

INDEPENDENT MARKET RESEARCH FOR PRC AND GLOBAL PBB, GSE AND MHS MARKET

Confidential for



中國消防企業集團有限公司
CHINA FIRE SAFETY ENTERPRISE GROUP LIMITED

Frost & Sullivan

March 15, 2018



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Terms, Abbreviations and Keywords

- ✓ **AGV:** Automatic Guided Vehicle
- ✓ **CAAC:** Civil Aviation Administration of China
- ✓ **CPSMA:** China Parking System Manufacturers Association
- ✓ **ERP:** Enterprise Resource Planning
- ✓ **GSE:** Ground Service Equipment
- ✓ **GPU:** Ground Power Unit
- ✓ **ICAO:** International Civil Aviation Organization
- ✓ **IATA:** International Air Transport Association
- ✓ **MHS:** Material Handling System
- ✓ **OICA:** International Organization of Motor Vehicle Manufacturers
- ✓ **PBB:** Passenger Boarding Bridge
- ✓ **PSH:** Lift-sliding Mechanical Parking System
- ✓ **PCS:** Vertical Lifting Mechanical Parking System
- ✓ **PCX:** Vertical Circulating Mechanical Parking System
- ✓ **PSX:** Lever Circulating Mechanical Parking System
- ✓ **PJS:** Mini Mechanical Parking System
- ✓ **PPY:** Slide Elevator Mechanical Parking System
- ✓ **PXD:** Aisle-stack Mechanical Parking System
- ✓ **PDX:** Multi-storey Circular Garage
- ✓ **RGV:** Rail Guided Vehicle
- ✓ **RFID:** Radio Frequency Identification Devices
- ✓ **RPK:** Revenue Passenger- Kilometers
- ✓ **R&D:** Research and Development
- ✓ **WMS:** Warehouse Management System
- ✓ **WCD:** Warehouse Control System
- ✓ **Civil Aviation Industry:** Civil aviation is one of two major categories of flying, representing all non-military aviation, both private and commercial.

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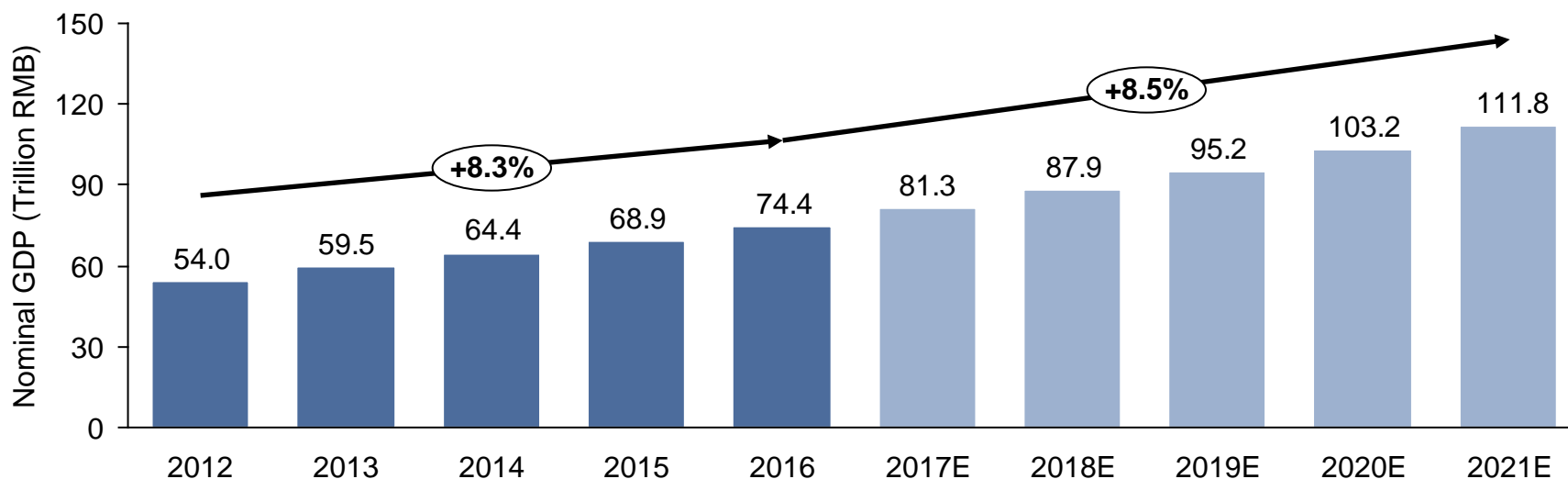
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China's Macro Economy

China's Nominal GDP

Nominal GDP (China), 2012 – 2021E



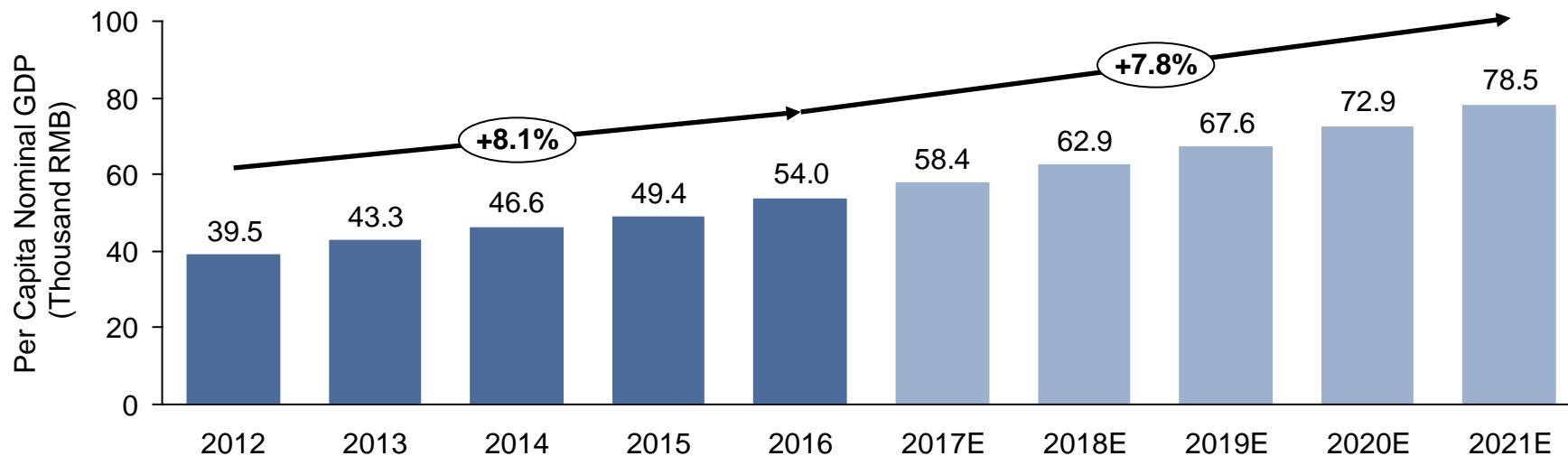
- Over the past years, the Chinese economy has maintained a solid growth pace even under the shock of the world financial crisis. During the time of world financial crisis, the Chinese government has taken effective stimulus policies to prevent the economy from huge decline. From 2012 to 2016, China's nominal GDP has realized a CAGR of 8.3%.
- Going forward, the Chinese authorities are likely to maintain the consistency and stability of macroeconomic policies so as to maintain macroeconomic stability. In the meantime, structural adjustment of the economy is predicted to be pushed forward strongly by the Chinese authorities to improve the quality and efficiency of economic development. The Chinese economy is likely to transfer from an investment-driven model to a consumption-driven model with the share of final consumption in GDP picking up. Under this trend, the Chinese economy is likely to maintain a sound and healthy development. According to International Monetary Fund (IMF), the Chinese economy is forecast to keep growing at a CAGR of 8.5% from 2016 to 2021.

Source: National Bureau of Statistics, IMF

China's Macro Economy

China's Per Capita Nominal GDP

Per Capita Nominal GDP (China), 2012 – 2021E



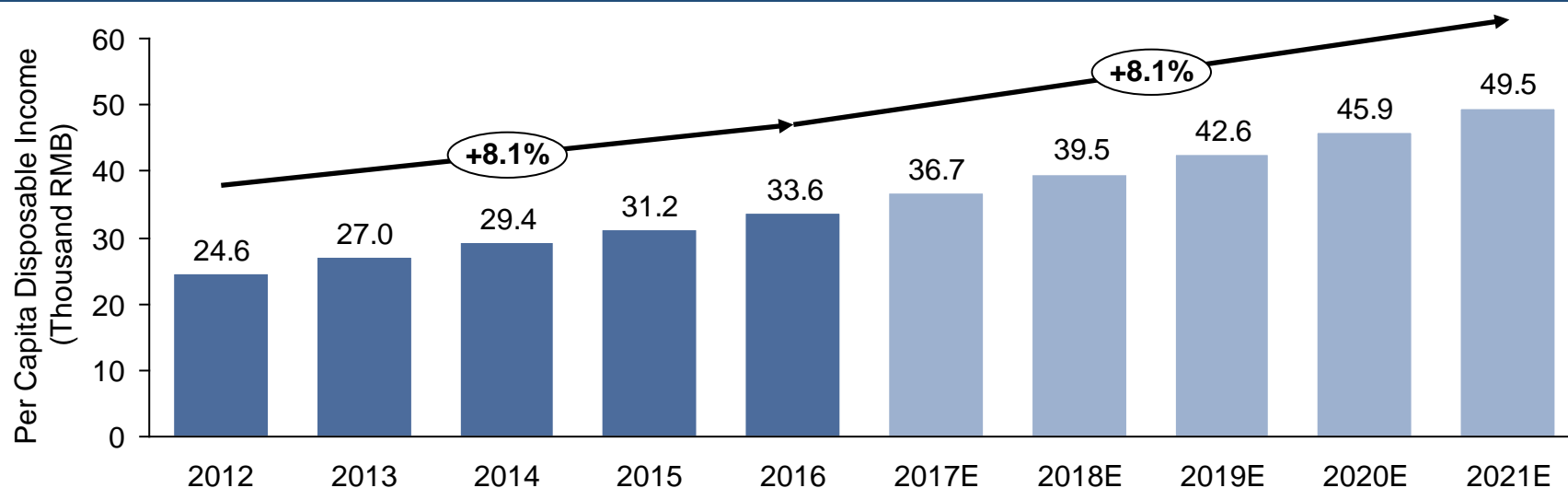
- In line with the fast growth of China's nominal GDP, per capita GDP also witnessed fast growth in the past years, reaching a CAGR of 8.1% from 2012 to 2016. Looking forward, the fast growth is expected to be maintained.
- The fast growth of per capita nominal GDP in China has also increased the income of Chinese people. Huge demand of consumer goods as well as service are stimulated.
- The growth of income also stimulate Chinese people's willingness of travel, boosting the tourism industry in China, as well as other related industries, such as hospitality industry, civil aviation industry, etc. This trend has been driving the construction of infrastructures, including airport, expressway, hotel, etc.

