is still in the piloting stage

Evaluating solutions

- ▶ Evaluating various prop-tech solutions, yet to adopt anything

Assessing the market

- ▶ Working to better understand the prop-tech market and what it might do for us

None

- ▶ Know that we have issues that technology might help, but have not started thinking about how technology could be applied

Among them, the non-tech sectors with the highest technology penetration rate are:

Real Estate Developers

39%

Real Estate Investment & Finance Professionals

35%

Is prop-tech in the application stage for enterprises in the GBA?

The technology application maturity assessment of the interviewed companies gives us a glimpse of the status of technology application for real estate industry players in the GBA.

Nearly half of the surveyed companies have implemented prop-tech

About 44% of the surveyed companies have adopted or implemented at least one prop-tech solution. Moreover, 11%, 12% and 16% of the surveyed companies are in the stage of piloting, evaluating and assessing the market. Technological tools and solutions are gaining widespread industry acceptance but have not yet transitioned from early adoption to full incorporation by the market. The majority of surveyed enterprises are at an early stage of technology application, and only a few have not yet initiated their prop-tech agenda. 17% of the respondents recognize that technology may help solve business problems, but have not yet given serious consideration on how to apply such technology.

Real estate developers, real estate investment and financial professionals are active technology users

Among the GBA companies surveyed, the leading sectors in the application of prop-tech are real estate development as well as investment and finance players. About 39% of real estate developers and 35% of investment and financial professionals said they have implemented at least one type of prop-tech within their companies. The interviews with senior management of real estate developers show that prop-tech is an important tool to improve the lifecycle performance of real estate development projects. While for real estate investors, they are more likely to consider using prop-tech for optimizing investment decisions.

Corporate management optimization has become the mainstream application for GBA enterprises

In which main areas are companies in the GBA implementing prop-tech?

Prop-tech implementation is concentrated in corporate management tools and tenant experience management

Software that provides full or partial automation of various asset / portfolio workflows or corporate systems are the mainstream application areas for the interviewed companies. 60% of the companies surveyed have adopted at least one technology for corporate management, ranking it as the most popular prop-tech field. In tenant experience management, 50% of companies have adopted at least one technology, followed by data and analytics and visualization technologies, reported by around 49% and 44% of companies. Construction and building management are slightly behind, with only 39% and 38% of the surveyed companies having implemented technology solutions.

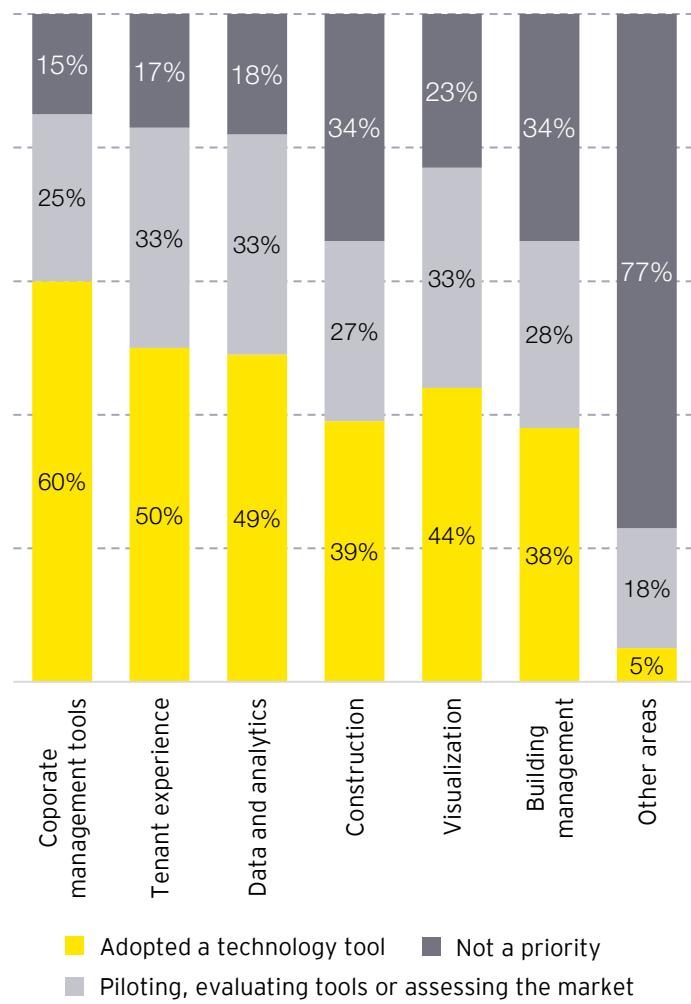
The high adoption rate in corporate management tools and tenant experience reflects the fact that most of the technology application and digital transformation is intended to improve efficiency and revenue. More than 60% of companies have not yet considered digitalizing fields such as construction and building management, but these fields are expected to grow as the quality of related products improves.

Product and service quality has not fully met market demand

Companies were asked in the survey which areas of product or service quality they would like to see further improvement in the current marketplace. Corporate management tools, tenant experience management and data analytics ranked highest. This reflects that market demand has not yet been fully met as the quality of prop-tech products and services still needs further improvement. This is especially so for corporate management tools. Some respondents pointed out that only a few products can truly meet their business needs, so they tend to choose customized or self-developed solutions.

Management tools are the major application area for the GBA companies

For the following areas, please indicate where you stand today in terms of adopting technology solutions.



What areas of digital products or services currently available in the market can be further improved to meet user needs?



1. **Corporate management tools**
2. **Tenant experience**
3. **Data and analytics**



GBA enterprises favor point solutions

How do companies in the GBA implement their technology strategies?

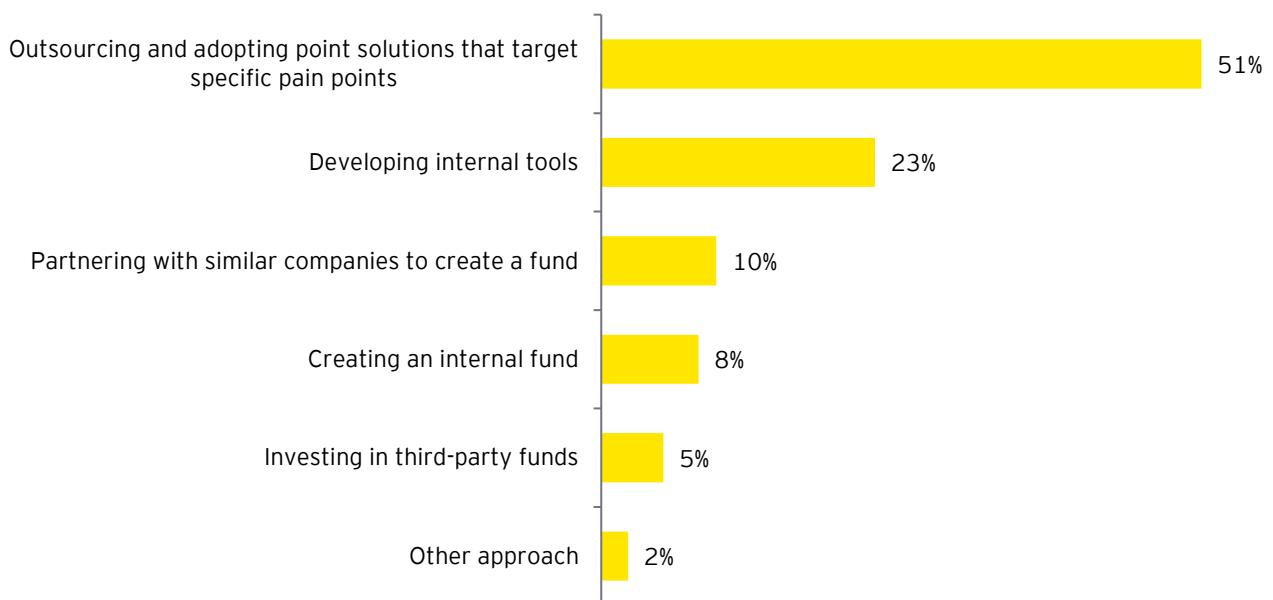
The most common way to implement prop-tech strategies is the adoption of point solutions

Procuring a single technology solution to address specific pain points is the most common way to implement prop-tech, with about 51% of respondents using this approach. Developing in-house technology tools is next, with about 23% of respondents choosing that approach. Most companies are solution-oriented and tend to seek outsourced technology solutions when they encounter pain points. Integrated digital solutions are expected to become the new demand as the overall level of industry digitalization rises.

At the same time, about 23% of respondents use funding-related approaches. Establishing funds is one of the most important ways for real estate companies to embrace the prop-tech market. Equity investments enable traditional real estate companies to diversify their business and prepare for the future transformation of the industry. As shareholders, real estate companies can leverage their experience and platform resources. Their unique experience will benefit the long-term development of technology solutions.

The most common way to implement prop-tech strategies is the adoption of point solutions

What approach are you taking or intend to use to deliver your technology strategy?