Source: National Bureau of Statistics, IMF

China's Macro Economy

China's Per Capita Annual Disposable Income of Urban Households

Per Capita Annual Disposable Income of Urban Households (China), 2012 – 2021E



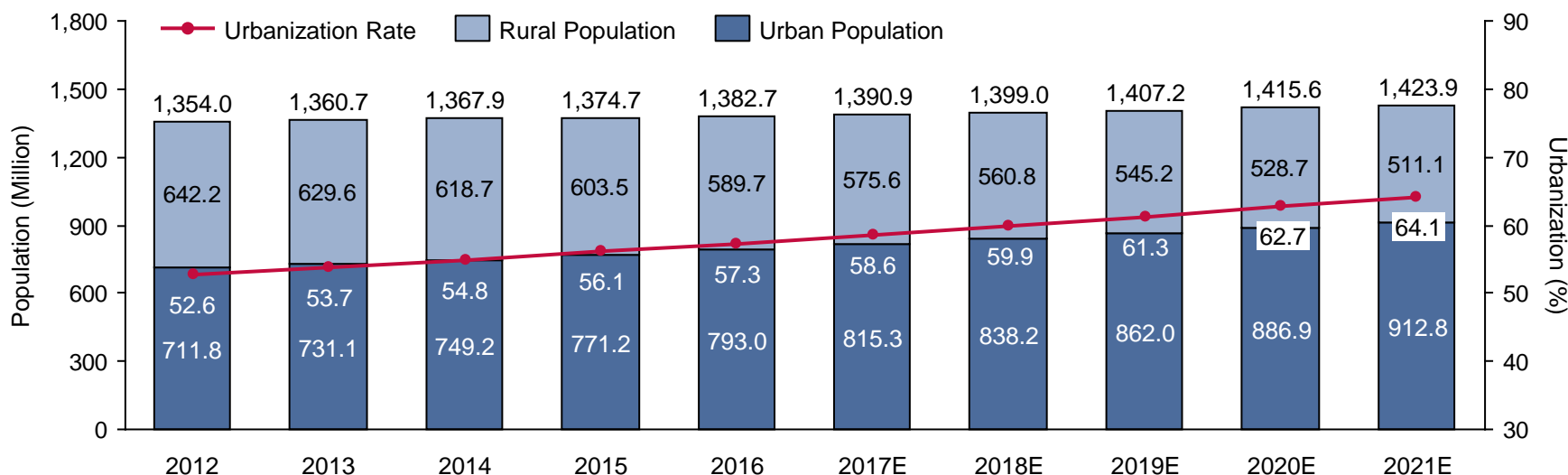
- Together with the continuous growth in economy and urbanization, the average income level of Chinese households has also increased continuously in recent years. In 2016, the per capita annual disposable income of urban households has increased to RMB33.6 thousand from RMB24.6 thousand in 2012.
- The growth of Chinese per capita annual disposable income of urban households has demonstrated positive effect on Chinese residents' purchasing power. Based on the prediction of steady increase of nominal GDP and urbanization in China for the next five years, which are expected to increase to RMB111.8 trillion and 64.1% in 2021 respectively, Frost & Sullivan estimates that by 2021, the per capita annual disposable income of urban households is expected to increase to RMB49.5 thousand with a CAGR of 8.1% from 2016.

Source: National Bureau of Statistics, IMF

China's Macro Economy

China's Population and Urbanization

Population and Urbanization (China), 2012 – 2021E



- China has the world's largest population. In 2016, China's total population reached 1,382.7 million. With the PRC Government investing a tremendous effort into controlling the enormous population, the population growth rate has been stable over the past five years. However, with the release of two child policy, the total population of China is estimated to grow at a moderate level, reaching 1,423.9 million in 2021.
- Due to the rapid economic development of China and the influx of migrants from rural areas to developed areas, Chinese urban population has been steadily increasing. China's rapid economic growth has fueled the unprecedented urbanization of its population since the 1990s. From 2012 to 2016, China's urban population increased from 711.8 million to 793.0 million, with a CAGR of 2.7%. During the same period, the urbanization rate in China increased from 52.6% in 2012 to 57.3% in 2016.
- With the continuous growth of urbanization, the urban population is expected to maintain a CAGR of 2.9% from 2016 to 2021. Frost & Sullivan forecasts that by 2021, China's urban population is expected to reach 912.8 million. Under the 'National Plan for Promoting Healthy Urbanization (《全国促进城镇化健康发展规划》)' raised in 2013, a new-style urbanization is expected to promote the urban-rural coordination and reasonable distribution. Accordingly, Frost & Sullivan forecasts China's urbanization rate is likely to increase gradually from 2016 to 2021, reaching 64.1% by 2021.

Source: National Bureau of Statistics, IMF

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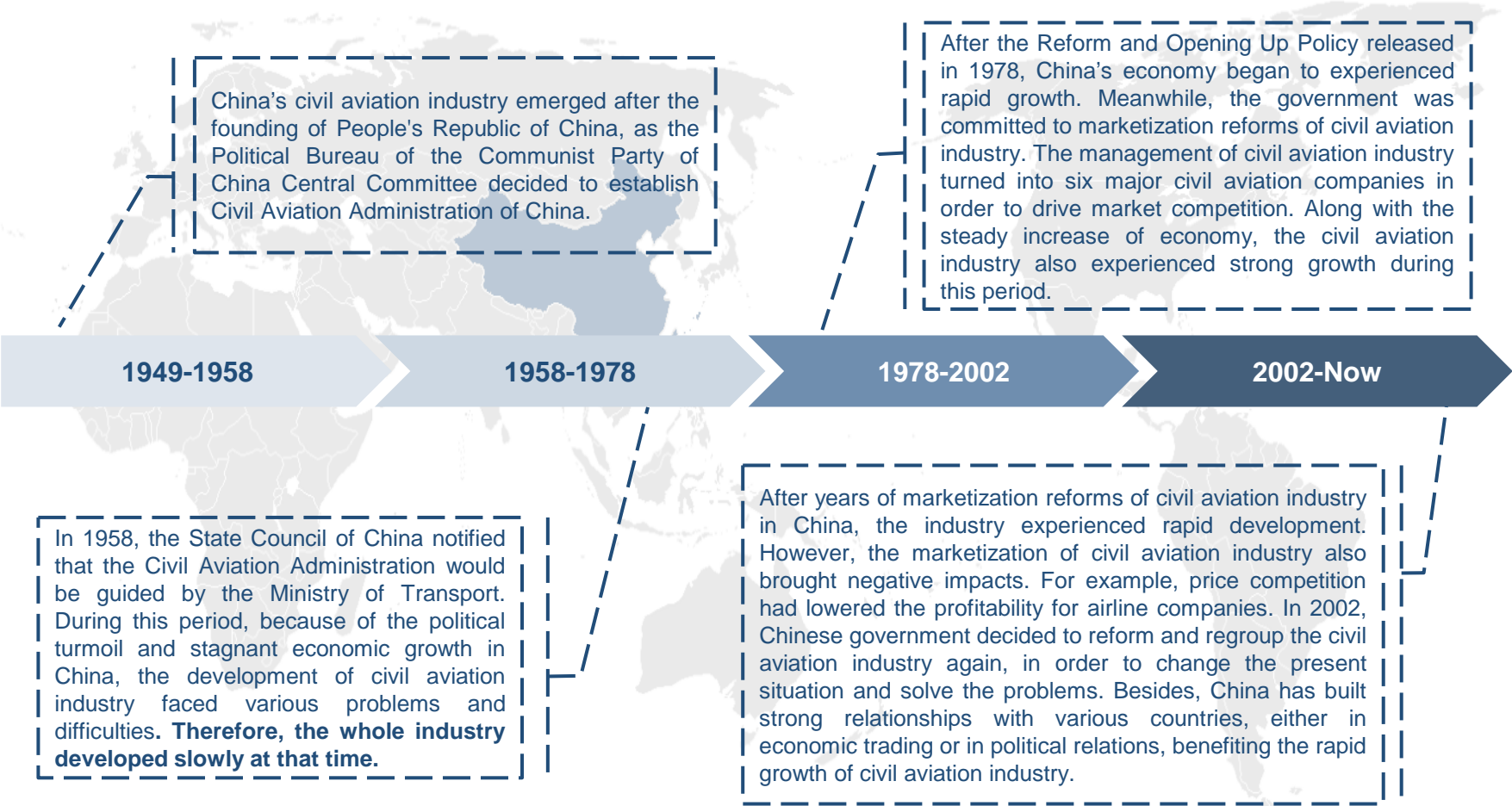
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Overview of China's Civil Aviation Industry

Developing History of China's Civil Aviation Industry

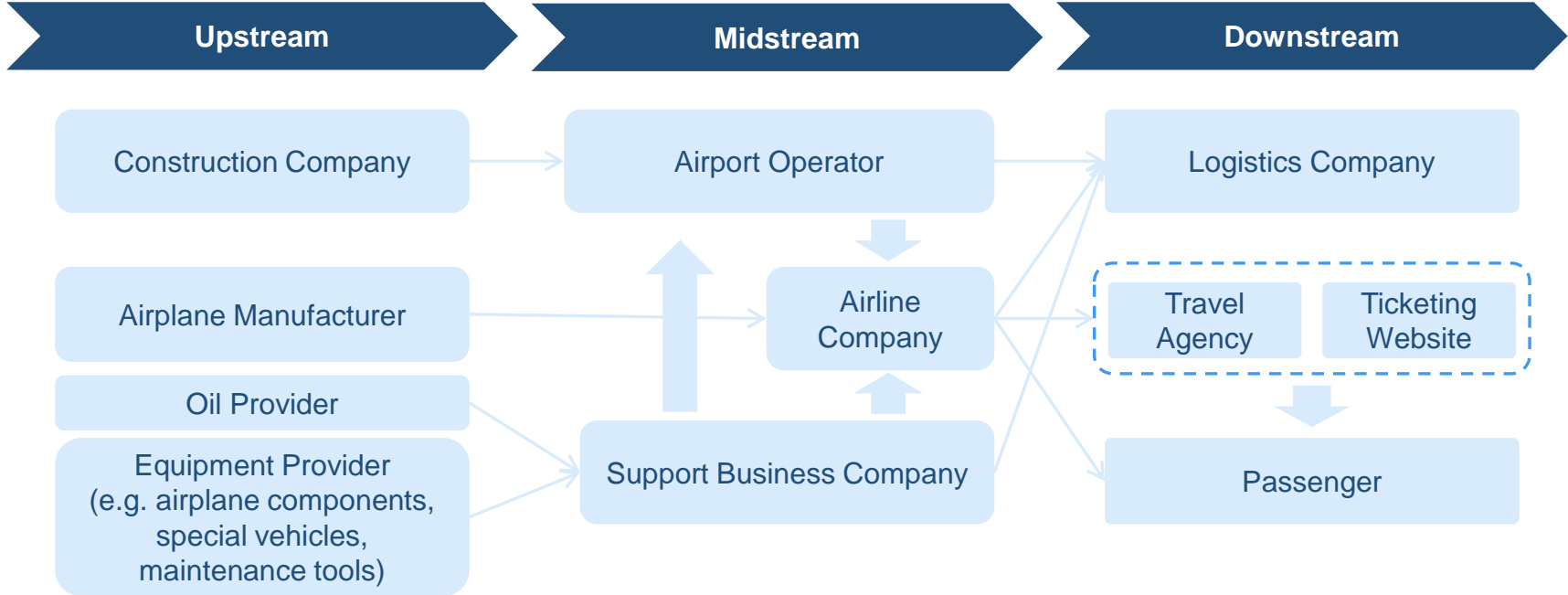
Developing History of Civil Aviation Industry (China), 1949-2016



Source: Frost & Sullivan

Overview of China's Civil Aviation Industry

Value Chain Analysis



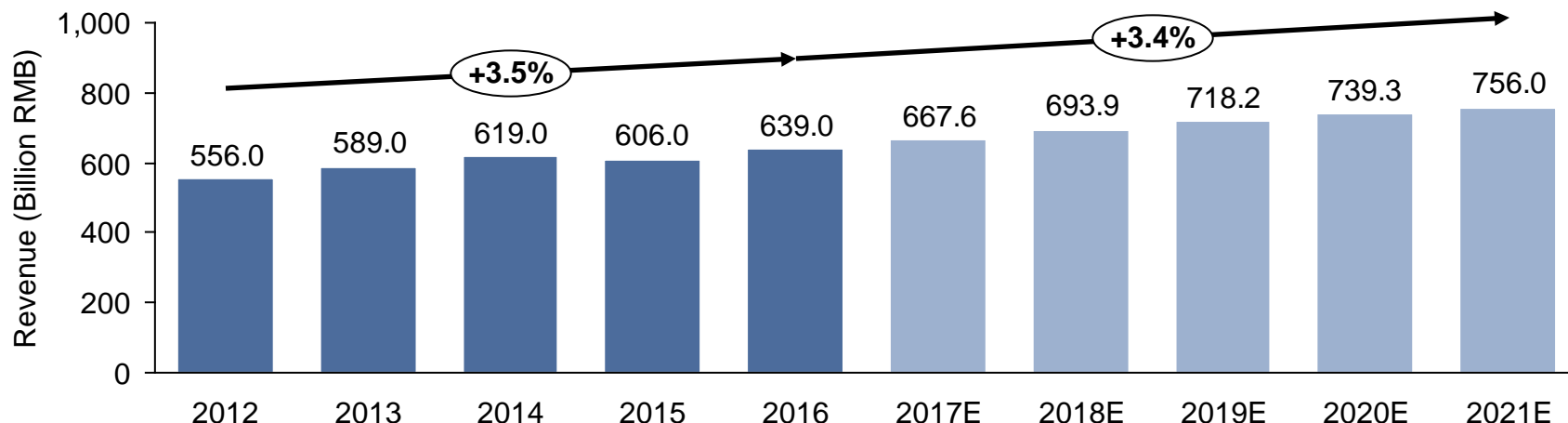
- China's civil aviation industry includes three major sectors, which are airport operator, airline company, and support business. Airport operators provide venues, runways, facilities and equipment for airline companies and some large logistics companies who own cargo airplanes. Support businesses provides supports for airline companies and logistics companies, including airplane components, special vehicles, information management, fuel supply, etc.
- The downstream of civil aviation airline companies is divided into 2 sectors: passengers and cargos. For passenger traffic, airline companies sell tickets to travel agencies or ticketing websites, as well as passenger directly. For cargo traffic, logistics companies are the major users.