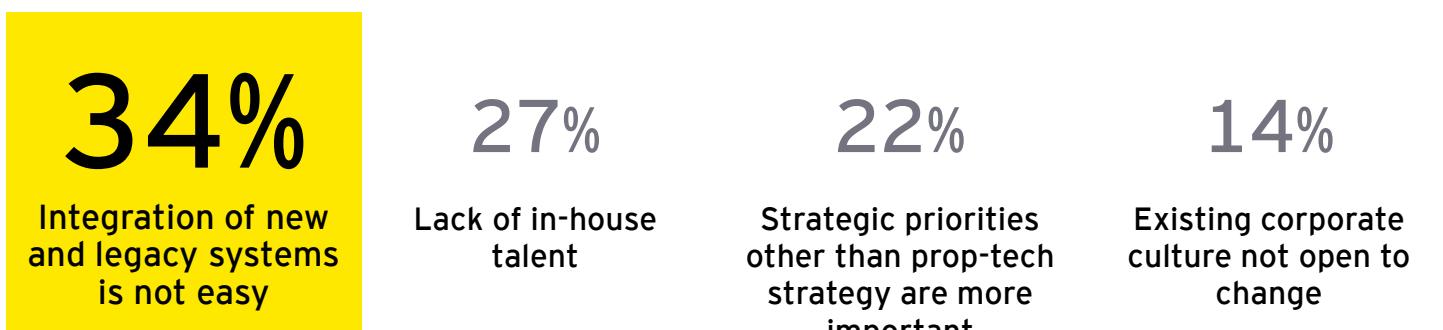




Integration of new and legacy systems and talent shortages are the main challenges

34% of the surveyed companies indicated that integration of new and legacy systems is the top challenge. By sector breakdown, about 71% of the interviewed real estate companies and 50% of tech companies have the same concern about system integration. Given the finding that companies primarily adopt point solutions, this implies that many companies are merely enhancing their existing platforms, rather than developing their digital infrastructure in a systematic manner. Furthermore, organizational challenges, such as a shortage of digital talent and a lack of aligned priority on prop-tech strategies, account for 27% and 22% respectively. At the same time, 14% of the surveyed companies agreed that lack of institutional support, i.e., a corporate culture open to innovation, is also a challenge. In addition to bridging the gap between the technical shortcomings of legacy systems and technology development goals, prop-tech strategy implementation requires other long-term considerations. The enterprise has to adapt its organizational structure and operating model to the technology. To this end, the enterprise should consider, amongst other issues, incorporating technology innovation into the long-term, company-wide strategy, cultivating digital talent and nurturing a corporate culture open to innovation and change.

Main implementation challenges for prop-tech and demand for tech talent



“

Interdisciplinary talent who have technology and real estate knowledge

– *A real estate developer executive in the GBA*

“

Having the ability to observe and think about new things and convert them into business models

– *A commercial real estate executive in the GBA*

“

Project management talent to coordinate multiple stakeholder needs

– *A real estate investment strategy executive in the GBA*



Augment organizational capabilities for technology implementation

What organizational capabilities do companies need to successfully apply and deploy prop-tech?

This section will focus on the capabilities that companies need to apply and deploy prop-tech. As part of the study, respondents first rated different organizational capabilities in terms of their importance in successful prop-tech application. We then invited respondents to give a self-assessment of their companies' current level of competency in the industry.

The nine organizational capabilities center around human and technology elements.

Some of the nine capabilities center around human elements: prop-tech leadership, open culture, innovative corporate management, agile development and external alliances. Others are more technology oriented: data management, advanced data analytics, availability of emerging technologies and information and cybersecurity.

Information and cybersecurity, data management and prop-tech leadership are of the highest importance, yet most companies are not highly competitive in the industry

The survey results reflect that, to make successful prop-tech applications, approximately 85% of the companies consider information and cybersecurity capabilities to be very important; data management comes second, with 78% of companies agreeing on its importance. The digital transformation process will generate a large amount of business and non-business data, and the resilience of the network environment and data management capabilities are the foundation to support this digital transformation. However, only 40% of respondents believe that they are highly competitive in information and cybersecurity.

1. Prop-tech leadership
Leadership articulates the vision, sets goals, deploys strategy and leads top-down prop-tech application and deployment with a proactive and supportive attitude

2. Open culture
Willingness to collaborate across departments within the organization and take risks

3. Innovative corporate management
Enterprises develop new revenue streams while maintaining existing revenue sources and business models

4. Agile development
An experimental approach in which collaborative, cross-functional teams work in progressive, iterative project cycles to effectively implement technology solutions

5. Data management
Capturing, storing, structuring, labelling, accessing and governing data to build the foundation and infrastructure for digital technologies



Moreover, most surveyed companies do not have robust data management capabilities, with around 70% believing they are at or below the industry average in data management. From the interviews with executives, we learned that solving the problem of system silos, improving data capture capabilities and safeguarding data quality are the key considerations for companies in the GBA as they embrace technology innovation and digital transformation. At the same time, about 62% of the companies said that advanced data analytics capabilities are also important for prop-tech adoption. However, the survey data shows that less than 30% of the surveyed companies in the real estate industry consider themselves as highly competitive in advanced data analytics capability.

6. Advanced data analytics

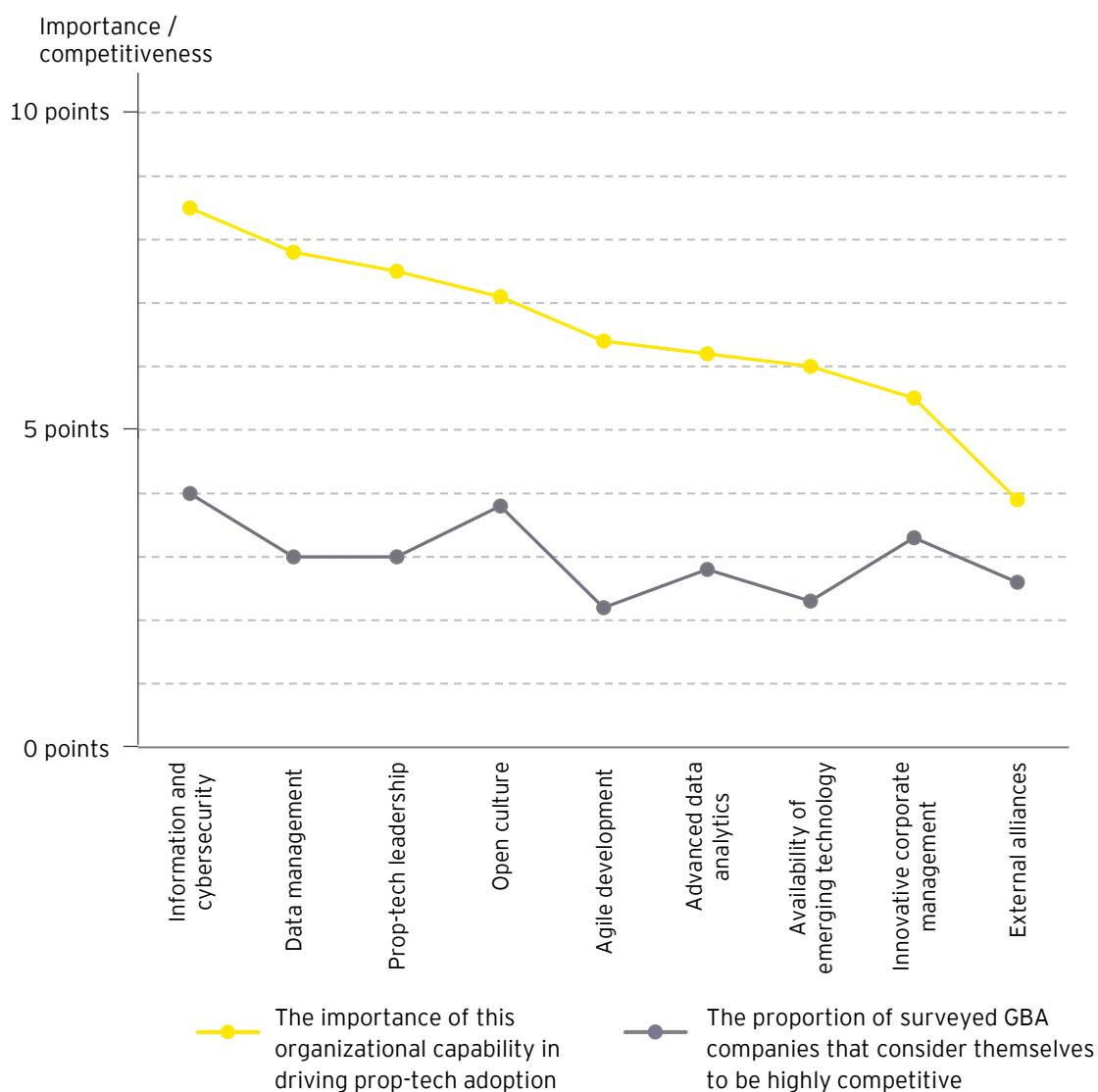
Analyzing large amounts of data, making projections based on visual analysis and data mining results, and obtaining data-driven business insights



In addition to the technology capabilities mentioned above, the importance of prop-tech leadership was highly recognized by the surveyed companies (75% regarded it as very important), suggesting that prop-tech should be deployed by a top-down approach and closely aligned with company-wide business development. However, only 30% of the companies surveyed indicated that they are highly competitive in this capability area. Although prop-tech is a hot topic among these companies, it has not yet been positioned as a matter of overall business strategy. Most companies are taking a wait-and-see approach.

Information and cybersecurity, data management and prop-tech leadership are seen as key organizational capabilities driving prop-tech adoption

How would you rate the importance of each of these organizational capabilities for successful prop-tech adoption?
How competent is your company within these organizational capabilities?