Source: Frost & Sullivan

Overview of China's Civil Aviation Industry

Market Size of China's Civil Aviation Industry in terms of Revenue

Revenue of Civil Aviation Industry (China), 2012-2021E



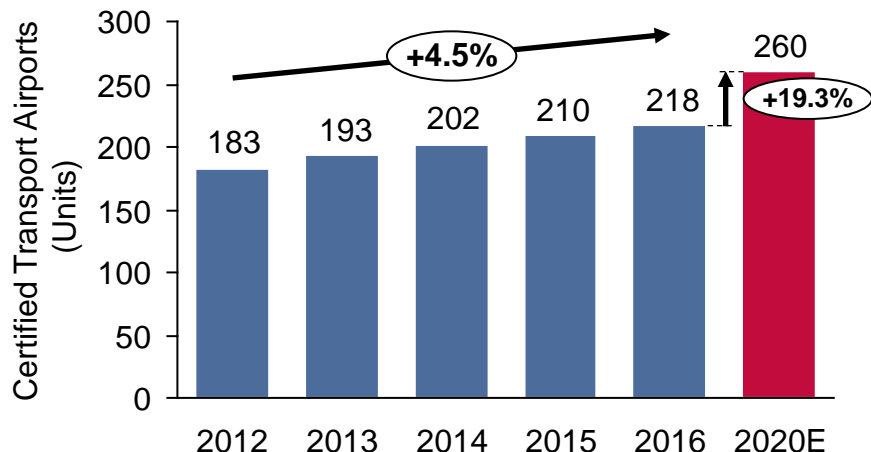
- In line with the continuous growth of macro economy, China's disposable income of households was also increased. The increase of households' disposable income has been driving the increase of willingness for travelling in China. Meanwhile, mass trading volume of merchandise lead to huge demands for cargo transportation. Therefore, this trend has been accelerating the development of China's civil aviation industry, including the airports construction, airlines, airplanes, and support businesses.
- In the historical period from 2012 to 2016, the revenue of China's civil aviation industry increased from RMB556.1 billion in 2012 to RMB639.3 billion in 2016, realizing a CAGR of 3.5%.
- Going forward, the China's National Development and Reform Commission has released "The 13th Five-Year Plan for Civil Aviation Industry" 《中国民用航空发展第十三个五年规划》, promoting the further development of civil aviation industry in China. China's civil aviation industry is expected to continuously focus on the improvement of performances in safety, quality of services, innovations, technologies, etc. The revenue of China's civil aviation industry is estimated to reach approximately RMB756.0 billion in 2021, realizing a CAGR of 3.4% from 2016 to 2021.

Source: CAAC, Frost & Sullivan

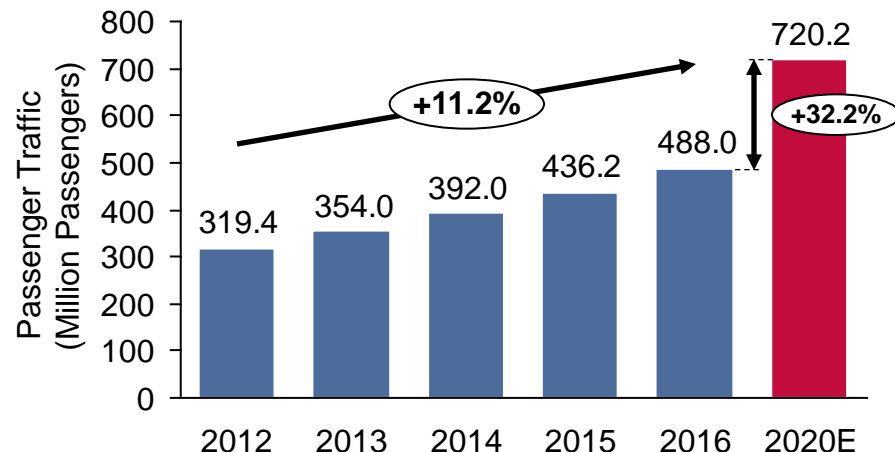
Overview of China's Civil Aviation Industry

Market Size of Airports China's Civil Aviation Industry

Number of Certified Transport Airports
(China), 2012-2016, 2020E



Passenger Traffic of Civil Aviation
(China), 2012-2016, 2020E



- Along with the continual growth in China's overall economy, the civil aviation industry has been observing steady growth. According to the Civil Aviation Administration of China, the number of certified transport airports (certified transport airports refer to those civil aviation airports acquired "Civil Airport License, 民用機場使用許可證" issued by CAAC) increased from 183 in 2012 to 218 in 2016, realizing a CAGR of 4.5%. Going forward, according to "The 13th Five-Year Plan for Civil Aviation Industry" 《中国民用航空发展第十三个五年规划》, the number of certified transport airports is likely to increase to 260 in 2020. The further increase in number of certified airports is expected to be driven by the continuous growth of logistics industry and tourism industry.
- Ministry of Transport of PRC has recorded that the passenger traffic of civil aviation increased from 319.4 million passengers in 2012 to 488.0 million passengers in 2016 by a double-digit CAGR of 11.2%. According to "The 13th Five-Year Plan for Civil Aviation Industry", the passenger traffic of civil aviation is expected to reach over 720 million in 2020. Such growth is driven by the increasing demand for civil aviation, either for business trips or personal tours.

Source: MOT, CAAC, Frost & Sullivan

Overview of China's Civil Aviation Industry

Market Drivers (1/2)

Major Drivers

- 1 Rising of China's Position In Global Economy
- 2 Increasing Number of Certified Transport Airport
- 3 Increasing Tourism Industry
- 4 Booming Logistics Industry



MAJOR DRIVERS

Major Drivers	Description
Rising of China's Position In Global Economy	China maintained a stable growth in nominal GDP over the past years from RMB54.0 trillion in 2012 to RMB74.4 trillion in 2016. The rapid growth in macro economy has led the rise of China's position in global economy. China is playing an important role in globalization of business and international trading, which is driving the demand for airlines and airports, either for businesses trips or transportation of goods. Going forward, China is expected to sustain the stable economic growth in the forecast period, resulting the further developing and expanding of civil aviation industry.
Increasing Number of Certified Transport Airport	Over the past five years, China spent huge investment and capital in the infrastructure construction, including the construction of airport. The amount of certified transport airport in China has increase from 183 in 2012 to 218 in 2016, driving the expanding and investing of airline companies and support businesses. Going forward, the China's National Development and Reform Commission has released "The 13th Five-Year Plan for Civil Aviation Industry" 《中国民用航空发展第十三个五年规划》, which is expected to increase the number of airports to 260 in the next 5 years and further drive the development of China's civil aviation industry, leading the increasing demands for airplanes, supporting equipment, airlines, etc.

Source: NBS, NDRC, CAAC, Frost&Sullivan

Overview of China's Civil Aviation Industry

Market Drivers (2/2)

Major Drivers

- 1 Rising of China's Position In Global Economy
- 2 Increasing Number of Certified Transport Airport
- 3 Increasing Tourism Industry
- 4 Booming Logistics Industry



MAJOR DRIVERS

Major Drivers	Description
<p>Increasing Tourism Industry</p>	<p>According to China National Tourism Administration, domestic tourist arrivals in China increased from 3.0 billion persons in 2012 to 4.4 billion persons in 2016. The increasing willingness of tourism is mainly caused by the increase of China's per capita annual disposable income, which increased from RMB16.5 thousand to RMB23.8 thousand, driving the demand for airports and airlines. Going forward, China's per capita annual disposable income is expected to over RMB36.8 thousand in 2021. Therefore, tourism industry is likely to remain growing, especially for outbound tourism, requiring the further developing and expanding of civil aviation industry.</p>
<p>Booming Logistics Industry</p>	<p>In recent years, China's e-commerce market has experienced rapid and outstanding growth. As a result, hundreds and millions of merchandises are trading online everyday, pushing the development of express industry in China. The increasing requirement of the national logistics system is driving the increase of cargo transportation. Especially, the cross-border e-commerce market is booming in the past years has been leading to more cargo traffic at airports, requiring more cargo airline services in China.</p>

Source: NBS, CNTA, Frost&Sullivan

Overview of China's Civil Aviation Industry

Future Outlook

China's position in the global economy is gradually rising, playing an important role in globalization of business and international trading.

Opportunities

- One Belt One Road: the implementation of the “One Belt, One Road” strategy by the Chinese government commenced in 2015. ‘One Belt, One Road’ refers to the Silk Road Economic Belt, which is an important benchmark in China’s overseas development. The Silk Road Economic Belt involves a population of around 4.4 billion and accounts for around 30% of worldwide trade value in 2016. The ‘One Belt, One Road’ strategy is expected to bring about closer ties between China and countries along the routes, fostering economic cooperation and development. Such development in economic cooperation is likely to create abundant growth opportunities for China’s civil aviation industry, as civil aviation is significant for accelerating the development of economic communication, business trading, cargo transportation, etc.
- The 13th Five-Year Plan: the implementation of “The 13th Five-Year Plan for Civil Aviation Industry” by Chinese government, which is a macro guide for the development of China’s civil aviation industry in the next five years, has accelerating the development in various aspects, including management, security, efficiency, quality of services, etc. Besides, the successful construction of China’s first domestically designed and built large airliner, C919, is expected to bring opportunities for airline companies to control the cost and expanding businesses, and improving services quality.

Future Trends of China’s Civil Aviation Industry

Threats

- Potential Price Competition: the globally expanding of China’s civil aviation business caused strong competition for airline companies in global market. As of 2016, China has totally 59 airline companies. With potential market competition, competitors who lack advantages in experience, network, capital, asset and technology are likely to raise price competition which may threaten overall industry stability and development.
- Economic protectionism: the protectionism at economic policies initiated by United States affects the globalization and international trading. China is one of the largest countries in exporting and importing. The protectionism of economy may affect China’s cargo traffic, threatening the development of China’s civil aviation industry.

Source: Frost & Sullivan

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China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Overview of China's PBB Market

Passenger boarding bridge is normally positioned as a kind of key airport equipment for airports' daily operation.

Introduction and Classification

- Passenger boarding bridge (PBB) is a closed connecting channel between the aircraft and the airport terminal (or fixed bridge), which allowed the passengers to get on/off the aircraft.
- Based on the different application scenarios, PBB can be classified into various products types, mainly including Nose Loader PBB, Apron Drive PBB, Commuter PBB, T-type PBB and A380 PBB.
- In China, the aircraft PBB market was developed since 1990s. As a technically demanding equipment, China's PBB market is really concentrated with limited manufacturers. CMIC-Tianda, one of the largest PBB manufacturers in China, almost dominated China's PBB market with over 90% of the market share.

Apron Drive PBB



- Apron Drive PBB is generally preferred by most of airport and is currently the most widely applied PBB type in the world, mainly for its maximum flexibility. Apron drive PBB is designed to accommodate a wide range of aircrafts, and easily installed according to the various apron configurations.

Nose Loader PBB



- This type of Passenger Boarding Bridge uses a cylinder for the telescopic extension and the elevation movement with only functions vertically (lifting) and horizontally (extending/retracting) to serve aircrafts.

Commuter PBB



- Commuter PBB is designed to service Narrow-Body and Commuter-type aircrafts. It has the basic functions of rotation, telescopic movement and lifting.

T-type PBB



- T-Bridges are specially designed to serve aircrafts with low boarding doors. The main difference is that this type of Passenger Boarding Bridge uses cabin translation movement and has no vertical elevation.