Note: The types of capabilities are arranged in the order of their importance

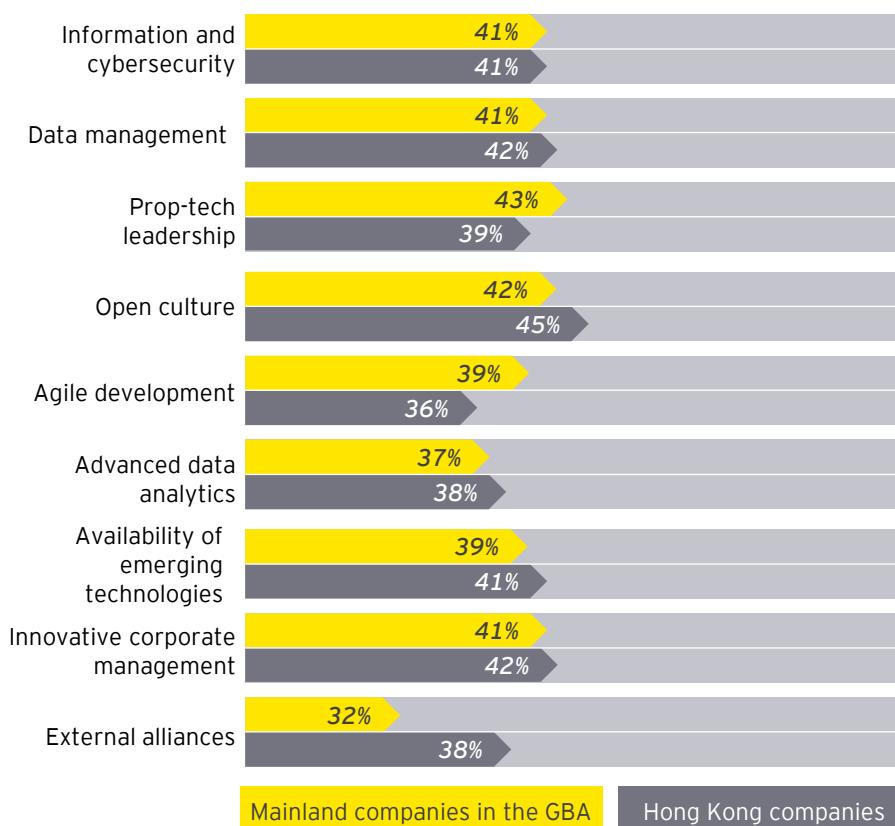
The self-assessment results show that the surveyed GBA enterprises can improve their key organizational capabilities

Based on self-assessment of the respondents' organizational capabilities, we learned that Hong Kong companies (headquartered in Hong Kong) have a slightly higher level of competency than mainland GBA companies, but the gap is small. The overall competency level of mainland GBA companies can be further enhanced. Hong Kong real estate companies entered the inventory stage earlier than their mainland counterparts, and therefore have accumulated more relevant experience. In terms of organizational capabilities related to human factors, especially in terms of open corporate culture and external alliances, they perform better than mainland GBA companies. In terms of organizational capabilities related to technological factors, they are slightly ahead of mainland GBA companies in data management and advanced data analytics capabilities. However, mainland GBA companies outperformed Hong Kong companies in prop-tech leadership and agile development capabilities.

Overall, the capability gap between Hong Kong and mainland companies is small. If the relevant capabilities are improved in a targeted manner, it is expected that Hong Kong and mainland companies can complement each other in promoting prop-tech development in a win-win scenario.

A comparison of the digital organization capabilities of Hong Kong and mainland enterprises in the GBA based on company self-assessment

For the following capabilities, the proportion of surveyed GBA companies that consider themselves having moderate to high competency level as compared to the industry average



7. Information and cybersecurity

A complete IT management framework, forward-looking cybersecurity deployment and contingency plan will together provide a reliable network environment for technologies

8. Availability of emerging technology

The organization-wide ability to continuously discover, deploy and create value chain from intelligent solution, applications and data platforms

9. External alliances

Identify external partners and establish external alliances through academic and enterprise collaboration, etc.



Technology will unleash the potential of enterprises and tap the hidden value of the industry

How will prop-tech continue to impact businesses in the next five years in the GBA?

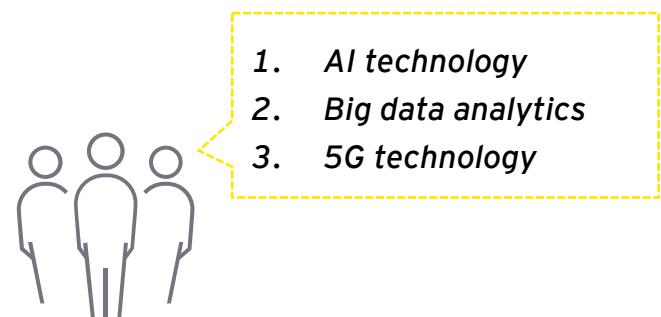
Artificial intelligence, big data analytics and 5G technology will drive innovation in the real estate industry in the GBA

When asked about the key technologies that will profoundly impact the real estate industry in the next five years, the top three responses were AI, big data analytics and 5G technology. More data will be collected with further development of 5G technology. Besides, as AI technology and data analytics improve, they will facilitate better business insights and drive smarter business decisions. The digital transformation of the real estate industry is expected to play a role in the GBA's booming digital economy.

A majority of the surveyed companies believe that technology will continue to improve operational efficiencies, facilitate better business decisions and accelerate sustainable development

Most companies surveyed are highly positive about the favorable impact of technology on real estate business. Approximately 46% of the companies believe that the use of technology will further improve operational efficiency and enable better asset management, indicating that companies in the GBA engage technology for economical and cost purposes. In terms of driving business decisions, 21% of companies believe that the use of collected market data and user behavioral data can help them make better business decisions. About 11% of the companies agree that technology will help them reach sustainability goals in the next five years.

Which of the following technologies do you see as a key technology affecting the real estate industry in the next five years?



GBA companies expect technology to help them execute their business blueprint

How do you think technology can help your company better execute your real estate business blueprint in the next five years?

46%

Improve overall efficiency of operations and achieve better asset management

21%

Business decisions will be based on market information and user behavioral data

11%

Accelerate sustainable development for businesses

7%

Improve building safety and create a healthier environment



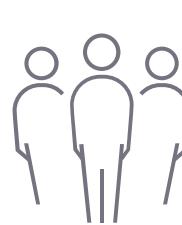
Technology application in the upstream value chain awaits further exploration

The surveyed companies expect to see more technology products in land planning, bidding and tendering and real estate investment. As companies are driven by the need to increase revenue and enhance customer stickiness, the market offers of technology products are concentrated in the midstream and downstream of the industry. As such, the upstream market bears significant untapped potential. At the upstream, the real estate industry is involved with the participation of multiple stakeholders, such as government sectors, planning and design companies, consultants, investment companies and developers. Future opportunities are manifested in efficient collaboration among stakeholders and facilitation of better investment decision-making. In addition, urban space in the GBA is becoming increasingly dense and demand for urban renewal is growing, thus it is imperative to use technology to enhance urban planning standards and reduce homogenized or redundant construction projects.

Industry players expect the government to roll out policies related to talent, funding and intellectual property protection

In addition to internal factors and considerations, about 40% of the surveyed companies believe that government incentives are an important external factor influencing prop-tech development. Respondents expect the government to provide support in terms of talent, special funding and intellectual property (IP) protection. In addition, based on the interviews with executives, we also learned that the companies expect the government to take the lead in promoting the application of innovative technologies in real estate projects by setting up demonstration zones for prop-tech. These demonstration zones will serve as a benchmark for prop-tech development in the GBA.

Are there any parts of the real estate value chain where technology needs are yet to be met?



1. *Land planning*
2. *Bidding and tendering*
3. *Real estate investment*

About **40%**

of the respondents believe that, in addition to business-related factors, government promotion is important for the development of prop-tech, especially in the following areas:

- 1** Talent-related policies
- 2** Specialized government funds
- 3** Intellectual property (IP) protection

Key areas of technology innovation and digital transformation in the GBA

Focus on four key technology innovation and digital transformation areas

To reduce costs, improve efficiency, enhance user experience and achieve sustainable development for the real estate industry, industry players must embrace technology innovation and digital transformation. From the qualitative and quantitative analyses of results from our survey, and workshops and interviews with senior executives and business leaders in the GBA, we have identified the following four critical areas for digital technology development in the GBA.

Key areas of technology innovation and digitalization in the GBA

Smart planning and design

Utilize AI, BIM and big data analytics to support pre-investment decision-making, project feasibility study, architecture design and design compliance assessment to improve efficiency and reduce input costs.

Smart construction

Utilize robotics and remote visualization technologies to improve efficiency in material supply, construction and safety surveillance, and eventually reduce carbon emissions.

Smart buildings and space operation

Utilize technologies including IoT, intelligent hardware, 5G, big data analytics, cloud platform and mobile internet to improve operational efficiency and spatial experience.

Smart asset management

Utilize the software as a service (SaaS) platform to enhance the reliability of investment decisions through real-time monitoring of portfolio performance.

Source: Survey, interviews, workshop, EY analysis

Smart planning and design

Prioritize customer selection and evaluation to maximize the value of the technology solution and improve pre-investment decision-making efficiency

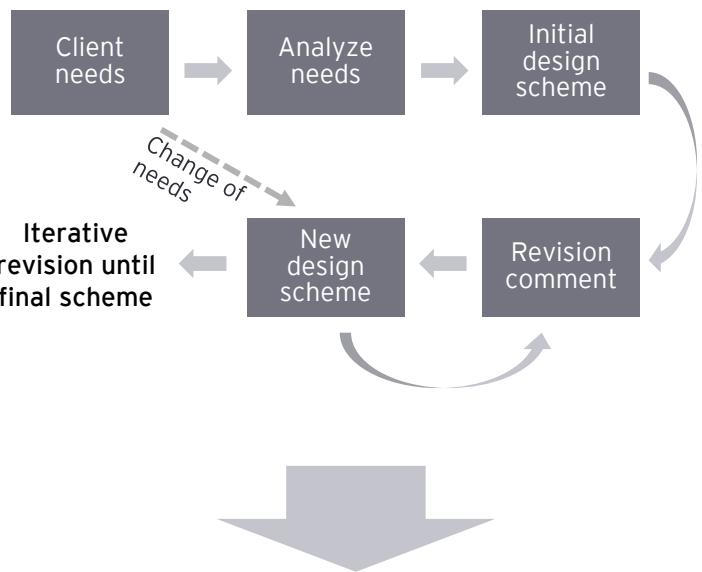
The data generated from the pre-planning and design stage of real estate projects are used in subsequent investment, construction, marketing and other related activities. Therefore, it is critical for the development of this field to learn how to produce, compile, analyze and share data in order to maximize value.

Traditional project design requirements are often communicated through the waterfall model, where designers are required to design and revise their proposals based on client needs and feedback. The entire process could be lengthy and tedious. A traditional work model like this is only feasible if the client's needs remain fairly constant throughout the design process. When business environments rapidly change, timely responses to market needs and policy requirements are key considerations during a project's initial planning and design phase.

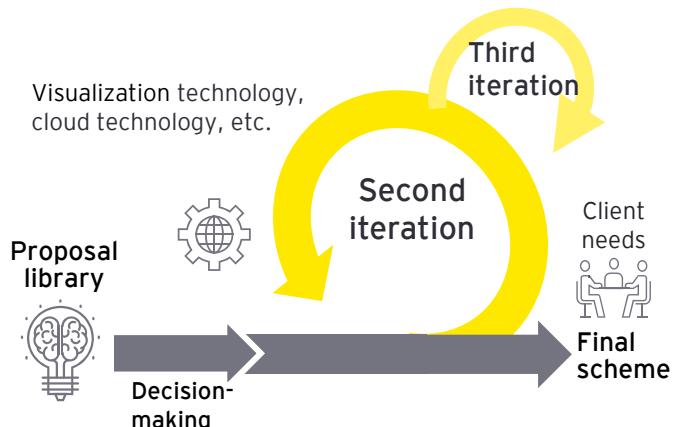
Furthermore, the increasing applicability of digital solutions has made it possible for AI technology, cloud technology and visualization to create a virtual space with real-time visibility, allowing clients to view and predict various schemes of their proposals. This enables timely feedback and prompt adjustments from the designers.

On the other hand, digitalized precision solutions can help enterprises estimate costs and make decisions for precision investments. Given the currently conservative sentiments in the market, real estate enterprises need to produce land research that is much more detailed and accurate, collecting large amounts of data for city and customer research. With the help of AI, big data analytics and other technologies, these enterprises can build a multi-dimensional, precise and data-driven investment system.

Traditional waterfall model:



Agile design iteration model:



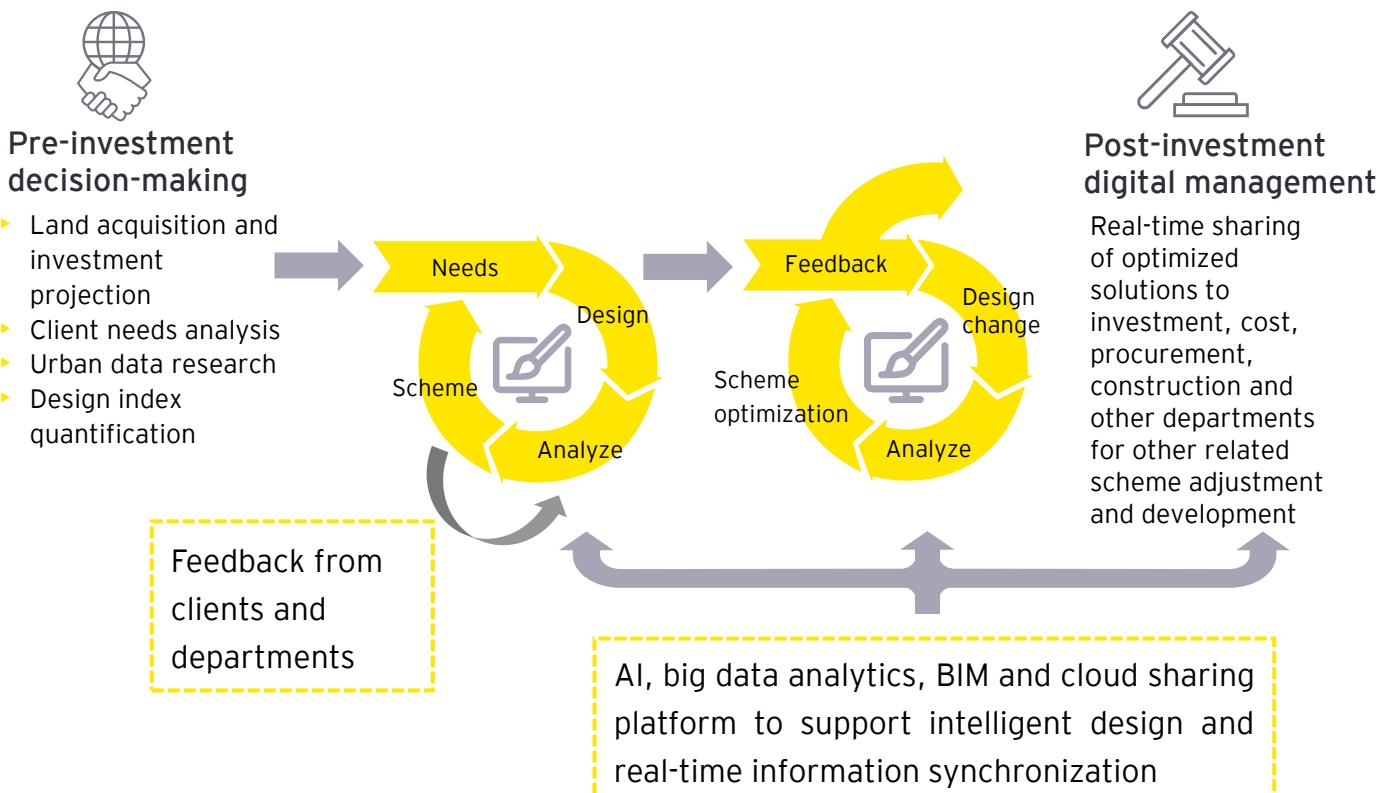
Source : EY interview

Post-investment management of performance indicators strengthens the interconnection along the industry supply chain

After finalizing the proposal, real estate companies will convert the design data into cost and investment-related measurements and share them amongst cost, marketing, engineering, procurement, investment and other departments. During this time, any adjustments in computational logic will be reverted to the design department, allowing designers to make corresponding modifications. With the support of smart technology, proposals and designs can now be digitally reviewed by artificial intelligence to help designers quickly identify non-compliance issues. These technologies are also useful during the engineering phase as they can automatically generate a wide range of proposals based on algorithms and provide multi-dimensional judgement on building performance and construction cycle. These capabilities deliver a basis for preliminary judgement that will inform subsequent construction plans.

In addition, the figures produced during the planning and design stage will be delivered to the enterprise's own evaluation system, generating preliminary data for the project's evaluation template. This will support the review of design indexes in any subsequent stage, ultimately enabling traceability for the entire development process of the real estate project. These figures will also be converted into a set of standardized data, creating a knowledge synthesis that will form the basis of future learning references within the enterprise.

Case study: A leading GBA AI-based design solution provider offers digital products to empower pre-investment decision-making and post-investment management of design projects



Source: EY interview

Smart construction

Moving toward eco-friendly building material production

In recent years, the total construction area in Guangdong Province has benefited from development of the GBA city cluster¹. At present, the GBA is 70% urbanized and is ready for more construction projects. The call for sustainable development in the GBA will require the reduction of carbon emissions resulting from future construction. Research data released by the China Association of Building Energy Efficiency (CABEE) show² that total carbon emissions from construction projects accounted for about 50.6% of the nation's total carbon emissions in 2019. Within this number, 28% came from building material production, exceeding the total emissions from building construction and building operation combined. By using environmentally-friendly building materials, we can approach smart construction by reducing carbon emissions significantly.

Transforming from "sites" to "factories" within the digital context

Digitalization throughout the entire supply chain is also a key direction for enterprises to consider in the process of comprehensive digital construction. Real estate developers often struggle with the issue of unqualified suppliers and substandard building materials. As a result they expend significant time and effort to find trustworthy partners. For small to medium-size building material suppliers, a key concern is to line up purchasers. Digital reform will help synchronize procurement information across departments, and put in place an automatic internal approval process that will serve the interest of all parties involved.

The complexity of the construction site environment, along with unpredictable factors such as worker movement, makes it difficult to manage construction sites. It takes new operational approaches and technology to improve construction quality, safety and efficiency. Based on the transformation seen in the manufacturing industry, whereby turning "sites" into "factories" has resulted in standardized and automated operation and reduced incidents of manual intervention, the same priority should guide the future development of the construction industry.

Changes in construction area in Guangdong Province, 2017-2021 (Unit: %)



Percentage of carbon emissions emanating from construction activities to total national carbon emissions, 2019

Total emissions in the construction process

50.6%

Emissions by phase in the construction process

28.0%
Production
of building
materials

1.0%
Building
construction

21.6%
Building
operation

Source:

¹ The Guangdong Provincial Bureau of Statistics

² The Research Report on China's Building Energy Consumption and Carbon Emission 2021, the China Building Energy Efficiency Association's Special Committee on Building Energy Consumption and Carbon Emission Data

Currently, the real estate development industry is committed to using AI-based construction robots to coordinate new materials and assemble building technologies. This type of technology will improve the precision and automation of on-site construction, meanwhile attaining environmental benefits and reducing labor costs. As we have learned from the executive interviews, leading real estate companies are keen on overcoming the existing barriers in smart hardware and software (such as SaaS) in construction robotics. They aim to invest in software technologies that play the role of the "brain hub," which can help robots make timely adjustments and enable precise management of complex construction sites. In addition, from the estimation of construction materials and construction work period to the introduction of robots, the accuracy of planning data in the upstream will affect the management of subsequent construction work. Therefore, to drive industry-wide reforms, leading real estate enterprises are closely following developments in BIM technology and making timely investments in the same.

Meanwhile, a host of leading technological solutions have emerged to resolve the lack of transparency in project management and lagging quality control. With capabilities in mobile internet, cloud technology, extensive data analysis and visualization, enterprises will develop the online visualization of the entire construction process.

Case study: In response to the national initiative for low carbon emissions, a leading developer in the GBA is promoting certification and procurement of green building materials based on its past experience in supply chain management



Credentials backed by industry experts



Leading industry experts advise on credential assessment mechanisms, establish certification criteria and issue certificates for qualified suppliers.

Efficient certification declaration process



Provide an optimized declaration workflow to accelerate consultation, document preparation and expert review processes, and therefore improve efficiency and reduce reporting costs.

Precision marketing and dedicated promotion



Use cloud computing and big data analytics to provide registered enterprises with digital precision marketing services. Set up dedicated sourcing channels to promote the sourcing of certificated green building material.