A380 PBB



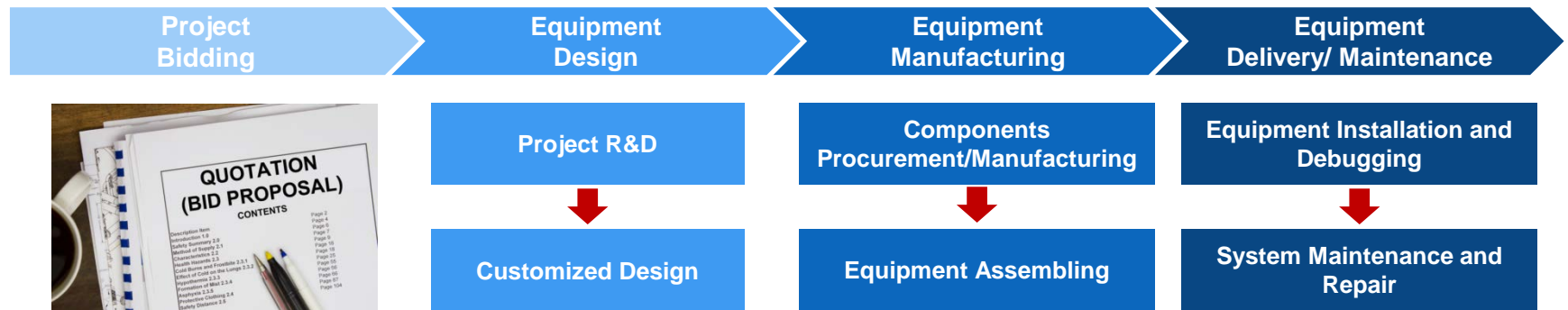
- A380 PBB is a telescopic passenger boarding bridge with the same characteristics as the Apron Drive but able to reach a height of 8m, which is specially designed for the Airbus A380 and is to accommodate upper deck U1 door of A380 aircraft.

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Value Chain of China's PBB Market

Value Chain Analysis of China's PBB Market



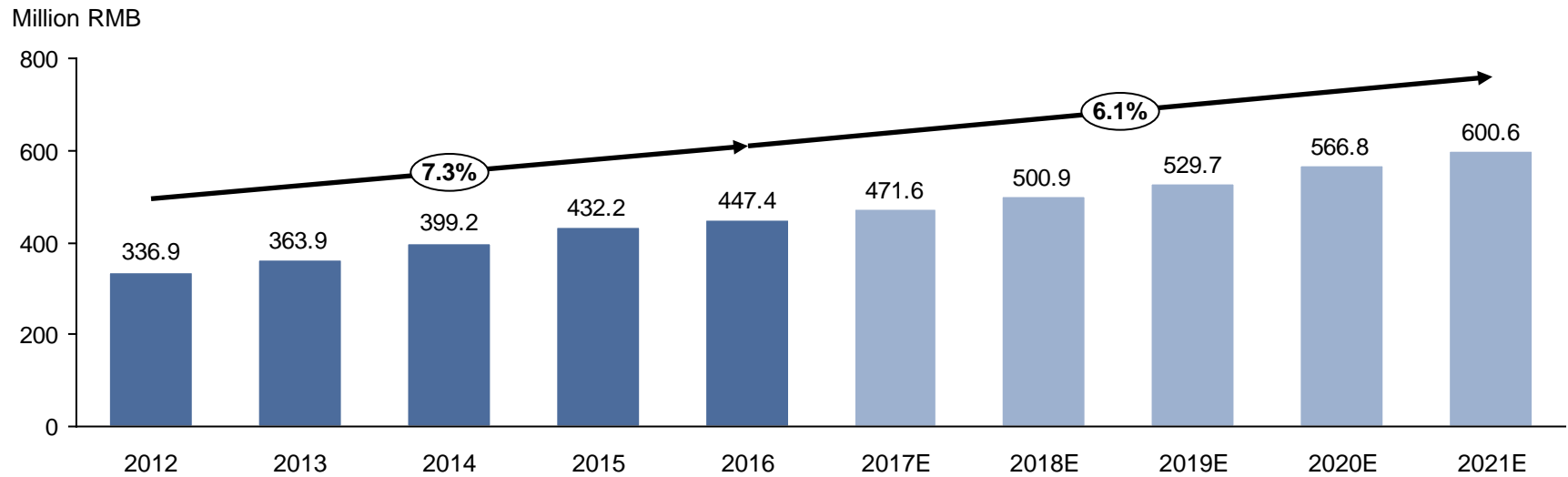
- For PBB manufacturers, the process of completing a PBB project mainly contains for stages from project bidding to the final delivery of the PBB products to end-customer. Among the four steps, equipment design and equipment manufacturing are the two key business flows which are usually valued by the clients like airport operators, as most of the PBB end-customer attach most importance to the customized product design and manufacturing capabilities of PBB manufactures.
- PBB market is relatively niche compared to other industrial equipment manufacturing industry due to the single-purpose downstream application and sophisticated manufacturing technique of PBB. Hence, during the project bidding stage, outstanding track record performance and industry reputation are usually the decisive factors for PBB manufacturers to acquire the projects. New PBB installation and old PBB maintenance and repair are the two major business segments for PBB market.

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Size of China's PBB Market

Revenue of PBB Market (China), 2012 – 2021E



- Along with the continuous airport upgrading and construction in China, China's PBB market rapidly increased from RMB336.9 million in 2012 to RMB447.4 million in 2016, representing a CAGR of 7.3%.
- In the coming five years, China's PBB market is estimated to maintain the decent growth pace owing to the increasing upgrading demand of PBB at existing airports and new airport construction plan issued by CAAC. The market is anticipated to reach approximately RMB600.6 million in 2021, realizing a CAGR of 6.1% from 2016 to 2021.

Note: Revenue of PBB market also includes service fee.

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Driver Analysis of China's PBB Market

- Growing demand for new PBB is the key market growth foundation for PBB market, which is normally driven by the increasing airport construction demand. According to the *Civil Transport Airport Plan* issued by CAAC, over 100 new airport is planned to be built till 2025, which is expected to bring more business orders to PBB products.
- The Belt and Road Initiative is a development strategy proposed China's central government that focuses on connectivity and cooperation between Eurasian countries, including infrastructure investment and support. Along with the further implementation of The Belt and Road Initiative, more and more business opportunities for China's airport equipment manufacturers is estimated to be brought.

Increasing Airport Construction Demand



The Belt and Road Initiative



Drivers to PBB Market

Thriving Civil Aviation Industry

- As the direct downstream industry of PBB market, China's civil aviation industry witnessed substantial growth during the past five years. The CAGR of passenger traffic volume of civil aviation and revenue of PRC airline companies recorded 11.2% and 4.8%, respectively during 2012 to 2016. The thriving civil aviation industry is anticipated to sustain the development of China's PBB market.

Growing Demand for PBB Maintenance

- The average service life of PBB is around 20 years and PBB also require periodical check and maintenance during the service period. Along with the increasing airport construction in China, the inventory of PBB in China also surged to approximately 2,000 by 2016, which is expected to incur growing demand for PBB maintenance business and thereby drive the development of China's PBB market.

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Opportunities and Threats to China's PBB Market

Continuous Policy and Government Support

- Chinese government has issued a series of relevant policies to support the development of China's PBB market. In 2016, PBB was first listed in the High-technology Industry Directory and identified PBB as a high-end equipment manufacturing industry. In the same year, CAAC issued the updated national standard about PBB products (MH/T 6028—2016) in order to set an advanced manufacturing benchmark of PBB comparable to the European standard. Sustained policy and government is anticipated to bring more development opportunities to China's PBB market.



Opportunities

Threats



Growing Manufacturing Cost

- Major production cost of PBB are raw material like steel and human resources. China's steel price index has doubled in the past two years and the average annual wages of China's manufacturing industry in 2016 was over 40% higher than that in 2012. Raw material and human cost take up over 80% of the manufacturing cost of PBB in China. The growing steel price and labor cost is inevitably result the increase of production cost of PBB, which is likely to reduce the profit margin of PBB manufacturers and pose threats to the PBB market.

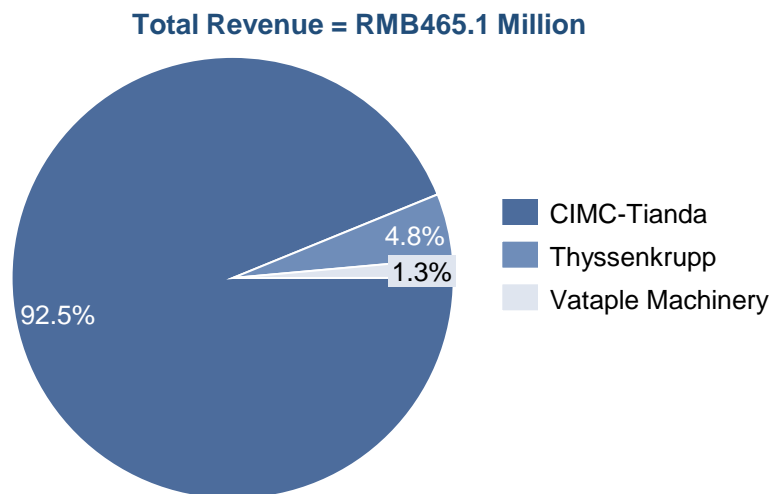
Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Competitive Landscape of China's PBB Market

CIMC-Tianda is the largest suppliers of passenger boarding bridges in the PRC in terms of revenue in 2016.

Market Share of the Top 3 Players in PBB Market in terms of Revenue (China), 2016



Ranking	Company	Revenue in 2016 (Million RMB)	Market Share (%)
1	CIMC-Tianda	414.0	92.5 %
2	Thyssenkrupp	21.6	4.8%
3	Vataple Machinery	5.8	1.3%
Total		447.4	100.0%

- China's PBB market was rather concentrated with a countable number of market players. The PRC market is dominated by CIMC-Tianda, an integrated PBB manufacturer in China, took up approximately 92.5% of the market share in terms of revenue in 2016.
- Other market players in China's PBB market include Thyssenkrupp, Vataple Machinery and JBT. Their production capacity and bargaining power are relatively much smaller than CIMC-Tianda in the PRC market.

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Overview of China's GSE Market

Introduction and Classification

- **Ground Support Equipment (GSE)** is the support equipment used to service the aircraft between flights at airports. Airport GSE comprises a diverse range of vehicles and equipment necessary to service aircraft during passenger and cargo loading and unloading, maintenance, and other ground-based operations.
- Generally, there are more than 20 kinds of GSE can be found and applied at an airport. GSE can be classified into non-powered equipment and powered equipment. Non-powered equipment are those auxiliary equipment used for powered vehicle equipment and mechanics such as dollies, aircraft tripod jack and aircraft service stairs. Most of the GSE are powered equipment which are normally different kinds of service vehicles with various functions.

High-end GSE



Towbarless Tractors



Conventional Tractors



Air Starters



Aircraft-Deicer



Maintenance Platforms



Refuelers



Loaders



Air Conditioners



Snow Plows



Airport Fire Truck

Middle-to-low-end GSE



Catering Trucks



Ground Power Units



Boarding Vehicle for Disabled



Light Tower



Airport Bus



Toilet Service Units



Passenger Steps



Lavatory and Water Trucks



Baggage Tractors



Belt Loaders



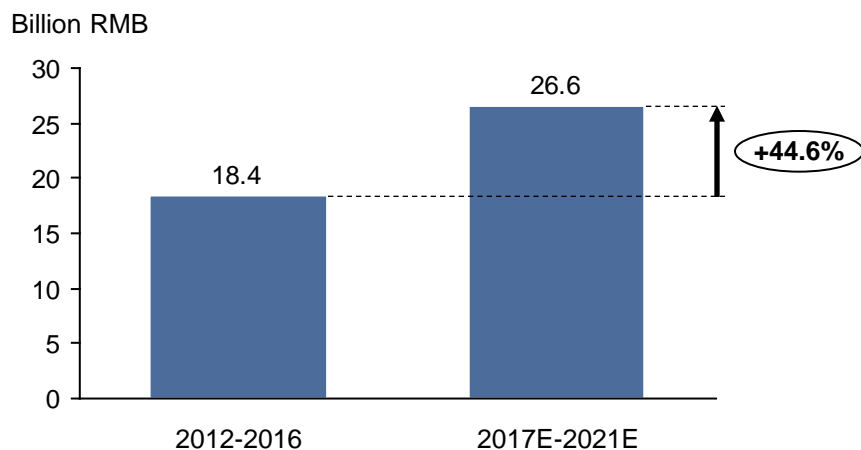
Garbage Truck

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Size and Competitive Landscape of China's GSE Market

Revenue of GSE Market (China), 2012 – 2021E



- China's GSE market realized approximately RMB18.4 billion of the revenue during the past five years from 2012 to 2016, owing to the flourishing development of China's civil aviation industry and airport infrastructure construction.
- Looking forward, benefiting from the sustaining new airport construction plan and upgrading and maintenance of current GSE, China's GSE market is expected to reach around RMB26.6 billion in the next five years from 2017 to 2021, achieving a 44.6% growth compared with the past five years.
- China's GSE market is relatively fragmented with a number of small and medium-sized domestic GSE manufacturers who have limited production capability for high-end GSE. Guangtai is currently the largest domestic GSE manufacturers in China. It covers a wide variety of GSE categories and the production capability for high-end GSE is much stronger than other domestic players.

Major Players in China's GSE Market

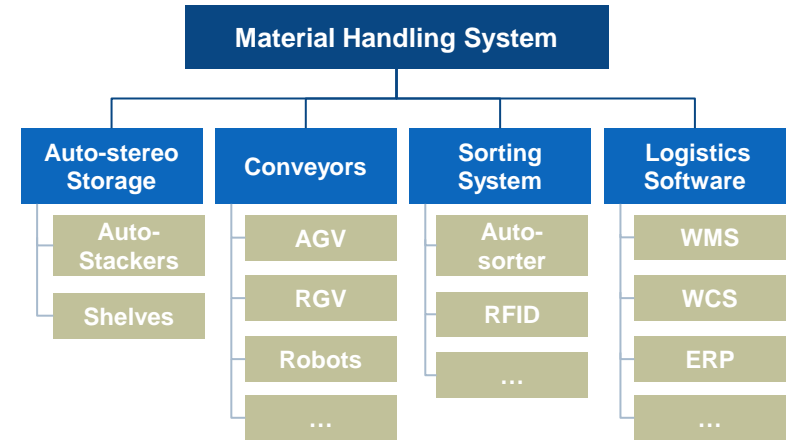
Company	Headquarter	Major GSE Product	
		High-end	Middle-to-low-end
 Guangtai	Shandong, Weihai	<ul style="list-style-type: none"> Tractors Air Starters Aircraft-Deicer Refuelers Loaders Snow Plows Air Conditioners 	<ul style="list-style-type: none"> Airport Bus Catering Trucks GPU Passenger Steps ...
 Dima Industry	Chongqing	<ul style="list-style-type: none"> Tractors Loaders 	<ul style="list-style-type: none"> Catering Trucks GPU Passenger Steps Garbage Truck Belt Loaders
 Eastern Equipment	Shanghai	<ul style="list-style-type: none"> Loaders 	<ul style="list-style-type: none"> Catering Trucks Passenger Steps Garbage Truck Belt Loaders Lavatory and Water Trucks
 Hangfu	Shanghai	<ul style="list-style-type: none"> Tractors 	<ul style="list-style-type: none"> Passenger Steps Baggage Tractors Garbage Truck Lavatory and Water Trucks
 Wuxi Ximei	Jiangsu, Wuxi	<ul style="list-style-type: none"> Tractors 	<ul style="list-style-type: none"> Catering Trucks Passenger Steps Baggage Tractors Garbage Truck Belt Loaders Lavatory and Water Trucks

Source: Frost & Sullivan Analysis

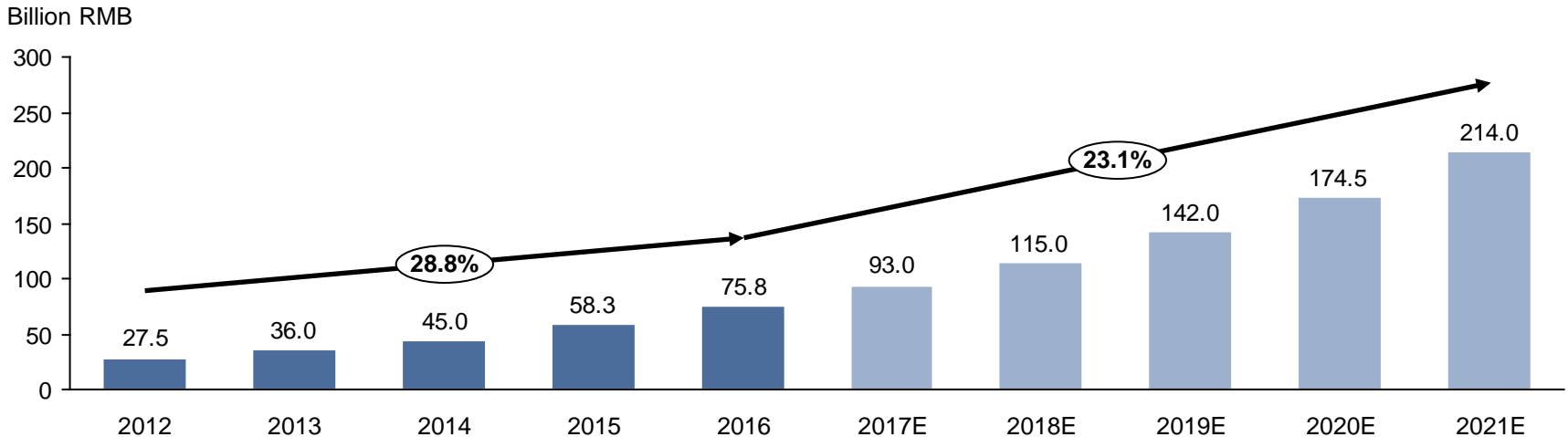
China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Overview of China's MHS Market

- **MHS** (Material Handling System) is a kind of automated logistics system which integrated a series of automatic logistics facilities and systems, including auto-stereo storage system, conveyors, sorting system, logistic software, etc.
- Thanks to the booming logistics industry sustained by the E-commerce industry as well as China's continuous economic development, China's MHS market has witnessed rapid growth during the past several years with a CAGR of 28.8% from 2012 to 2016.
- China's MHS market is forecasted to maintain the steadily growth in the following five years from 2017 to 2021, reaching approximately RMB214 billion in 2021. The market is supposed to be continuously driven by the industrial automation transformation and increasing application of automated logistics system in traditional logistics industry.



Market Size of MHS Market (China), 2012 – 2021E

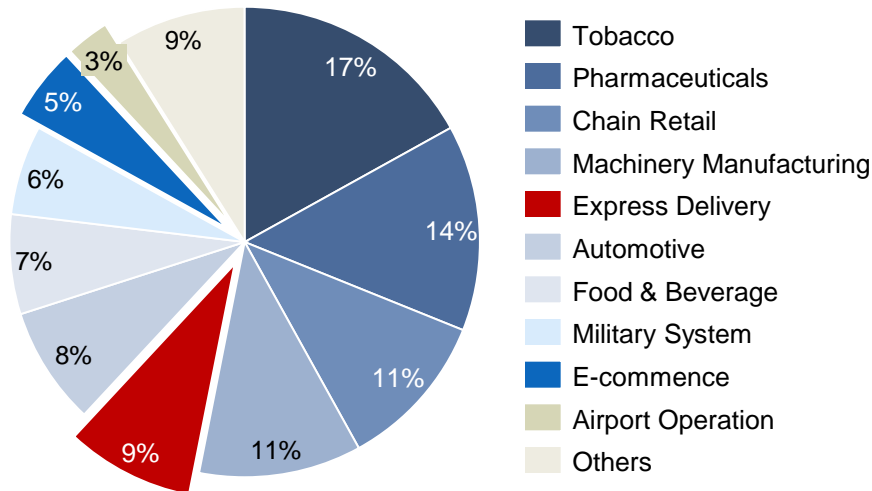


Source: Frost & Sullivan Analysis

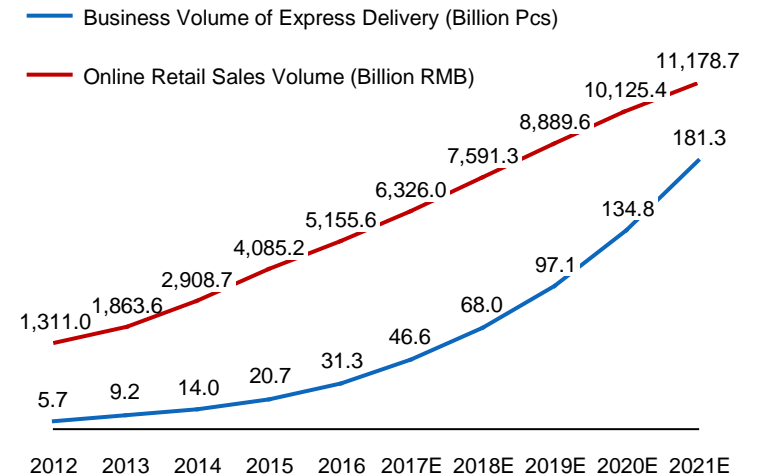
China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Driver Analysis of China's MHS Market for Express Delivery, E-commerce and Airport Operation Industry

Downstream Application Industry of MHS, (China), 2016

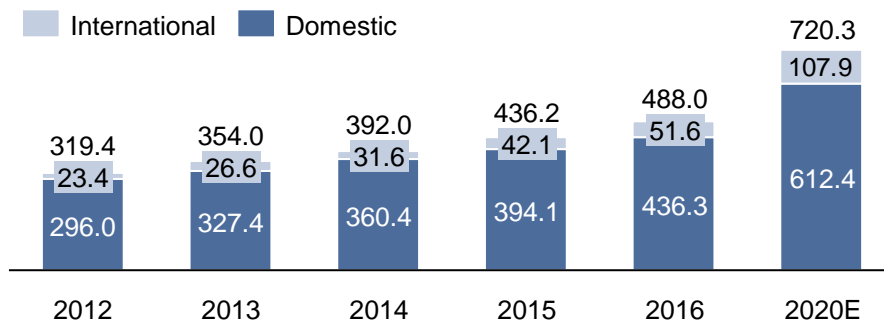


Key Index of Express Delivery and E-commerce Industry, (China), 2012-2020E



Civil Aviation Passenger Traffic Volume, (China), 2012-2016,2020E

Unit: Million Person



- Among various downstream industries of MHS products, Express delivery, E-commerce and airport operation industry accounted approximately 17% of the market share in 2016, representing a market size of around RMB12.9 billion of MHS market.
- During the past five years from 2012 to 2016, the performance of express delivery, E-commerce and airport operation industry in China showed decent growth pace. Driven by the robust and steadily growth of these industries, China's MHS Market for express delivery, E-commerce and airport operation industry is estimated to reach around RMB47.1 billion in 2020, with a CAGR of 29.6%.

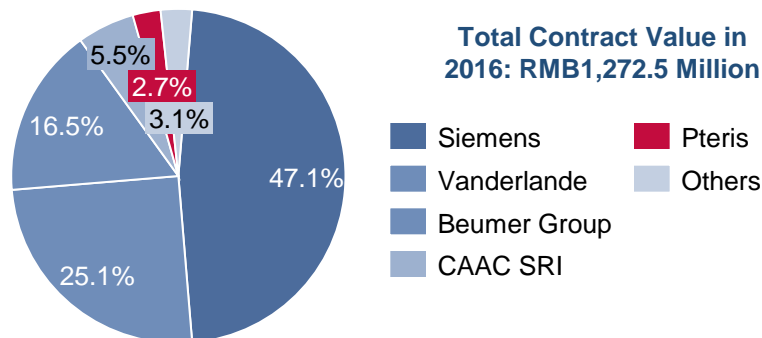
Source: State Postal Bureau of China, Ministry of Commerce, Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Competitive Landscape of China's Airport Logistic System and Airport Apron Bus Market

Pteris Group is the fifth largest supplier of airport logistic systems in the PRC in terms of contract value in 2016.

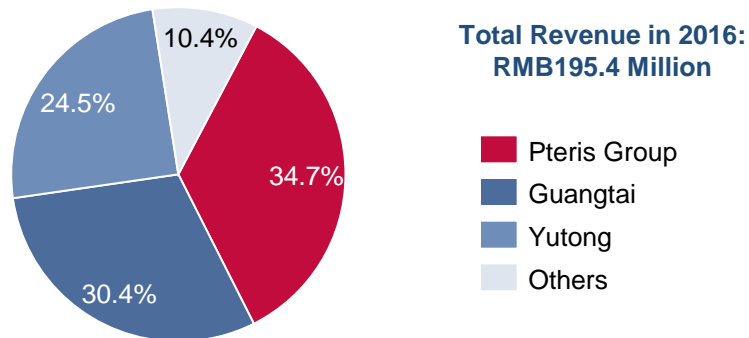
Market Share of the Top 5 Players in Airport Logistic System Market in terms of Contract Value (China), 2016



Ranking	Company	Contract Value in 2016 (Million RMB)	Share (%)
1	Siemens	600.0	47.1%
2	Vanderlande	320.0	25.1%
3	Beumer Group	210.0	16.5%
4	CAAC SRI	70.0	5.5%
5	Pteris Group	34.7	2.7%
Top 5		1,234.7	96.9%
Others		37.8	3.1%
Total		1,272.5	100.0%

Pteris Group is the largest supplier of airport apron buses in the PRC in terms of revenue in 2016.