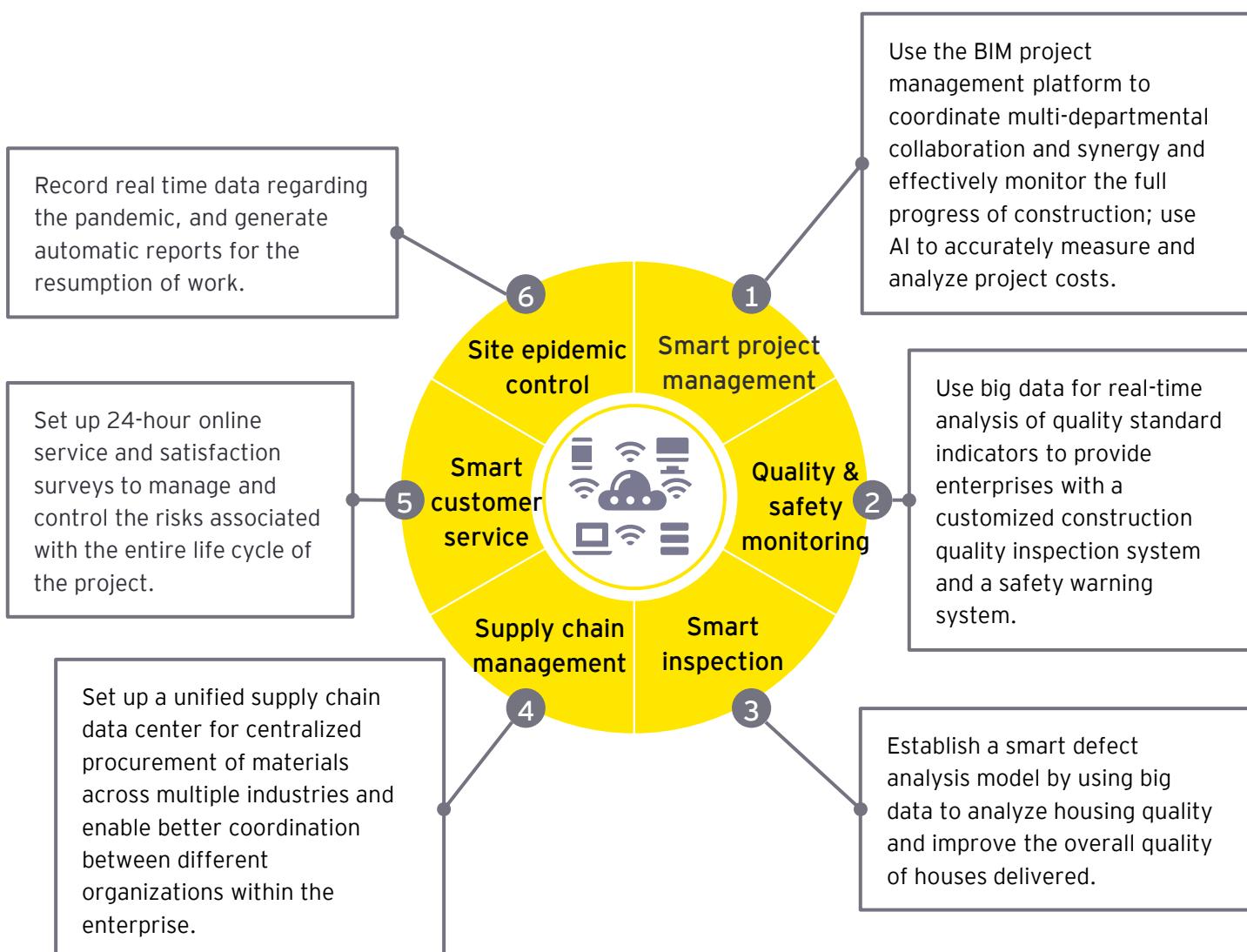
Additional points for tender, gaining extra credibility



Certified enterprises will receive extra points in the Group's centralized or joint procurement bidding evaluation, helping them obtain prioritized purchase orders.

Source: EY interview

Case study: A leading prop-tech company in the GBA uses a cloud-based engineering management platform to maintain transparency in construction process management



Source: EY interview

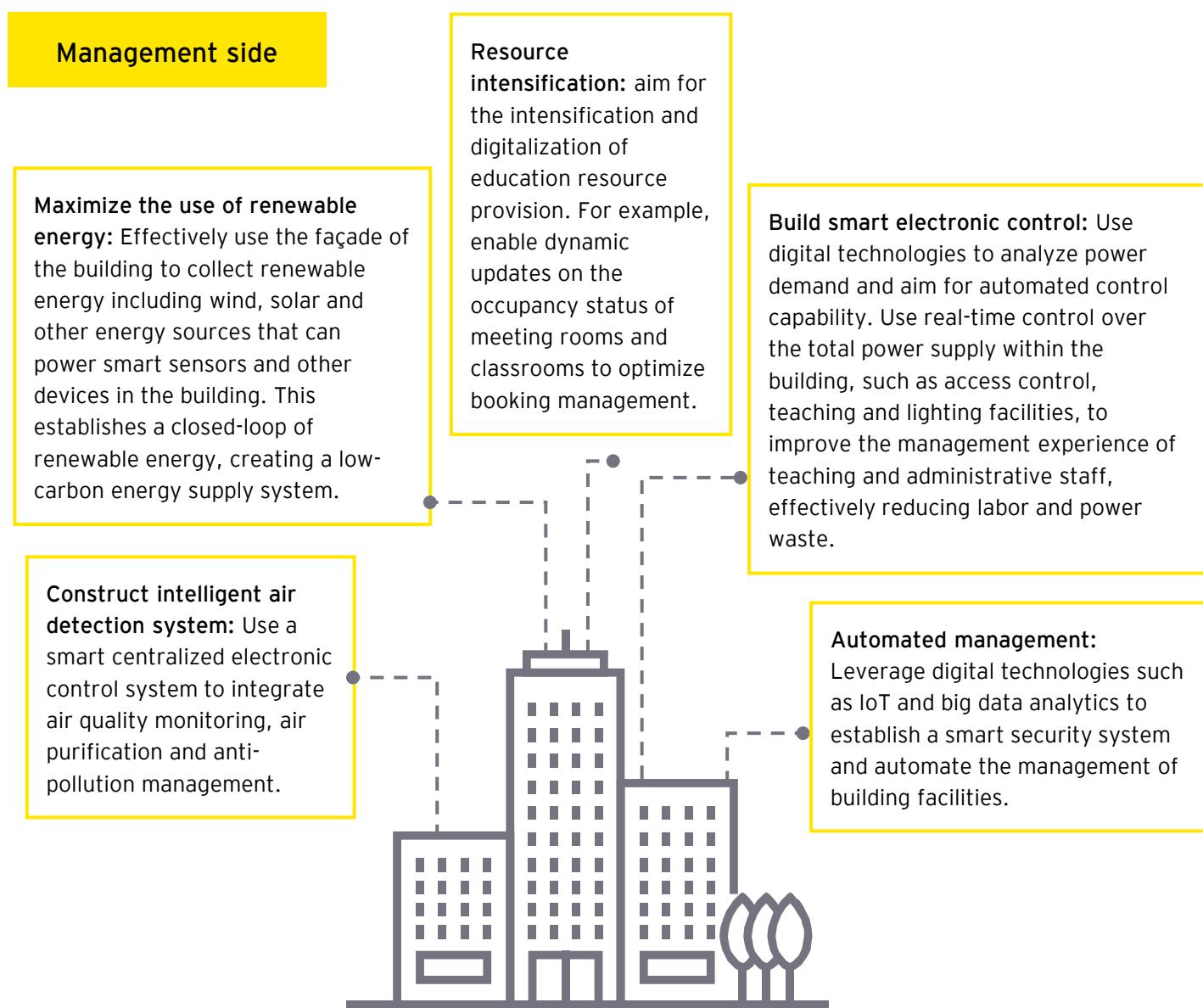
Smart buildings and space operation

Smart buildings are about the fusing of physical and virtual space by digital applications

Smart buildings empower both management and end users. For management, smart buildings represent a means of improving management efficiency and reduce costs through technical means such as digital energy monitoring, facility operation and real-time people flow visualizations. It also provides decision-making support for future space expansion. For end users, a single interface with integrated functions, such as indoor navigation, automatic temperature control and smart parking, can improve the comfort and convenience of users within the space.

The fast-developing supply chain for software and hardware R&D and production, along with the rapid growth of 5G commercial applications in the GBA, will provide a solid technical foundation for smart buildings. With the additional promotion of smart city-related policies, the GBA is expected to bring together the integration of physical and virtual space meeting the specific needs of different scenarios.

Taking a school campus as an example, future smart buildings should aim beyond a mere digital improvement for the physical space. Instead it should be a seamless fusion of physical and virtual spaces



End user side



Smart space:

- Remove traditional restrictions in space by softening the boundary between formal and informal teaching and learning space. Promote a scenario-based, experiential and personalized learning environment.
- Break down the traditional restrictions in time by introducing the new concept of 24-7 into smart buildings with integrated teaching, meeting, resting, leisure, fitness and living functionalities. Establish a heavily-utilized, community-based campus.