Market Share of the Top 3 Players in Airport Apron Bus Market in terms of Revenue (China), 2016



Ranking	Company	Revenue in 2016 (Million RMB)	Share (%)
1	Pteris Group	67.9	34.7%
2	Guangtai	59.4	30.4%
3	Yutong	48.0	24.5%
Top 3		175.3	89.6%
Others		20.1	10.4%
Total		195.4	100.0%

Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Overview of China's Auto Stereoscopic Parking System Market

Introduction and Classification

- Auto stereoscopic parking system, also known as mechanical equipment for parking automobile, is a mechanical system designed to minimize the area required for parking cars.
- Auto stereoscopic parking system can be classified into several types in terms of the different car-parking mechanical models such as PSH, PXD, PSH, PCS, PCX, PSX, PJS, etc.
- China's auto stereoscopic parking system market has just in the developing stage and the market is relatively fragmented with over 500 manufacturers. Most of the stereoscopic parking system manufacturers are small-scale players with limited technical knowhow and focus on middle-to-low-end types of products such as Lift-sliding Mechanical Parking System (PSH).



Lift-sliding Mechanical Parking System (PSH)



Vertical Lifting Mechanical Parking System (PCS)



Vertical Circulating Mechanical Parking System (PCX)



Lever Circulating Mechanical Parking System (PSX)



Mini Mechanical Parking System (PJS)



Slide Elevator Mechanical Parking System (PPY)



Aisle-stack Mechanical Parking System (PXD)



Multi-storey Circular Garage (PDX)

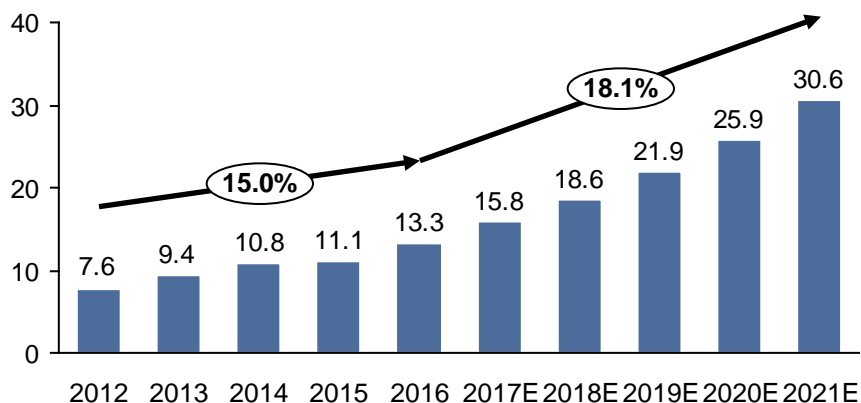
Source: Frost & Sullivan Analysis

China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Size of China's Auto Stereoscopic Parking System Market

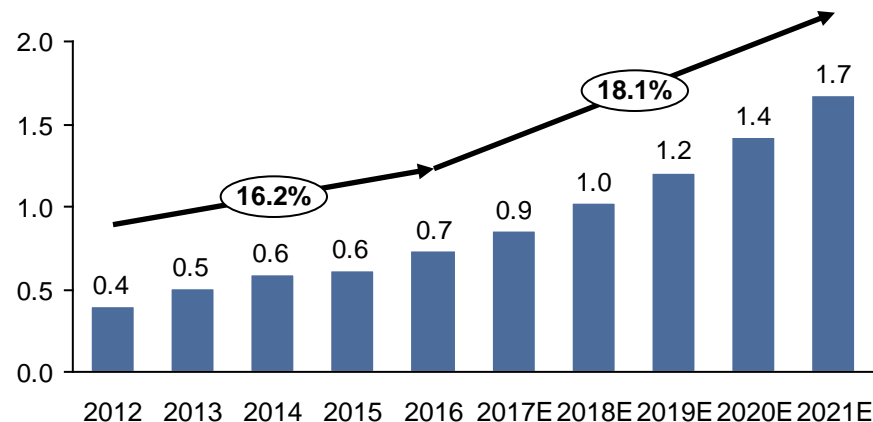
Revenue of Auto Stereoscopic Parking System Market, (China), 2012-2021E

Unit: RMB Billion



Annual Increased Parking Units, (China), 2012-2021E

Million Unit



- Facing with the parking deficiency caused by China's increasing number of private vehicles, China's auto stereoscopic parking system market ushered in a rapid developing stage. In the past five years from 2012 to 2016, the revenue of China's auto stereoscopic parking system market increased from RMB7.6 billion to RMB13.3 billion, with a CAGR of 15.0%. The number of newly-increased parking units of stereoscopic parking system also reached around 2.8 million during the same period .
- In the foreseeable future, the number of car parc in China is expected to over 300 million in 2021, which is expected to further result the parking and parking area deficiency in China, especially in those tier 1 and tier 2 cities with vast car parc. Based on above assumption, the auto stereoscopic parking system market in China is forecasted to keep the strong growth momentum in the following years from 2017 to 2021, the revenue of China's auto stereoscopic parking system market is likely to reach approximately RMB30.6 billion in 2021, representing a CAGR of 18.1% from 2016 to 2021. The number of newly-increased parking units of stereoscopic parking system in China is also estimated reached around 6.2 million during 2017 to 2021.

Source: CPSMA, Frost & Sullivan Analysis

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5 Appendix

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Overview of Global Civil Aviation Industry

- Air transport has become essential to global society. It is a driver of economic, social and cultural development worldwide and has totally changed how people travel, interact with others and do business. It would be difficult to envisage a world without aviation. Due to the democratization of international air travel, the real cost of flying has fallen by 60% over the last 40 years making it more accessible to more people as well as good economic means of goods delivery/ transportation.
- According to ICAO, civil aviation industry directly and indirectly supports the employment of 58.1 million people, contributes over \$2.4 trillion to global GDP and carries over 3.3 billion passengers and \$6.4 trillion worth of cargo annually. ICAO estimated that by 2030 the number of domestic and international passengers will reach 6 billion, travelling on approximately 50 million flights
- In 2016, in terms of passenger traffic expressed in terms of total scheduled revenue passenger-kilometers (RPKs), Asia-Pacific is the largest regional market of civil aviation. It is 32.9% of world traffic, followed by Europe and North America, which are 26.5% and 23.8% of world traffic respectively.
- In line with the sustainable growth of global civil aviation industry, the global aviation community is also facing significant challenges. As demand for air transportation services increase, States are faced with finding solutions to safely increase capacity, efficiency, and access.
- The global cargo traffic of civil aviation amounted to approximately 47.7 million tonnes in 2012, and it reached approximately 52.6 million tonnes in 2016, representing a CAGR of approximately 2.5%. It is estimated that it will reach 54.7 million tonnes in 2017 and 64.1 million tonnes by 2021 representing a CAGR of approximately 4.0%

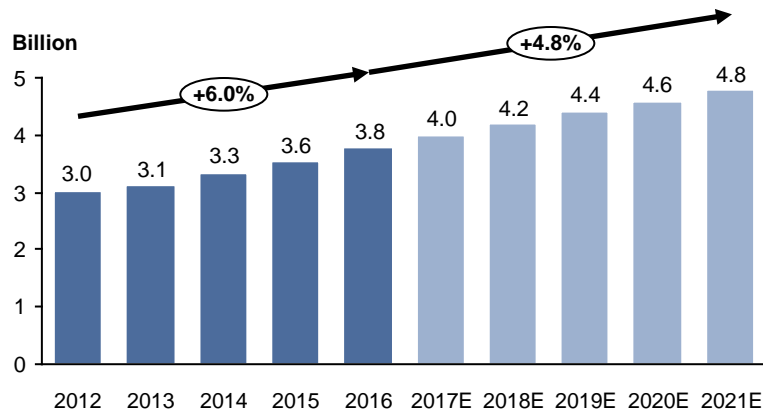


Source: ICAO, Frost & Sullivan Analysis

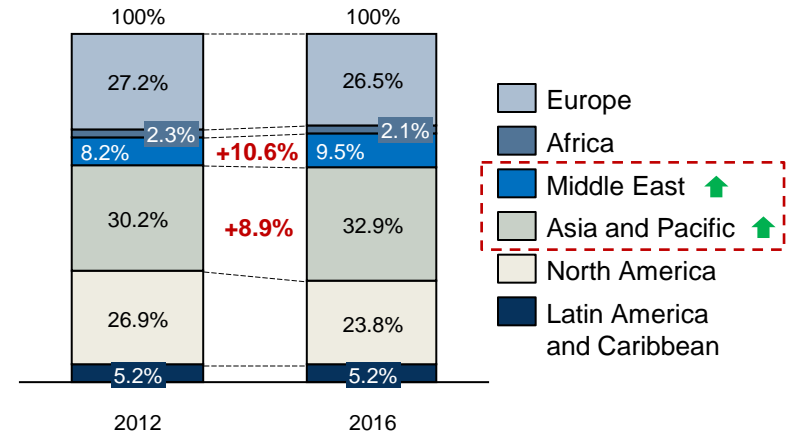
Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Size of Global Civil Aviation Industry

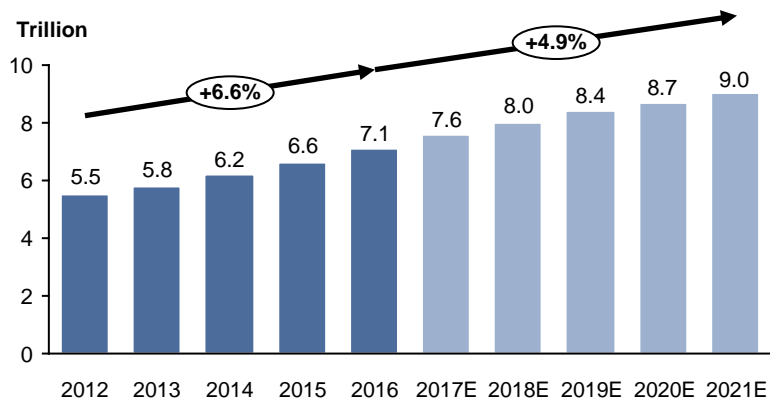
Passenger Traffic of Civil Aviation (Global), 2012-2021E



Regional Share and Growth of RPK (Global), 2012-2016



Revenue Passenger- Kilometers (RPK) (Global), 2012-2021E



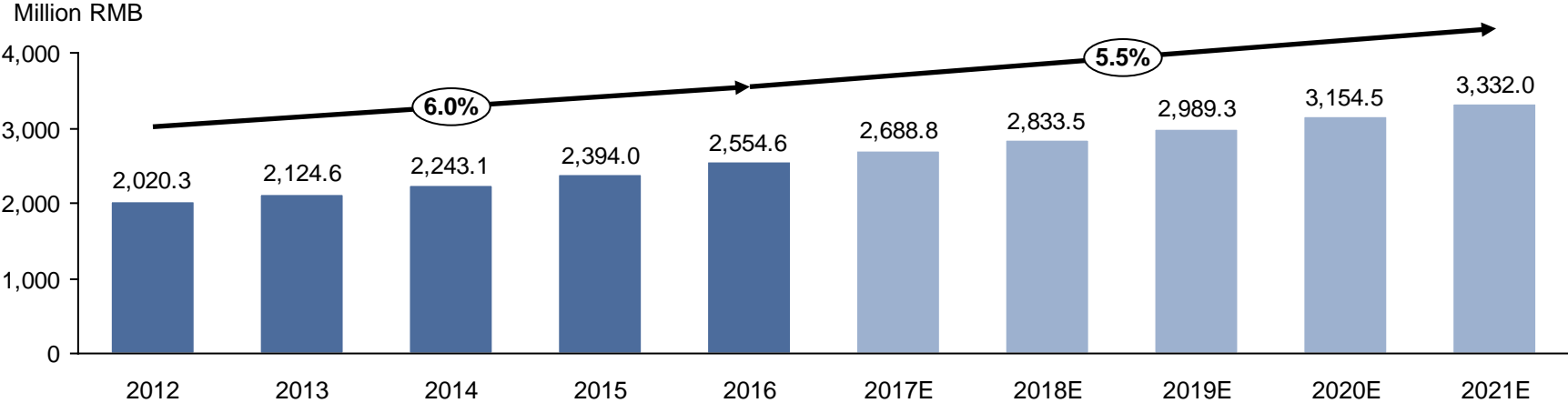
- Despite the weak global economic conditions, passenger traffic demand continued to grow in recent years helped by the lower air fares owing to the fall in oil prices. Both the global passenger traffic of civil aviation and revenue passenger-kilometers witnessed steady growth during 2012 to 2016, representing CAGRs of 6.0% and 6.6%, respectively.
- The civil aviation industry in Middle East and Asia/Pacific showed impressive growth in the past five years, the CAGRs of RPK in these two regions realized 10.6% and 8.9%, respectively from 2012 to 2016. Over 40% of the civil aviation passenger transport in the world are generated by these two regions in 2016.

Source: ICAO, Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Size of Global PBB Market

Revenue of PBB Market (Global), 2012 – 2021E



- Driven by the sustaining development of global civil aviation industry and continuous growth of air traffic volume, the global PBB market showed decent growth from RMB2,020.3 million in 2012 to RMB2,554.6 million in 2016, representing a CAGR of 6.0%.
- Looking forward, global PBB market is estimated to keep the stable growth pace underpinned by growing market demand driven by increasing airline passenger traffic as well as the further airport infrastructure development of those emerging regions like Middle East and Asia/Pacific. The Global PBB market is forecasted to reach approximately RMB3,332.0 million in 2021, realizing a CAGR of 5.5% from 2016 to 2021.
- According to AT Kearney, the annual market demand for boarding bridges in the U.S. for approximately 25% of the global demand and is the highest in the world. Amongst the approximately 7,000 boarding bridges in the U.S. currently in use, it is expected that 2,000 of them require maintenance or replacement in the next five years, with the estimated demand of such replacement market amounted to approximately USD800 million in aggregate.

Note: Revenue of PBB market also includes service fee.

Source: AT Kearney, Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Driver Analysis of Global PBB Market

	Major Drivers	Impact (1-2 years)	Impact (3-5 years)
1	Recovery of Global Economy	High	Medium
2	Growth of World Passenger Traffic	High	Medium
3	Thriving Civil Aviation Industry in Emerging Markets	High	Medium



MAJOR DRIVERS

Major Drivers	Description
Recovery of Global Economy	The global economy was negatively affected during the time of world financial crisis. Afterwards, many countries were committed to reinvigorate world economy by trade promotion, policy supports, technology innovation, international cooperation, etc. According to International Monetary Fund (IMF), the global GDP remains a steady recovery from USD74.5 trillion in 2012 to USD75.4 trillion in 2016. Further, it is expected to increase to USD98.3 trillion in 2021, driving the increase of investment in international civil aviation industry. As a result, the demand of PBB products is likely to grow consistently.
Growth of World Passenger Traffic	The Global civil aviation industry experienced substantial growth during the past five years. According to ICAO, the world passenger traffic expressed in terms of total scheduled revenue passenger-kilometers (RPKs) increased from 5.5 trillion RPKs in 2012 to 7.1 trillion RPKs in 2016, realizing a CAGR of 6.6%. The growth of global civil aviation industry brings more business orders to PBB products.
Thriving Civil Aviation Industry in Emerging Markets	The growth of global civil aviation industry keeps eastwards during the past five years. Driven by the rapid developments in manufacturing and tourism, China is ranked No.1 in terms of international total (scheduled and non-scheduled) RTK by ICAO. Emerging markets like India, Vietnam, Thailand has also witnessed fast growth in civil aviation industry. Therefore, the increasing airport construction demand and passenger traffic in these emerging countries is estimated to further drives the purchase and maintenance of PBB products.

Source: IMF, ICAO, Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Opportunities and Threats to Global PBB Market

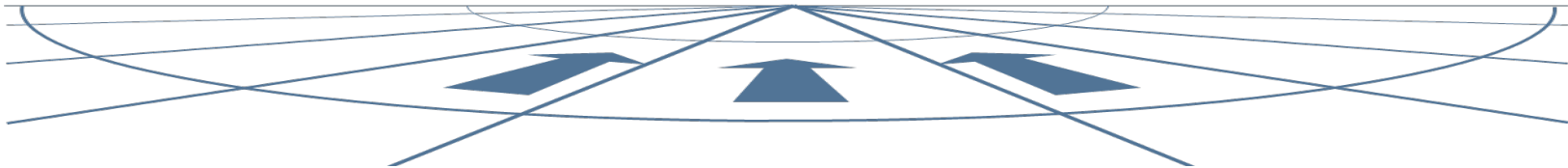
Opportunities

- The emerging market of civil aviation industry in India, Thailand, Qatar, as well as Africa and South America are expected to create opportunities for global civil aviation industry. The rapid growth of economy in those countries and regions drives the demand for airport construction, and promotes the passenger traffic. Therefore, the demand for PBB products is expected to be increased as well.
- Over the past years, the steady growth in global civil aviation industry has driven the consumption of PBB products. Since the average service life of PBB is around 20 years and PBB products also require periodical check and maintenance during the service period, the growth in global inventory of PBB products creates an opportunities in PBB maintenance services and replacement of old PBB products.

Threats

- Safety has always been the first priority for the development of global civil aviation industry. Over the past years, the terrorism activities has seriously damaged the global tourism industry, especially in Europe and Mid East. Meanwhile, political issues in countries like North Korea, Qatar, Syria, etc. has limited the development of civil aviation industry. Besides, the protectionism at economic policies initiated by United States is likely to slowdown the development of global civil aviation industry. As the direct downstream industry of PBB market, those instability factors in civil aviation industry are also expected to negatively affected the global demand for PBB products.

Future Outlook of Global PBB Market



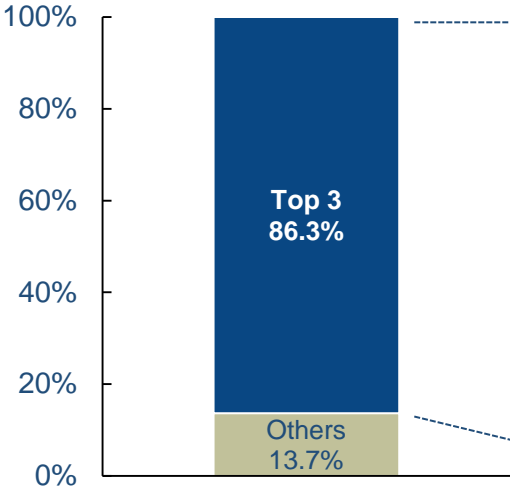
Source: Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

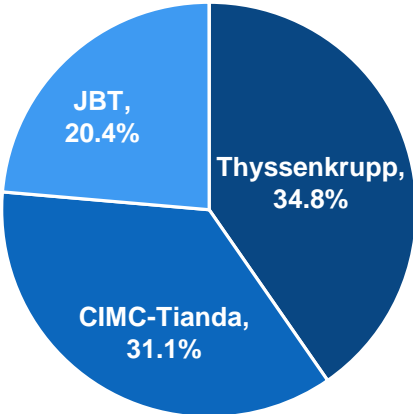
Competitive Landscape of Global PBB Market

CIMC-Tianda is one of the world's largest suppliers of passenger boarding bridges in terms of revenue in 2016.

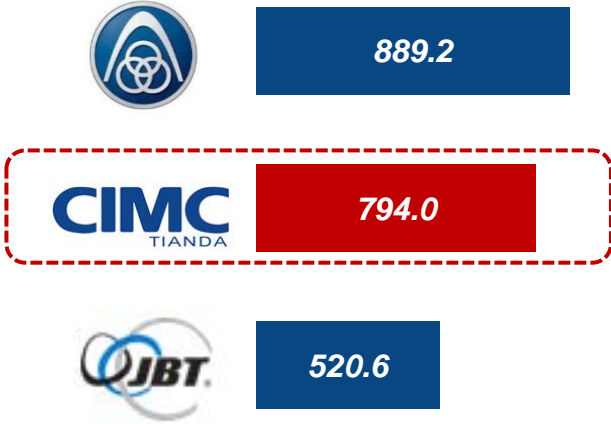
Market Concentration of PBB Market , (Global), 2016



Market Share of Top 3 Players in the PBB Market (Global), 2016



Revenue of top 3 Players in the PBB Market (Global), 2016



Unit: RMB Million

Total Revenue: RMB2,554.6 million

- Global PBB market is also concentrated. The top three players occupied 86.3% percent market share and aggregately realized total revenue of RMB2,203.8 million.
- For the Global PBB market in 2016, Thyssenkrupp and CIMC-Tianda ranked first and second place, with a revenue of RMB889.2 million and RMB794.0 million, respectively, holding market shares of 34.8 percent and 31.1 percent. JBT, realized a revenue of RMB520.6 million, ranked the third in the Global PBB market in 2016.
- In terms of revenue, Pteris Group ranked the second largest supplier of passenger boarding bridges in the world in 2016.

Source: Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Competitive Edge of CIMC-Tianda

Competitive Edge

Differentiated and Customized Product Lines

Leading Market Presence in Both Domestic and Global PBB Market

Strong R&D Capabilities

Observations

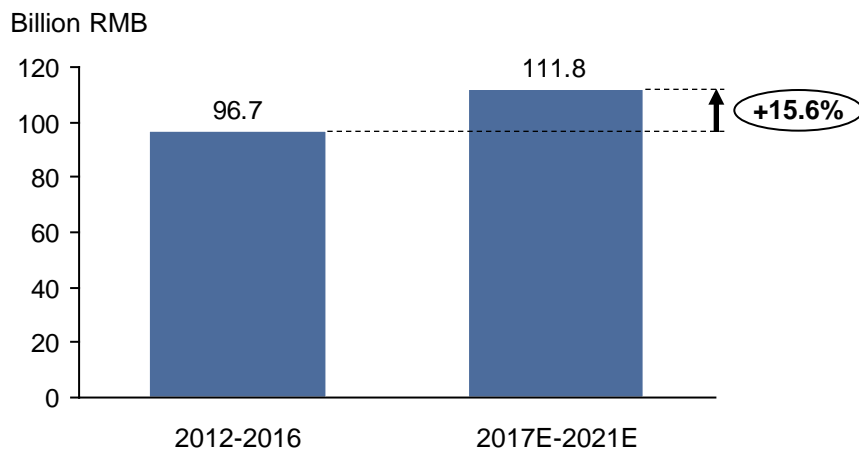
- The core and initial business of CIMC-Tianda is airport PBB products. While after years of development and R&D, CIMC-Tianda has gradually transformed into a professional company in the design, development, manufacture, installation, and maintenance services for various kind of industrial equipment and products such as airport & seaport equipment, automated material handling solutions and technology, and auto-parking systems. Besides the differentiated product lines, CIMC-Tianda also acquire capabilities of customized design of the products according to client’s diversified product requirements. Customized product design enables CIMC-Tianda win excellent reputation among the customers and further help the company’s business development.
- Over the years, CIMC-Tianda have established a leading market position in the PBB industry. Since its establishment in 1992, CIMC-Tianda have sold various PBB products such as Fixed Tunnels, T-Type PBBs, Pedestal PBBs, Apron Drive Type PBBs and apron buses to customers in more than 69 countries. In particular, CIMC-Tianda have manufactured and supplied more than 5,200 PBBs to airports across the world. By 2016, CIMC-Tianda is the largest suppliers in China’s PBB market and second largest suppliers in global PBB market in terms of revenue.
- CIMC-Tianda possess a strong and dedicated R&D team, with many of the core team members having more than 20 years of experience in technology and product design. Their ability to solve complex technical problems and strength in product design enable CIMC-Tianda to design new and more efficient products in order to respond quickly to market demands. By leveraging its strong R&D capabilities, CIMC-Tianda is able to build upon the sophisticated technologies and introduce products tailored to customers’ specific needs. In addition, CIMC-Tianda’s strong R&D capabilities have also enabled it to continually manufacture new and advanced products with significant commercial value. By 2016, CIMC-Tianda have over two hundred patents and was the first in the world to successfully develop PBB products compatible with the A380 aircraft.

Source: Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis






Market Size and Competitive Landscape of Global GSE Market

Revenue of GSE Market (Global), 2012 – 2021E



- Global GSE market has experienced stable development in the past five years with average annual revenue of around RMB19.3 billion from 2012 to 2016. Underpinned by growing upgrading and new deploy demand around the world, the global GSE market is expected to achieve a 15.6% of the revenue growth in the coming five years from 2017 to 2021 as compared with the past half decade.
- Global GSE market is also scattered with a large number of GSE manufacturers from different countries. There are limited numbers of specialized GSE manufacturers in the world who can cover extensive GSE production lines. Most of the manufacturers can only produce specific kinds of GSE. Leading players in global GSE market includes TLD, TREPEL, JBT, Sovam, TUG, etc..