Interactive instruction:

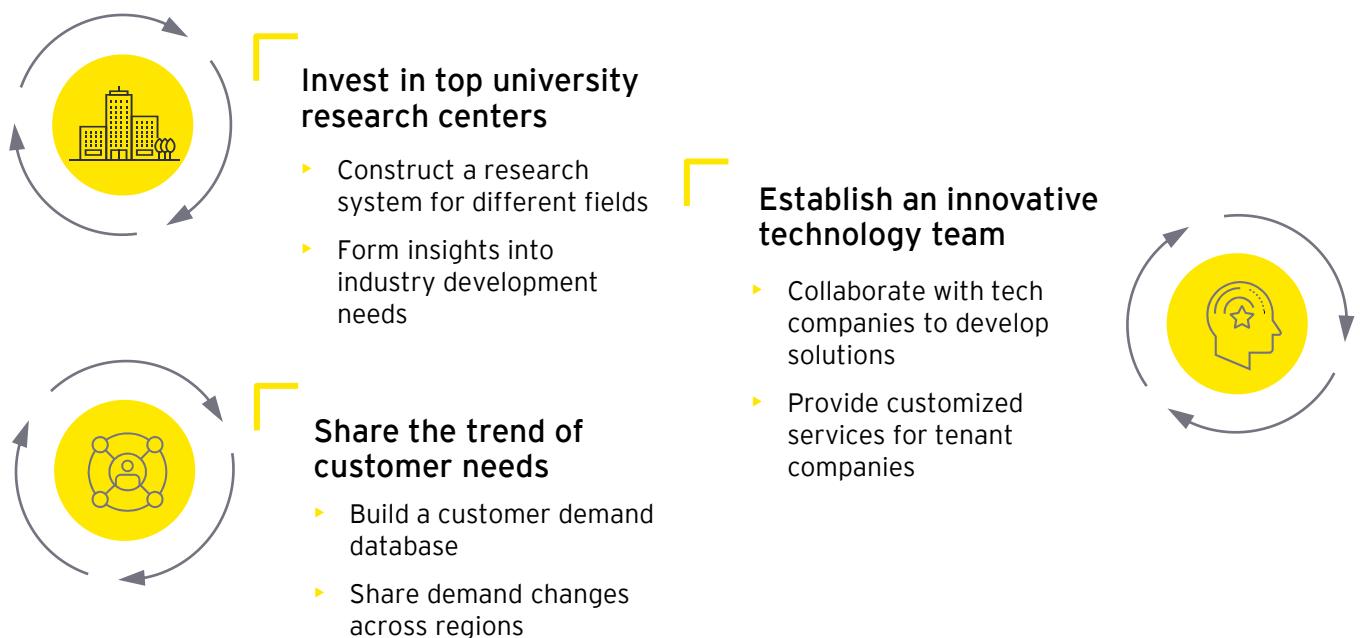
- Strengthen network infrastructure, use new digital technologies such as AR / VR to promote virtual simulated laboratories and other types of smart classrooms. In addition, facilitate interactive applications for the integration of online and offline learning.
- Facilitate cross-institutional and cross-regional collaboration. Create an information-based, network-supported teaching environment with an immersive experience. Endeavor to meet the needs of both big- and small-group interactive teaching and learning. Make learning a personalized experience.

Future space operations should prioritize the user's needs by creating customized products

Space operation should be guided by the users' needs, including their primary demands and any other derived demands. Furthermore, as epidemic measures become the norm, there is a trend toward contactless spatial interaction. Taking office buildings as an example, the main objective for office workers is work efficiency. Therefore, smart office facilities, such as smart conference rooms and smart lighting control, will be increasingly demanded by end users. Office occupants may also have derived demands in resting, dining and fitness. These needs can be fulfilled by adding smart sleeping cabins, 24-hour convenience stores and smart gyms in the office space. With a growing population of young workers, it is important to consider the all-round needs of these working professionals.

The rapid development of high-tech industries in the GBA is supported by national development policies such as the Outline Development Plan for the GBA and the 14th Five-Year Plan of Guangdong Province. It is expected to lead to the further concentration of high-tech industries in the GBA in the near future. With adequate understanding of the value chain sectors and key production elements of emerging industries, the real estate industry will better serve clients by offering industrial space that is specialized, customized and differentiated with value-added services. We have learned from the executive interviews that several leading real estate developers are partnering with universities and research institutions to conduct in-depth research on the company clients' industrial value chains. This partnership allows them to better understand the primary space needs for industrial development (i.e., pilot production space) and to enhance the integration of technology and industrial space by further collaborating with technology companies.

Case study: A real estate developer in the GBA provides customized industrial services to its company clients through extensive external collaborations



Source : EY interview



Smart asset management

Appreciate the value of inventory assets with data intelligence and introduce smart asset management tools that come with strong adaptability

Proper real estate asset management requires diligent oversight of portfolio performance and judgement in making operational decisions. The real estate industry in the GBA has stepped into the inventory era, and lean management of inventory assets has become the focus of investors.

In terms of internal asset management, there is a rising need for digitalization as many mainstream industries are still adhering to conventional methods in asset evaluation. Our interviews with industry executives revealed that companies expect to use a unified operating interface to conduct visualized life-cycle tracking and analysis by integrating data coming from various property portfolios, and this demand is pressing as they are faced with increasingly massive financial data and non-financial data. They can use auto-synchronized data, asset maps and dynamic dashboards to inform real-time decision-making. An intelligent risk-warning mechanism can be established to manage risks from all aspects of the business, including asset, operation, finance and customer.

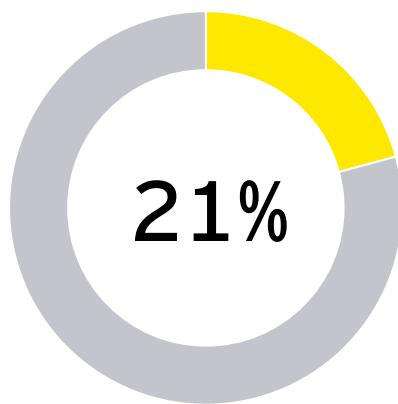
Furthermore, for leading asset management enterprises, their business in the GBA typically involves the management of cross-boundary (such as Shenzhen and Hong Kong) real estate assets. Therefore, the key purchasing criteria for real estate asset managers in the GBA will include whether the asset management product is equipped with multilingual interfaces, unified data standards, customizable data reports and readily accessible product maintenance services.

Driven by policies, commercial and logistics real estate will see a wave of digitalization and green asset operations

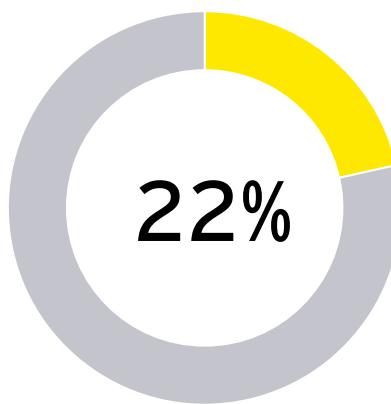
Improving the operation of existing assets is also an industry focus. The GBA is expected to rise to national leadership with its specialty in commercial and logistics real estate. Regarding commercial real estate, the Shenzhen Municipal Bureau of Commerce released the Several Measures of Shenzhen on Accelerating the Construction of an International Consumption Center City in mid-February 2022. The policy emphasizes the need to free up the market's purchasing power by digital means. The construction of digitalized business venues will bring more data, the reliance upon which can help companies build long-term customer management models that strengthen customer loyalty. Companies may also re-engage existing members by setting up standardized membership profiles and a tagging system. These initiatives form the basis for personalized customer service. Owing to the fact that most real estate companies run an array of businesses, companies can fully integrate membership data from various data pools for unified operation management and membership traffic exchange.

Regarding logistics real estate, the advantages of the GBA as a logistics hub are apparent. With the accelerated pace of development initiatives such as interconnected logistics information, stock connect and smart ports, the GBA will step up efforts on logistics technology innovation and cross-boundary interconnection. The 2021 national statistics of the express delivery industry show that the nine GBA mainland cities are leading China in package volume and business revenue. In addition, there is a high level of foreign economic interaction in the GBA driven by the express delivery businesses of international, Hong Kong, Macau and Taiwan (HMT) origins.

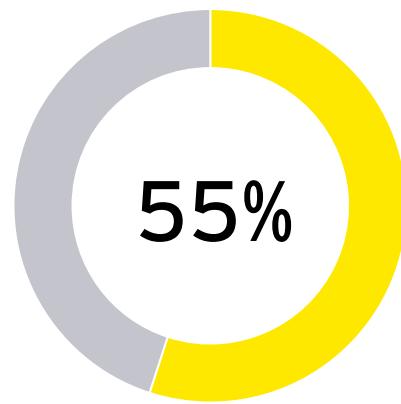
Logistics industry development in the GBA takes the lead in China, 2021



Percentage of package volume of the nine GBA mainland cities to the national total



Percentage of express business revenue from the nine GBA mainland cities to the national total



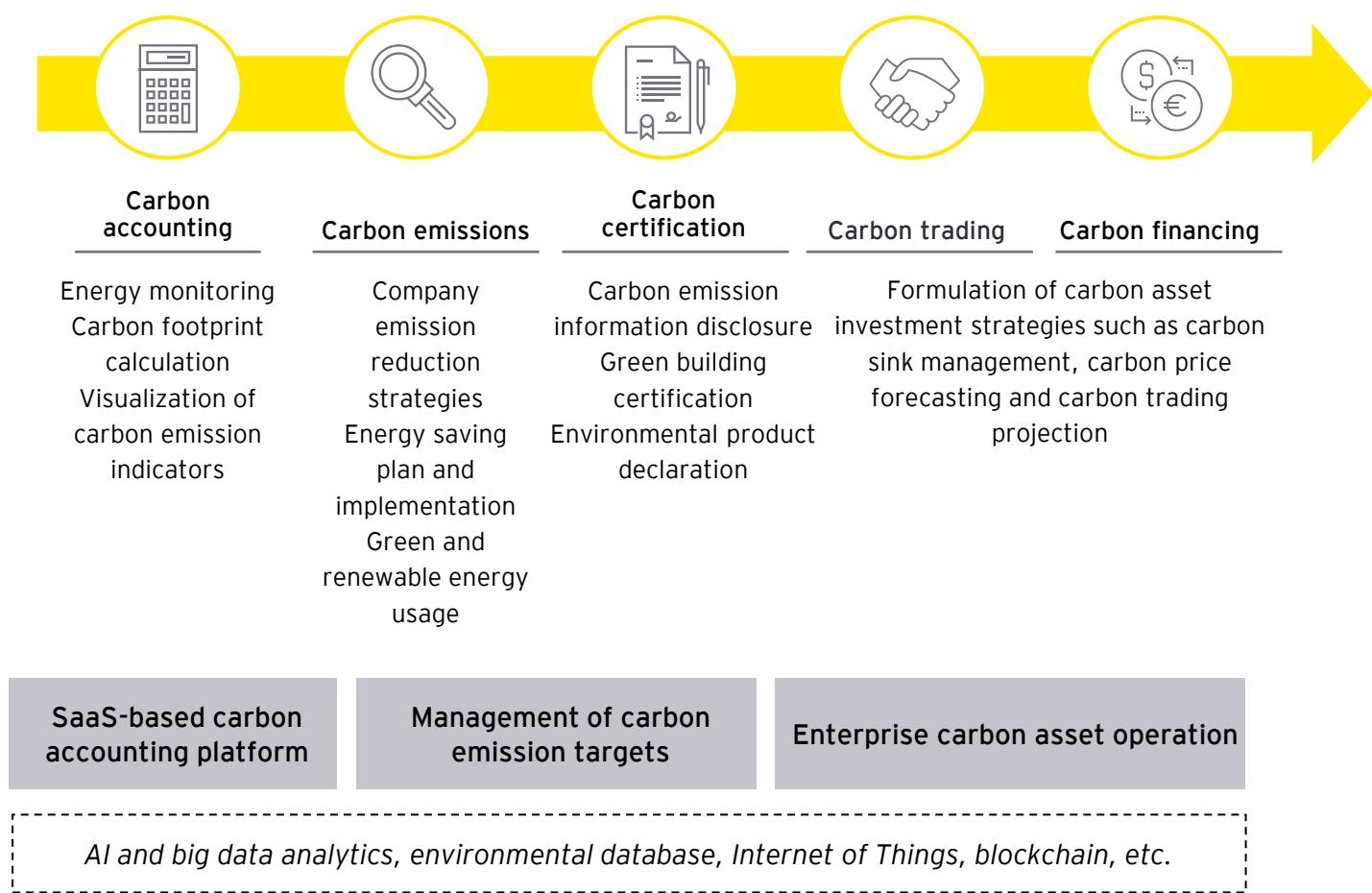
Percentage of international and HMT package volume of the nine GBA mainland cities to the national total