Major Players in Global GSE Market

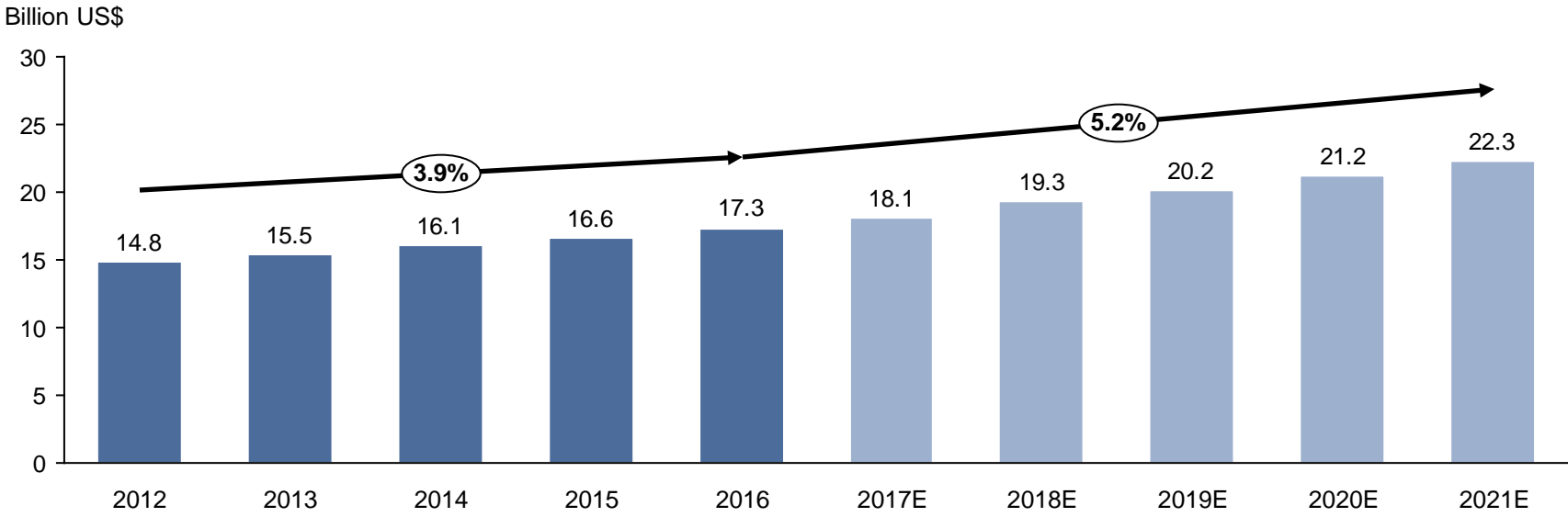
Company	Headquarter	Major GSE Product	
		High-end	Middle-to-low-end
 TLD	Lyon, France	<ul style="list-style-type: none"> Tractors Air Starters Loaders Air Conditioners Maintenance Platforms 	<ul style="list-style-type: none"> Catering Trucks GPU Passenger Steps Belt Loaders Baggage Tractors Lavatory and Water Trucks
 TREPEL	Tauberbischofsheim, Germany	<ul style="list-style-type: none"> Tractors Loaders 	<ul style="list-style-type: none"> Catering Trucks Baggage Tractors
 JBT	Chicago, U.S.	<ul style="list-style-type: none"> Tractors Loaders Aircraft-Deicer 	<ul style="list-style-type: none"> Passenger Steps Belt Loaders Baggage Tractors
 Sovam	Parthenay, France	<ul style="list-style-type: none"> Tractors Maintenance Platforms 	<ul style="list-style-type: none"> Catering Trucks Passenger Steps Belt Loaders Lavatory and Water Trucks
 TUG	Rhode Island, U.S.	<ul style="list-style-type: none"> Tractors Air Starters Air Conditioners 	<ul style="list-style-type: none"> Belt Loaders Baggage Tractors

Source: Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Overview of Global MHS Market

Revenue of MHS Market (Global), 2012 – 2021E



- Global MHS market also showed stable growth along with the application of more and more intelligent automation equipment in various industries. The revenue of Global MHS market increased from about US\$14.8 billion in 2012 to approximately US\$17.3 billion in 2016, with a CAGR of 3.9%.
- It is forecasted that the Global MHS market is likely to maintain the steadily growth in the following five years from **2016** to 2021, reaching approximately US\$22.3 billion in 2021, representing a CAGR of 5.2%. The market is expected to be continuously driven by those emerging market like those developing countries and increasing application of automated MHS systems in various kinds of industries.

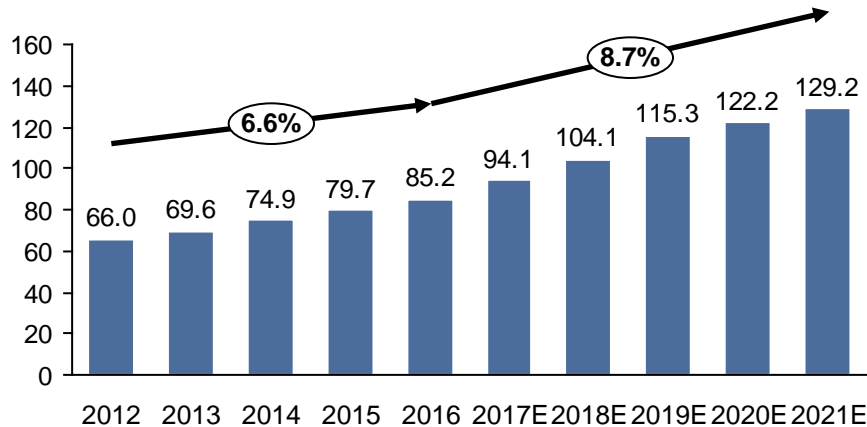
Source: Frost & Sullivan Analysis

Global PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

Market Size of Global Auto Stereoscopic Parking System Market

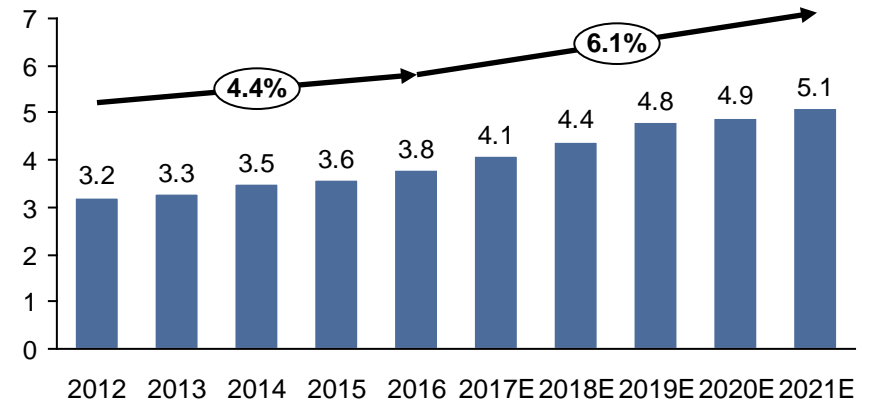
Revenue of Auto Stereoscopic Parking System Market, (Global), 2012-2021E

Unit: RMB Billion



Annual Increased Parking Units, (Global), 2012-2021E

Million Unit



- Stereoscopic parking system was firstly applied in those developed countries like Germany and Japan. Auto stereoscopic parking system market was well developed in these developed countries. In the past five years from 2012 to 2016, the revenue of Global auto stereoscopic parking system market increased from approximately RMB66 billion to RMB85.2 billion, with a CAGR of 6.6%. The number of newly-increased parking units of stereoscopic parking system in the world also reached over 3.5 million per year in recent years.
- In the foreseeable future, the global car parc is expected to be further increased to around 16.0 billion, which is expected to further drive the penetration and application of stereoscopic parking system in the world, especially in those emerging market with rapid growth of car parc and vast population base like China and India. Based on above assumption, the global auto stereoscopic parking system market is forecasted to keep the stable growth from 2017 to 2021, the revenue of global auto stereoscopic parking system market is likely to reach approximately RMB129.2 billion in 2021, representing a CAGR of 8.7% from 2016 to 2021. The number of annual newly-increased parking units of stereoscopic parking system in the world is also estimated reach over 5 million per year after 2021.

Source: OICA, Frost & Sullivan Analysis

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3 China's PBB, GSE, MHS and Auto Stereoscopic Parking System Market Analysis

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5 Appendix

Abbreviations and Terms

Abbreviations and Terms

- **Bn:** Billion
- **Mn:** Million
- **CAGR:** compound annual growth rate
- **PRC:** if not specified refers to mainland PRC, excluding Hong Kong, Taiwan and Macau
- **GDP:** gross domestic product
- **RMB:** Renminbi, the lawful currency of mainland PRC.
- **CAAC:** Civil Aviation Administration of China

Limitations in Source of Information

- Interviews with industry experts and market participants are conducted to collect information for this report, based on a best-efforts basis.
- Frost & Sullivan will not be responsible for any information gaps where interviewees have refused to divulge confidential data or figures.
- In instances where information is not available, figures based on similar indicators combined with Frost & Sullivan in-house analysis will be deployed to arrive at an estimate.
- Frost & Sullivan will state the information sources at the bottom right-hand corner of each slide for easy reference.

Note to Numeric Calculations

- Value and percentage figures in this report are all rounded. Figures may not add up to the respective totals owing to rounding.
- The base year is 2016. The historic period is from 2012 to 2015. The forecast period is from 2017 to 2021.

Source: Frost & Sullivan

Abbreviations and Terms

Chinese Name	English Abbreviation	English Name
威海广泰空港设备股份有限公司	Guangtai	Weihai Guangtai Airport Equipment Co.,Ltd
重庆迪马工业有限责任公司	Dima Industry	Chongqing Dima Industry Co., Ltd.
上海东方航空设备制造有限公司	Eastern Equipment	Shanghai Eastern Airline Equipment Manufacturing Co., Ltd.
上海航福机场设备有限公司	Hangfu	Shanghai Hangfu Airdrome Equipment Co., Ltd.
无锡锡梅特种汽车有限公司	Wuxi Ximei	Wuxi Ximei Special Automobile Co., Ltd.
NA	TLD	TLD Group
NA	TREPEL	TREPEL Airport Equipment GmbH
NA	JBT	John Bean Technologies Corporation
NA	TUG	Textron Specialized Vehicles Inc.
NA	Sovam	SOciété des Véhicules André Morin
华德宝机械(昆山)有限公司	Vataple Machinery	Vataple Machinery (Kunshan) Co., Ltd.
蒂森克虏伯集团	Thyssenkrupp	Thyssenkrupp AG

Source: Frost & Sullivan

Methodologies

- Frost & Sullivan is a global consulting company founded in 1961 in New York and has over 40 global offices with more than 2,000 industry consultants, market research analysts, technology analysts and economists. Frost & Sullivan's services include technology research, independent market research, economic research, corporate best practices advising, training, customer research, competitive intelligence and corporate strategy. Frost & Sullivan has four offices in Hong Kong and the PRC and direct access to the most knowledgeable experts and market participants in the event management industry.
- The Frost & Sullivan's report includes information on macro economy of China, China's civil aviation industry, global and China's PBB, GSE and MHS solution market.
- The methodology used by Frost & Sullivan in gathering the relevant market data in compiling the Frost & Sullivan Report included secondary research and primary interviews. Secondary research involves information integration of data and publication from publicly available resources, including official data and announcements from Hong Kong, PRC and Macau government departments, and market research on industry and enterprise player information issued by our major competitors. Primary interviews are conducted with relevant institutions to obtain objective and factual data and prospective predictions. The information and statistics as set out in this section have been extracted from the Frost & Sullivan Report.
- Projected total market size was obtained from historical data analysis plotted against macroeconomic data as well as specific related industry drivers.
- Frost & Sullivan's report was compiled based on the below assumptions:(i) the PRC and global economy are assumed to maintain steady growth across the forecast period; (ii) the social, economic and political environments of the PRC and global are likely to remain stable in the forecast period, which ensure the stable and healthy development of the civil aviation industry; and (iii) there is no war or large scale disaster during the forecast period.

Source: Frost & Sullivan

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