Source: State Post Bureau, Municipal Post Bureau

With the introduction of the Implementation Plan on Promoting the High-Quality Development of Postal and Express Industry in Guangdong Province in May 2021, the logistics industry in the GBA will further develop to become more digital, smart, sustainable and international. The GBA is expected to transform into a global logistics hub.

As to sustainability, some leaders of the logistics industry are already one step ahead. They have been transforming their role as long-term asset operators to asset operation service providers by leveraging their expertise in asset operation.

Case study: A leading logistics real estate operator provides value-added life-cycle carbon management services for logistics industrial parks in addition to its major businesses



Source: EY interview

Future outlook and recommendations

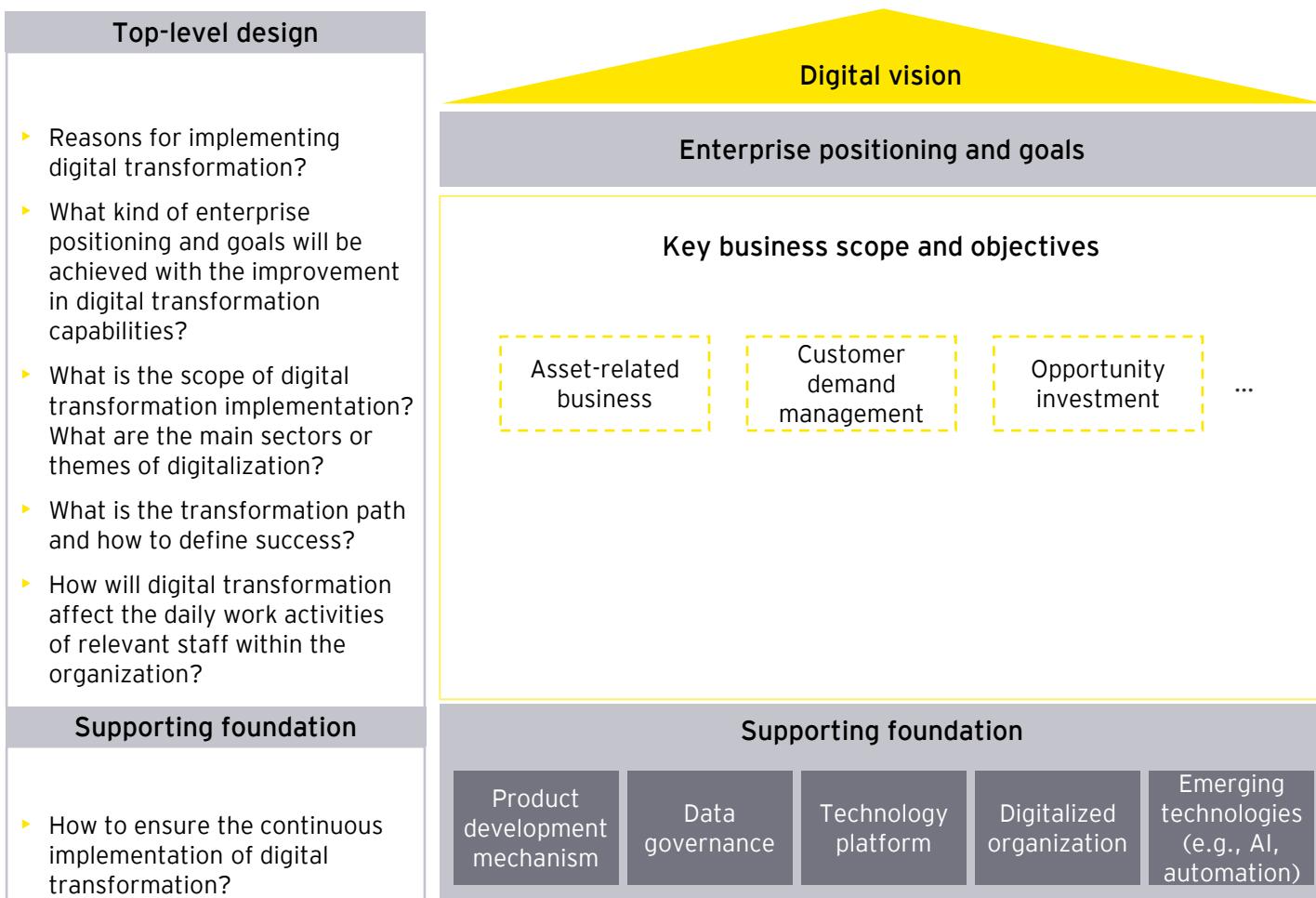
Develop a systematic digital innovation strategy

To ensure the implementation of digital transformation, enterprises should look to formulate a real estate digital innovation strategy by a top-down approach. Based on EY GBA's experience, many companies have missed opportunities due to the lack of proven strategies. Formulation of a digital strategy mainly involves the following two aspects:

Develop a top-level design: Including the digital vision, strategy and implementation path. It is imperative to define clearly the reason to drive digital transformation, the scope of digital transformation, any competitive advantages to reach by digitalization, the capability gaps that must be addressed, the transformation roadmap and finally the measurements of success.

Building a foundation of support: Including building a technical platform for internal management and external output to ensure standardized data management, exploring emerging technologies to improve business operation efficiency, establishing a digital product or service development mechanism and building an associated branding mechanism that breaks away from the traditional operating model and forms a suitable digital operating model.

Design elements of a digital transformation strategy



Reshape the operating model to complement the innovation strategy

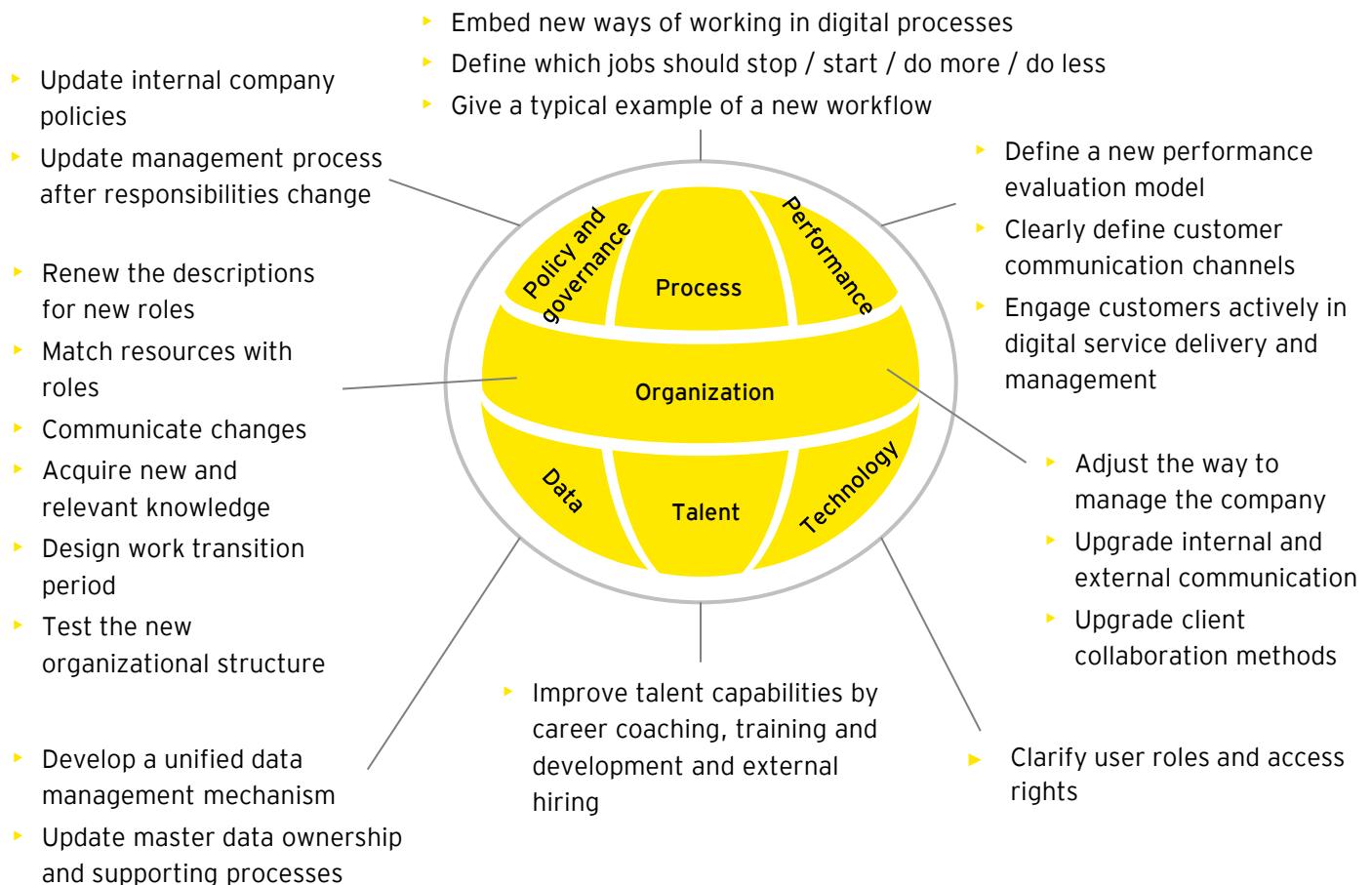
The traditional operating model is hardly complementary to digital transformation. In the survey, more than half of the interviewed companies strongly endorsed the factors of technological leadership, agile development models and company innovation management capabilities in promoting digital transformation.

A digital operating model is the nexus between digital strategy, staff and technology that enables effective execution and strategic alignment. The aim is to answer the question of how businesses can work, invest and adapt quickly in a digital context. This requires management to begin their thinking with the end in mind. Companies must consider what kind of operating model is needed to support digital innovation, and establish a comprehensive underlying support system covering organizational structure, resources, mechanisms and governance model to ensure a solid foundation for technology application.

The following are the key design elements for adjusting the enterprise operating model:

- ▶ Create new ways of working in the digital context and establish agile development processes for better cross-functional collaboration
- ▶ Clearly define the interface between the digital process owner and the relevant departments to help smooth the operation
- ▶ Rethink the performance evaluation system and incentive mechanism of each department to encourage active participation in innovative initiatives
- ▶ Adjust the management model to maintain its effectiveness and affirm management's driving role in digital transformation
- ▶ Cultivate an open and collaborative culture to support continuous development of innovative ideas within the company

Reshaping the operating model in the digital age





We learned from the executive interviews that the following two key capabilities require management's special attention during the process of optimizing the operating model:

Alignment of data management standards and data synchronization

Survey results show that more than 50% of the interviewed companies adopted point solutions to address the pain points identified as the way they implement prop-tech. This implies that most enterprises tend to adopt technology to serve cost-effectiveness, adopting technology tools rather than systematically deploying and implementing digital transformation. More than one-third of the interviewed companies have encountered challenges in integrating new and legacy systems. This shows the drawbacks of the piecemeal approach and localized deployment.

For a typical large-scale real estate conglomerate, the challenges in the process of digital transformation mainly concern two respects:

One is lack of a company-wide standardized data collection method. In the early stage, the subsidiaries and/or business departments collect data purely based on their own business needs without a holistic strategic view. Therefore, in a later stage, difficulties in data integration will surface at the company-wide level.

In addition, there is an existing information gap and low willingness in data sharing, making it difficult to implement data synchronization across departments or subsidiaries.

From a long-term perspective, setting up a dedicated digital transformation team and reviewing data asset with a top-down approach will provide the basis for establishing a unified data management mechanism and mitigating data asset silos for successful digital transformation.

Cultivate data science talent

Data science for the real estate industry involves statistics, IT and industry knowledge. With these skills, one can conduct forecasts on business trend or demand changes through massive data analysis. After enterprises accumulate their data assets, it is up to data scientists to render these data assets into business insights. Enterprises are therefore encouraged to develop data science talent to manage data gathering from the top management level. This will assist management in formulating standardized data management and application processes to generate forward-looking insights for front-end business activities, enhancing existing business value or tapping into new markets. In terms of talent development, companies can help transform in-house talent skills through career counselling, training and development projects, external recruitment and the introduction of a new performance assessment scheme. For project management, the role of IT staff within the company should be enhanced with a "Dual Manager" model, whereby the business staff will be project managers and the IT staff will be deputy project managers, to facilitate the integration of business and technology.

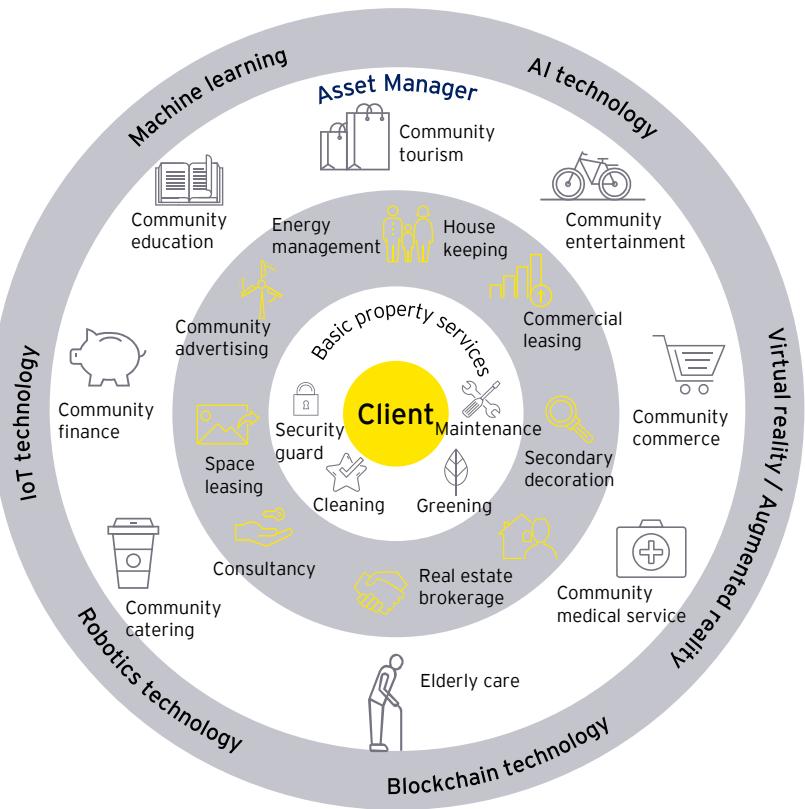
Establish a broad technology partnership ecosystem

After clarifying the strategic design, the top management must consider the development of core digital capabilities.

We learned from the executive interviews that most leading real estate companies in the GBA will choose ecological cooperation with complementary advantages and resource integration as their approach. The leading companies build their own innovation ecosystems through strategic alliances, investment and financing, mergers and acquisitions, etc. In this way, they make full use of ecosystem resources, develop intelligent operations and data-driven decision-making, optimize tenant experience, ensure information technology and data security, and promote the digitalization of business models.

In addition, from the view of the end users/clients, in order to improve product and service experience and provide more value-added services, future solutions toward integration, cross-border cooperation and industry integration are expected to continue to develop.

Taking property services as an example, an "Asset Manager" that can meet all the needs of the back-end value chain of the real estate industry will gradually emerge.



Understanding key digital capability models

Advantages	+	Disadvantages
Self-invested intelligent devices		<ul style="list-style-type: none">▶ High degree of autonomy:▶ With a high degree of authority in supplier selection, without concern to third-party interests <ul style="list-style-type: none">▶ Heavy investment:▶ Some hardware is expensive, and it is difficult to independently undertake investment in multiple projects at the same time▶ A large amount of hardware investment will gradually shift enterprises to become heavy asset-oriented
Self-developed software platforms		<ul style="list-style-type: none">▶ High degree of self-management:▶ There is no issue with third-party company partnership, and all systems and mechanisms are clear <ul style="list-style-type: none">▶ Lack of professional competence:▶ Compared with mature software suppliers, the company has no existing technical foundation, and both the talent introduction and platform construction periods are relatively long. The company may lose market opportunities <ul style="list-style-type: none">▶ Seek partners to acquire professional capabilities rapidly▶ Integrate resources from multiple channels to capture market opportunities



About us

ULI Team

James Wong Jr.

Chair, Greater Bay Area Sub-committee

David Faulkner

President, Asia Pacific

Phil Kim

Council Chair, Hong Kong

Ariel Shtarkman

Chair, HK Tech & Innovation Working Group

LinLin Wang

Vice Chair, Greater Bay Area Sub-committee

Ivan Ho

Vice Chair, Greater Bay Area Sub-committee

Harvey Coe

Member, Hong Kong and Greater Bay Area Sub-committees

Kelly Mai

Executive Director, Greater Bay Area

EY GBA Team

Jasmine Lee

Managing Partner of Hong Kong and Macau

Vincent Chan

Partner and Greater Bay Area Leader, Consulting*

Tony Tsang

Hong Kong and Macau Leader, Strategy and Transactions

Steve Lewis

Partner, Infrastructure Advisory, Hong Kong

William Huang

Managing Partner of China South

Chris Chan

Partner, Strategy and Transactions, Greater Bay Area

Alan Li

China South Leader, Strategy and Transactions*

Daniel Lu

Partner, Strategy and Transactions, China South

* Vincent Chan and Alan Li are Partners of Ernst & Young Advisory Services Limited and Ernst & Young (China) Advisory Limited, respectively



About the Urban Land Institute

The Urban Land Institute is a global, member-driven organization 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 2021 alone, more than 2,700 events, both virtual and in person, were held in 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.

More information is available at uli.org. Follow ULI on Twitter, Facebook, LinkedIn, and Instagram.

EY | Building a better working world

EY exists to build a better working world, helping to create long-term value for clients, people and society and build trust in the capital markets.

Enabled by data and technology, diverse EY teams in over 150 countries provide trust through assurance and help clients grow, transform and operate.

Working across assurance, consulting, law, strategy, tax and transactions, EY teams ask better questions to find new answers for the complex issues facing our world today.

EY refers to the global organization, and may refer to one or more, of the member firms of Ernst & Young Global Limited, each of which is a separate legal entity. Ernst & Young Global Limited, a UK company limited by guarantee, does not provide services to clients, nor does it own or control any member firm or act as the headquarters of any member firm. Information about how EY collects and uses personal data and a description of the rights individuals have under data protection legislation are available via ey.com/privacy. EY member firms do not practice law where prohibited by local laws. For more information about our organization, please visit ey.com.

© 2022, Ernst & Young Transactions Limited.
All Rights Reserved.

APAC no. 03015111
ED None

This material has been prepared for general informational purposes only and is not intended to be relied upon as accounting, tax, legal or other professional advice. Please refer to your advisors for specific advice.

ey.com/china

Follow us on WeChat

Scan the QR code and stay up-to-date with the latest EY news.

